Trends in International Mathematics and Science Study (TIMSS) (continued)

Appendix D

TIMSS 2015 and TIMSS Advanced 2015 Questionnaires (continued)

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TIMSS Advanced 2015

TRENDS IN INTERNATIONAL MATHEMATICS AND SCIENCE STUDY

Student Questionnaire Physics

National Center for Education Statistics
U.S. Department of Education
1990 K St. NW
Washington, DC 20006-5650

TIMSS & PIRLS
International Study Center
Lynch School of Education, Boston College

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Directions

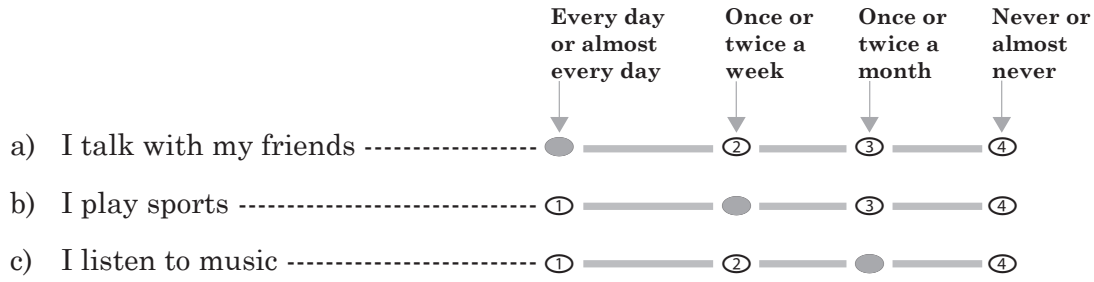
In this booklet, you will find questions about yourself. Some questions ask for facts while other questions ask for your opinion.

Each question is followed by a number of answers. Fill in the oval next to or under the answer of your choice as shown in the example below.

Example

How often do you do these things?

*Fill in only **one** oval for each row.*



- Read each question carefully, and pick the answer you think is best.
- Fill in the oval next to or under your answer.
- If you decide to change your answer, completely erase your first choice. Then, fill in the oval next to or under your new answer.
- Ask for help if you do not understand something or are not sure how to answer.

About You

1

A. Are you female or male?

*Fill in **one** oval only.*

Female -- ①

Male -- ②

B. Are you Hispanic or Latino?

*Fill in **one** oval only.*

Yes, I am Hispanic or Latino -- ①

No, I am not Hispanic or Latino -- ②

C. Which of the following best describes you?

*Fill in ovals for **all** that apply.*

White -- ①

Black or African American -- ①

Asian -- ①

American Indian or Alaska Native -- ①

Native Hawaiian or other Pacific Islander -- ①

2

When were you born?

Fill in the ovals next to the month and year you were born.

a) Month	b) Year
January --- Ⓐ	1993 --- ①
February --- Ⓑ	1994 --- ②
March --- Ⓒ	1995 --- ③
April --- Ⓓ	1996 --- ④
May --- Ⓔ	1997 --- ⑤
June --- Ⓕ	1998 --- ⑥
July --- Ⓖ	1999 --- ⑦
August --- Ⓗ	2000 --- ⑧
September --- Ⓘ	2001 --- ⑨
October --- Ⓙ	Other --- ⓪
November --- Ⓚ	
December --- Ⓛ	

3

A. How often do you speak English at home?

*Fill in **one** oval only.*

Always -- ① If **Always**, please go to question 4

Almost always -- ②

Sometimes -- ③

Never -- ④

If Almost always, Sometimes, Never,
please go to question 3B

B. What language do you speak at home (other than English)?

*Fill in **one** oval only.*

Spanish -- ①

Other -- ② Please specify _____

4

How many days were you absent from school in the last month?

*Fill in **one** oval only.*

None -- ①

1 or 2 days -- ②

3 or 4 days -- ③

5 to 10 days -- ④

More than 10 days -- ⑤

5

Have you ever repeated a grade?

*Fill in only **one** oval for each row.*

	Yes	No
a) In elementary school	①	②
b) In middle or junior high school	①	②
c) In high school	①	②

6

About how many books are there in your home? (Do not count magazines, newspapers, or your school books.)

*Fill in **one** oval only.*

None or very few (0–10 books) -- ①

Enough to fill one shelf (11–25 books) -- ②

Enough to fill one bookcase (26–100 books) -- ③

Enough to fill two bookcases (101–200 books) -- ④

Enough to fill three or more bookcases (more than 200) -- ⑤

7

How many digital information devices are there in your home? Count computers, tablets, smartphones, smart TVs, and e-readers. (Do not count other devices.)

*Fill in **one** oval only.*

None -- ①

1-3 devices -- ②

4-6 devices -- ③

7-10 devices -- ④

More than 10 devices -- ⑤

8

Do you have any of these things?

*Fill in only **one** oval for each row.*

	Yes	No
a) Your own computer	①	②
b) Your own tablet	①	②
c) Your own smartphone	①	②
d) Your own graphing calculator	①	②
e) A gaming system (e.g., PlayStation, Wii, Xbox)	①	②
f) Study desk/table for your use	①	②
g) Your own room	①	②
h) Your own car	①	②

9

A. What is the highest level of education completed by your mother (or stepmother or female legal guardian)?

*Fill in **one** oval only.*

Less than high school -- ①

Some high school -- ②

High school graduate -- ③

Associate's degree (2-year college program) -- ④

Bachelor's degree (4-year college program) -- ⑤

Master's degree or professional degree (MD, DDS, lawyer, minister) -- ⑥

Doctorate (Ph.D., or Ed.D.) -- ⑦

I don't know -- ⑧

B. What is the highest level of education completed by your father (or stepfather or male legal guardian)?

*Fill in **one** oval only.*

Less than high school -- ①

Some high school -- ②

High school graduate -- ③

Associate's degree (2-year college program) -- ④

Bachelor's degree (4-year college program) -- ⑤

Master's degree or professional degree (MD, DDS, lawyer, minister) -- ⑥

Doctorate (Ph.D., or Ed.D.) -- ⑦

I don't know -- ⑧

10

What kind of work do your father (or stepfather or male legal guardian) and mother (or stepmother or female legal guardian) do for their main jobs?

For each, fill in the oval for the job category that best describes what he/she does. Each category has a few examples to help you decide the correct category. If your father or mother is not working now, think about the last job he/she had.

*Fill in only **one** oval for each column.*

	Your father	Your mother
a) Has never worked for pay	①	②
b) Small Business Owner Includes owners of small businesses (fewer than 25 employees) such as retail shops, services, restaurants	①	②
c) Clerk Includes office clerks; secretaries; typists; data entry operators; customer service clerks	①	②
d) Service or Sales Worker Includes travel attendants; restaurant service workers; personal care workers; protective service workers; enlisted military and police; salespersons; street vendors	①	②
e) Skilled Agricultural or Fishery Worker Includes farmers; forestry workers; fishery workers; hunters and trappers	①	②
f) Craft or Trade Worker Includes builders, carpenters, plumbers, electricians, metal workers; machine mechanics; handicraft workers	①	②

Continued on next page →

10 (continued)

	Your father	Your mother
g) Plant or Machine Operator Includes plant and machine operators; assembly-line operators; motor-vehicle drivers	①	②
h) General Laborers Includes domestic helpers and cleaners; building caretakers; messengers, porters, and doorkeepers; farm, fishery, agricultural, and construction workers	①	②
i) Corporate Manager or Senior Official Includes corporate managers such as managers of large companies (25 or more employees) or managers of departments within large companies; legislators or senior government officials; senior officials of special-interest organizations; military officers	①	②
j) Professional Includes scientists; mathematicians; computer scientists; architects; engineers; life science and health professionals; teachers; legal professionals; social scientists; writers and artists; religious professionals	①	②
k) Technician or Associate Professional Includes science, engineering, and computer associates and technicians; life science and health technicians and assistants; teacher aides; finance and sales associate professionals; business service agents; administrative assistants	①	②
l) I don't know	①	②

11

How far in your education do you expect to go?

*Fill in **one** oval only.*

High school -- ①

Associate's degree
(2-year college program) -- ②

Bachelor's degree
(4-year college program) -- ③

Master's degree or professional degree
(MD, DDS, lawyer, minister) -- ④

Doctorate (Ph.D., or Ed.D.) -- ⑤

12

If you plan to continue your education, which area(s) do you intend to study?

*Fill in ovals for **all** that apply.*

a) Mathematics or Statistics ---------- ①

b) Physics ---------- ①

c) Chemistry ---------- ①

d) Biological and Biomedical Sciences (e.g., dentistry, medicine, nursing, pharmacology, veterinary medicine) ---------- ①

e) Engineering and Engineering Technologies (e.g., aerospace engineering, chemical engineering, civil engineering, electrical engineering, mechanical engineering) ---------- ①

f) Computer and Information Sciences ---------- ①

g) Education ---------- ①

h) Business (e.g., accounting, marketing, administration, finance, management) ---------- ①

i) Law ---------- ①

j) Social Sciences (e.g., sociology, political science, economics, psychology) ---------- ①

k) Arts and Humanities (e.g., art, language, literature, history, philosophy) ---------- ①

l) Other Science Fields of Study ---------- ①

m) Other Non-science Fields of Study ---------- ①

13

In the future, do you want to work in any of the following professional fields?

*Fill in only **one** oval for each row.*

		Yes	Maybe	No
a)	Education (e.g., teacher, university professor)	①	②	③
b)	Engineering and Engineering Technologies (e.g., aerospace engineer, chemical engineer, civil engineer, electrical engineer, mechanical engineer)	①	②	③
c)	Computer and Information Sciences (e.g., database administrator, network administrator, software or application developer, systems analyst)	①	②	③
d)	Finance/Banking	①	②	③
e)	Biological and Biomedical Sciences (e.g., biomedical engineer, biochemist, biophysicist, dentist, medical doctor, nurse, veterinarian)	①	②	③
f)	Environmental Sciences	①	②	③
g)	Agriculture and Agricultural Sciences	①	②	③
h)	Actuarial Sciences (i.e., uses mathematical and statistical methods to assess risk)	①	②	③
i)	Other Fields	①	②	③

14

A. Was your mother (or stepmother or female legal guardian) born in the United States? ("United States" includes the 50 states, its territories, the District of Columbia, and U.S. military bases abroad.)

*Fill in **one** oval only.*

Yes -- ①

No -- ②

I don't know -- ③

B. Was your father (or stepfather or male legal guardian) born in the United States?

*Fill in **one** oval only.*

Yes -- ①

No -- ②

I don't know -- ③

15

A. Were you born in the United States?

*Fill in **one** oval only.*

Yes -- ①

(If Yes, go to question 16)

No -- ②

If No,

B. If you were not born in the United States, how old were you when you came to the United States?

*Fill in **one** oval only.*

Older than 15 years old -- ①

11 to 15 years old -- ②

5 to 10 years old -- ③

Younger than 5 years old -- ④

Studying Physics

16

How much time do you spend in physics class each week?

_____ minutes per week

*Write in the number of **minutes** per week.*

Please convert the number of classes/periods into minutes.

17

How much time do you spend on physics outside of class each week?

_____ minutes per week

*Write in the number of **minutes** per week.*

Please convert the number of hours into minutes.

18

A. During the school year, do you work at a paid job on a regular basis?

*Fill in **one** oval only.*

Yes -- ①

No -- ② →

(If No, go to question 19)

If Yes,

B. How much time do you spend working at the paid job each week?

_____ minutes per week

*Write in the number of **minutes** per week.*

Please convert the number of hours into minutes.

19

A. During the last 12 months, have you attended extra lessons or tutoring not provided by the school in physics?

*Fill in **one** oval only.*

Yes -- ①

No -- ② →

(If No, go to question 20)

If Yes,

B. Why did you attend these extra lessons or tutoring?

*Fill in only **one** oval for each row.*

	Yes	No
a) To excel in class	①	②
b) To keep up in class	①	②
c) To do well on an examination	①	②

C. For how many of the last 12 months have you attended extra lessons or tutoring in physics?

*Fill in **one** oval only.*

Less than 4 months -- ①

4-8 months -- ②

More than 8 months -- ③

20

How much do you agree with these statements about your physics lessons?

*Fill in only **one** oval for each row.*

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) The teacher clearly communicates the purpose of each physics lesson	①	②	③	④
b) I know what my teacher expects me to do	①	②	③	④
c) My teacher is easy to understand	①	②	③	④
d) I am interested in what my teacher says	①	②	③	④
e) My teacher gives me interesting things to do	①	②	③	④
f) My teacher asks me thought-provoking questions	①	②	③	④
g) My teacher has clear answers to my questions	①	②	③	④
h) My teacher links new content to what I already know	①	②	③	④

20 (continued)

How much do you agree with these statements about your physics lessons?

*Fill in only **one** oval for each row.*

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
i) My teacher is good at explaining physics	①	②	③	④
j) My teacher provides the opportunity for me to show what I have learned	①	②	③	④
k) My teacher encourages me to keep working on physics problems until I solve them	①	②	③	④
l) My teacher provides helpful feedback on my schoolwork (including homework)	①	②	③	④
m) My teacher uses a variety of teaching methods, tasks, and activities to help us learn	①	②	③	④
n) My teacher believes that I can learn difficult physics material	①	②	③	④
o) I like the way my teacher teaches physics	①	②	③	④

21

Do you use the Internet to do any of the following tasks for physics schoolwork (including classroom tasks, homework, and studying outside of class)?

*Fill in only **one** oval for each row.*

	Yes	No
a) Access the textbook or other course materials	①	②
b) Access assignments posted online by my teacher	①	②
c) Collaborate with classmates on physics assignments or projects	①	②
d) Communicate with the teacher	①	②
e) Discuss physics topics with other students	①	②
f) Find information, articles, or tutorials to aid in understanding physics concepts	①	②
g) Find information, articles, or tutorials to aid in solving physics problems	①	②

22

How much do you agree with these statements about the physics you are studying?

*Fill in only **one** oval for each row.*

		Agree a lot	Agree a little	Disagree a little	Disagree a lot
a)	I enjoy conducting experiments or investigations in physics	①	②	③	④
b)	I get a sense of satisfaction when I solve physics problems	①	②	③	④
c)	I feel bored when I do my physics schoolwork	①	②	③	④
d)	I like studying for my physics class outside of school	①	②	③	④
e)	It is interesting to learn physics laws and principles	①	②	③	④
f)	I dread my physics class	①	②	③	④
g)	I am studying physics because I like to learn new things	①	②	③	④
h)	I enjoy figuring out challenging physics	①	②	③	④
i)	Physics is one of my favorite subjects	①	②	③	④
j)	Jobs that require physics skills seem interesting to me	①	②	③	④
k)	I wish I did not have to study physics	①	②	③	④
l)	I enjoy thinking about the world in terms of laws of physics	①	②	③	④

23

How much do you agree with these statements about the physics you are studying?

*Fill in only **one** oval for each row.*

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) Learning physics will help me get ahead in the world	①	②	③	④
b) It is important to do well in my physics class	①	②	③	④
c) The physics I am studying is not useful for my future	①	②	③	④
d) My parents are pleased that I am taking physics	①	②	③	④
e) Doing well in physics will help me get into the college or university of my choice	①	②	③	④
f) Learning physics does not seem to be a worthwhile exercise	①	②	③	④
g) My parents think that it is important that I do well in my physics class	①	②	③	④
h) I like telling people I am studying physics	①	②	③	④
i) Learning physics will give me more job opportunities	①	②	③	④

24

How hard was this test compared to most other tests you have taken this year in school?

*Fill in **one** oval only.*

Easier than other tests -- ①

About as hard as other tests -- ②

Harder than other tests -- ③

Much harder than other tests -- ④

25

How hard did you try on this test compared to how hard you tried on most other tests you have taken this year in school?

*Fill in **one** oval only.*

Not as hard as on other tests -- ①

About as hard as on other tests -- ②

Harder than on other tests -- ③

Much harder than on other tests -- ④

26

How important was it to you to do well on this test?

*Fill in **one** oval only.*

Not very important -- ①

Somewhat important -- ②

Important -- ③

Very important -- ④

Academic and Post-Secondary Preparation

27

In what grade did you complete any of the courses listed below?

*Fill in **one or more** ovals in each row.*

	Never	Grade 8 or earlier	Grade 9	Grade 10	Grade 11	Grade 12
a) General or unified science	①	①	①	①	①	①
b) Earth and space science	①	①	①	①	①	①
c) Life science (other than biology)	①	①	①	①	①	①
d) Physical science (other than chemistry or physics)	①	①	①	①	①	①
e) First-year biology	①	①	①	①	①	①
f) Second-year biology	①	①	①	①	①	①
g) First-year chemistry	①	①	①	①	①	①
h) Second-year chemistry	①	①	①	①	①	①
i) First-year physics	①	①	①	①	①	①
j) Second-year physics	①	①	①	①	①	①
k) Engineering and technology	①	①	①	①	①	①
l) Other advanced science course	①	①	①	①	①	①

28

Please indicate if you have taken or are currently enrolled in any of the following Advanced Placement (AP) courses. Have taken or are enrolled in:

*Fill in only **one** oval for each row.*

	Yes	No
a) Advanced Placement (AP) Biology	①	②
b) Advanced Placement (AP) Environmental Science	①	②
c) Advanced Placement (AP) Chemistry	①	②
d) Advanced Placement (AP) Physics B or C	①	②
e) Advanced Placement (AP) Computer Science A or AB	①	②

29

Are you currently enrolled in or have you taken any online science courses?

*Fill in **one** oval only.*

No -- ①

Yes, but not for credit -- ②

Yes, for high school credit -- ③

Yes, for college credit -- ④

Yes, for both high school and college credit -- ⑤

30

Are you currently enrolled in or have you taken an International Baccalaureate (IB) physics course?

*Fill in **one** oval only.*

Yes -- ①

No -- ②

31

During this school year, which of the following have you done?

Taken the SAT or ACT college entrance exams -- ①

Submitted the Free Application for Federal Student Aid (FAFSA) -- ①

Applied to a 2-year college -- ①

Been accepted to a 2-year college -- ①

Applied to a 4-year college -- ①

Been accepted to a 4-year college -- ①

Talked with a military recruiter or contacted a ROTC program -- ①

Enlisted in the military or enrolled in a ROTC program -- ①

Applied for a full-time job -- ①

Been interviewed for a full-time job -- ①

None of the above -- ①

Your School

32

What do you think about your school? Tell how much you agree with these statements.

*Fill in only **one** oval for each row.*

	Agree a lot	Agree a little	Disagree a little	Disagree a lot
a) I enjoy school	①	②	③	④
b) I feel safe when I am at school	①	②	③	④
c) I feel like I belong at this school	①	②	③	④
d) I like to see my classmates at school	①	②	③	④
e) Teachers at my school are fair to me	①	②	③	④
f) I am proud to go to this school	①	②	③	④
g) I learn a lot in school	①	②	③	④
h) My classmates respect students who excel in school subjects	①	②	③	④
i) My classmates respect students who struggle learning school subjects	①	②	③	④

33

During this school year, how often have other students from your school done any of the following things to you (including through texting or the Internet)?

*Fill in only **one** oval for each row.*

	At least once a week	Once or twice a month	A few times a year	Never
a) Made fun of me or called me names	①	②	③	④
b) Excluded me from their activities	①	②	③	④
c) Spread lies about me	①	②	③	④
d) Stole something from me	①	②	③	④
e) Hit or hurt me (*e.g., shoving, hitting, kicking*)	①	②	③	④
f) Made me do things I didn't want to do	①	②	③	④
g) Posted embarrassing things about me online	①	②	③	④
h) Threatened me	①	②	③	④

34

During this school year, did you participate in any of these extracurricular activities?

*Fill in ovals for **all** that apply.*

Sports -- ①

Performing arts -- ①

Academic clubs -- ①

Vocational/professional clubs -- ①

Honor societies -- ①

Publications -- ①

Student government -- ①

Service clubs -- ①

Hobby clubs -- ①

Thank You!

Thank you for filling out the questionnaire!

TIMSS Advanced 2015

TIMSS Advanced 2015 Curriculum Questionnaire—Mathematics

Advanced

M

Mathematics

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

Exhibit D-15. TIMSS Advanced 2015 Math Curriculum Questionnaire—Continued

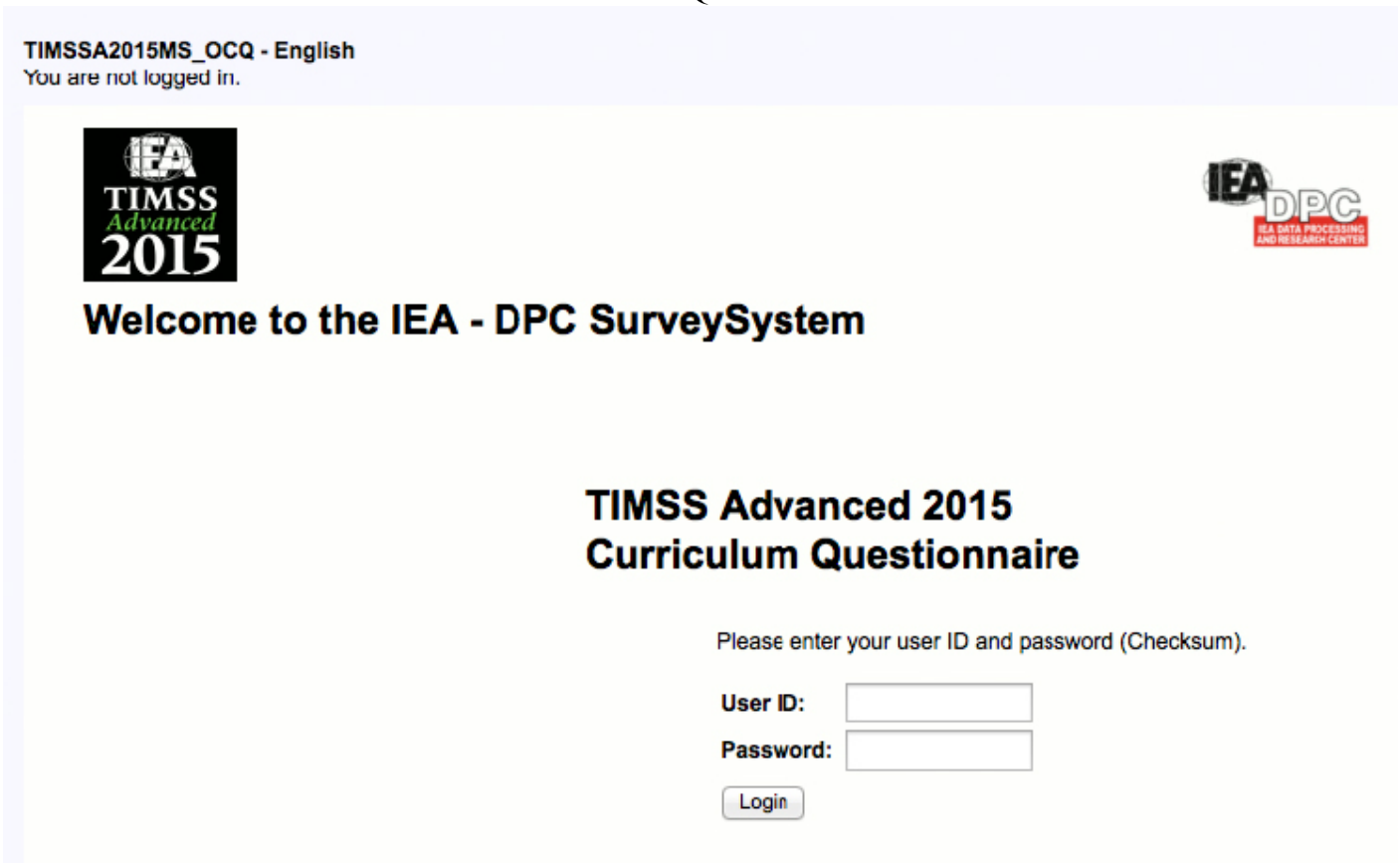


Exhibit D-15. TIMSS Advanced 2015 Math Curriculum Questionnaire—Continued

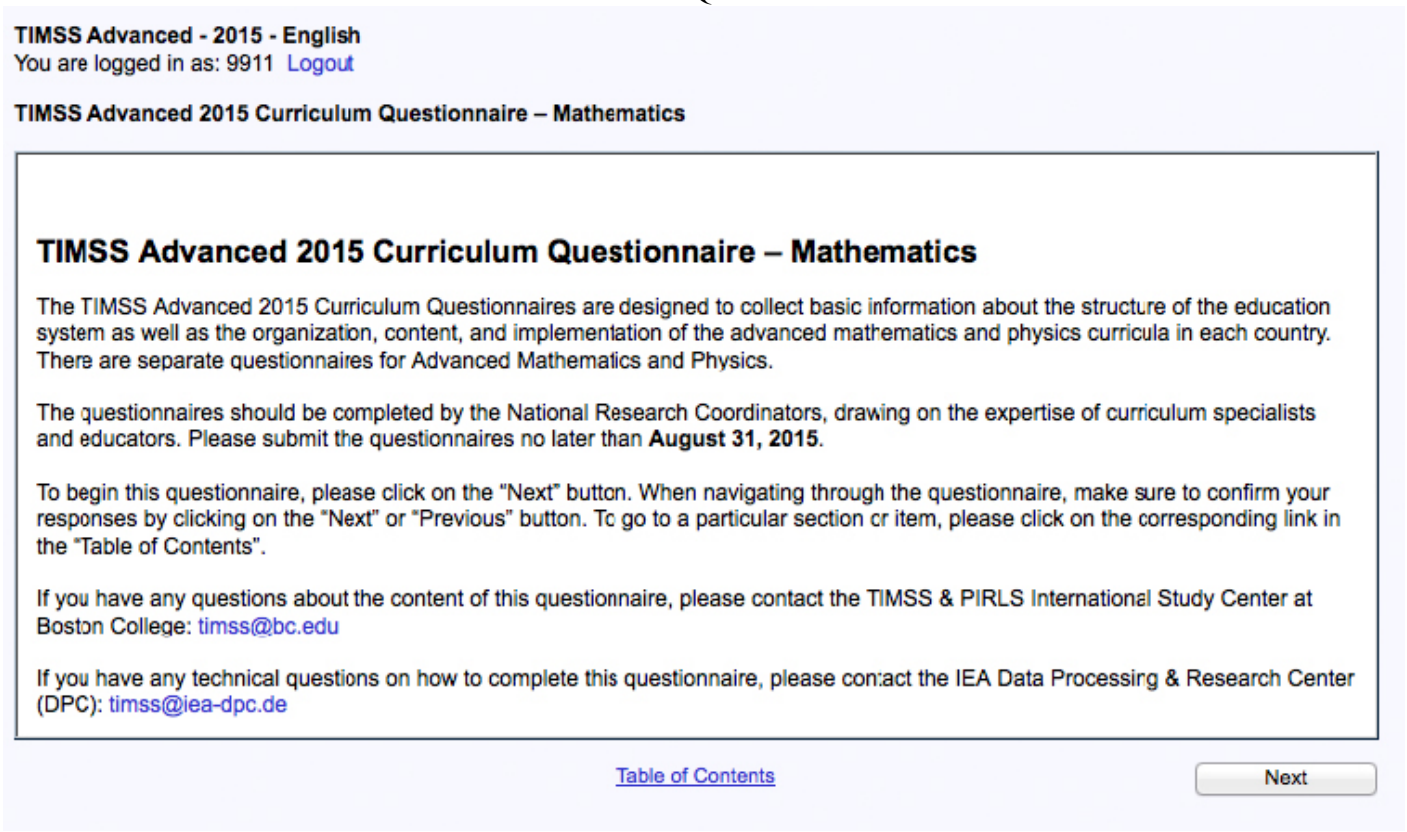


Exhibit D-15. TIMSS Advanced 2015 Math Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Mathematics - About the Advanced Mathematics Programs (Tracks)

About the Advanced Mathematics Programs (Tracks)

This questionnaire refers to the national advanced mathematics curriculum that was in effect for the students assessed in TIMSS Advanced 2015—the curriculum that covers advanced mathematics instruction for the majority of students in these programs or tracks. If you do not have a national curriculum, please summarize for your state or provincial curricula.

1. A. Describe the advanced mathematics programs/tracks assessed by TIMSS Advanced 2015. How do the programs/tracks fit into the overall curriculum from the first grade through the final year? How do they relate with programs at the university level, if at all (e.g., is participation a prerequisite for studying certain fields such as engineering or medicine)?

Examples of information reported for TIMSS Advanced 2008 can be found in the second column of Exhibit 1.1 on pages 26-27 of the 2008 report. Click here to view

B. How many years are students in these programs/tracks, and at which grade do they start?

Examples of information reported for TIMSS Advanced 2008 can be found in the third column of Exhibit 1.1 on pages 26-27 of the 2008 report. Click here to view

Exhibit D-15. TIMSS Advanced 2015 Math Curriculum Questionnaire—Continued

C. What is the total amount of class time in advanced mathematics for the students in the advanced mathematics programs/tracks?

Examples of information reported for TIMSS Advanced 2008 can be found in the fourth column of Exhibit 1.1 on pages 26-27 of the 2008 report. *Click here to view*

hours per year (1 hour = 60 minutes)

Comments:

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Exhibit D-15. TIMSS Advanced 2015 Math Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Mathematics - Criteria for Admission

Criteria for Admission

2. A. What are the criteria for admission to these advanced mathematics programs/tracks?

Examples of information reported for TIMSS Advanced 2008 can be found in the fifth column of Exhibit 1.1 on pages 26-27 of the 2008 report. *Click here to view*

B. Are there any prerequisite courses for students taking these advanced mathematics programs/tracks?

*Check **one** circle only.*

- ○ Yes
- ○ No

If Yes…
Please explain:

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Exhibit D-15. TIMSS Advanced 2015 Math Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Mathematics - Advanced Mathematics Curriculum

Advanced Mathematics Curriculum

3. A. Summarize the mathematics curriculum that was in effect for the students assessed in TIMSS Advanced 2015. (750 words)

If applicable, please reference your country's curricular documents.

B. In what year was the advanced mathematics curriculum introduced?

Examples of information reported for TIMSS Advanced 2008 can be found in the second column of Exhibit 1.3 on page 33 of the 2008 report. Click here to view

Comments:

Exhibit D-15. TIMSS Advanced 2015 Math Curriculum Questionnaire—Continued

TIMSS Advanced 2015 Curriculum Questionnaire – Mathematics - Advanced Mathematics Curriculum

C. Is the advanced mathematics curriculum currently being revised?

Examples of information reported for TIMSS Advanced 2008 can be found in the third column of Exhibit 1.3 on page 33 of the 2008 report. Click here to view

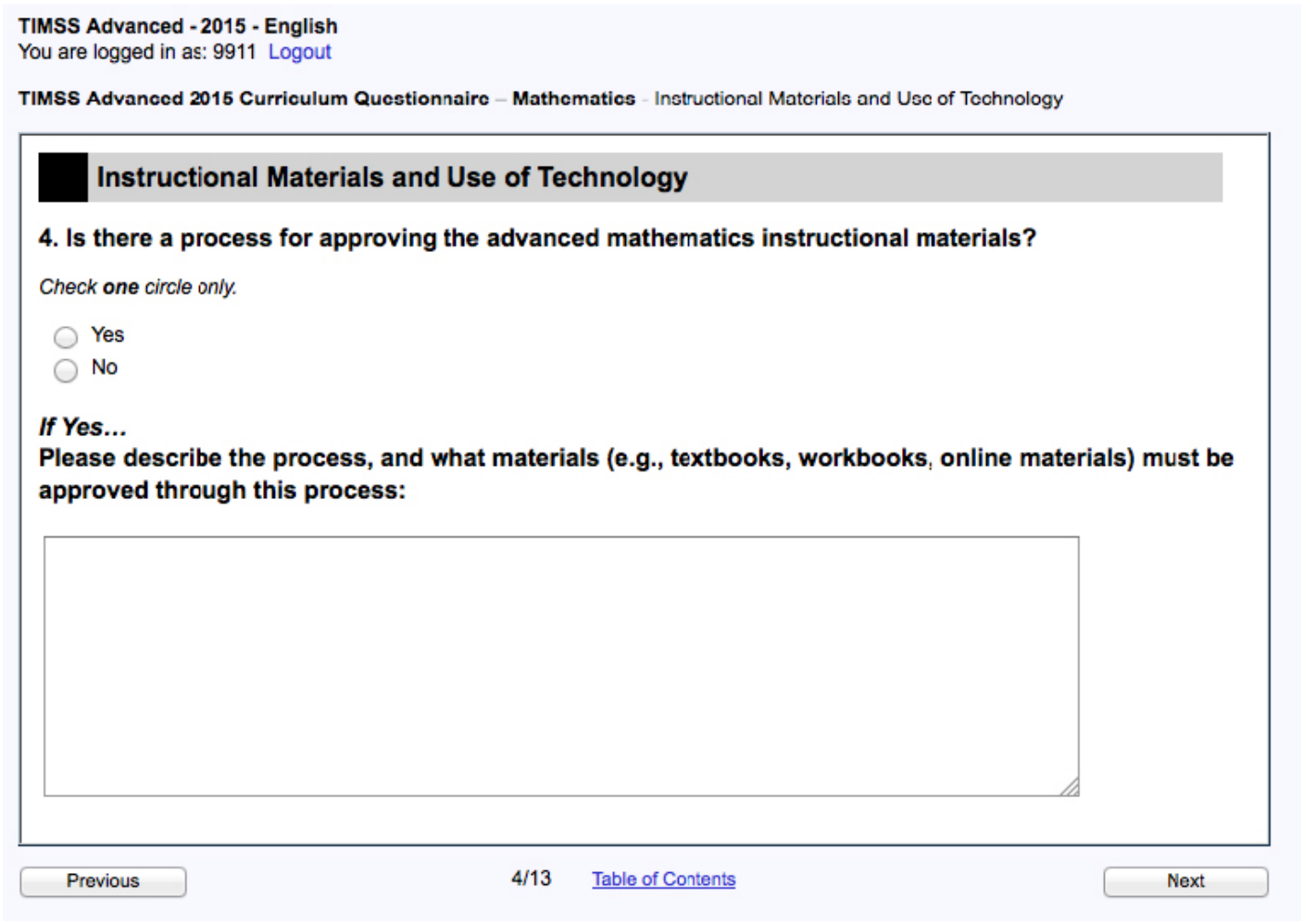
*Check **one** circle only.*

- ○ Yes
- ○ No

If Yes…
Please explain:

If No…
Comments:

Exhibit D-15. TIMSS Advanced 2015 Math Curriculum Questionnaire—Continued



TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Mathematics – Instructional Materials and Use of Technology

Instructional Materials and Use of Technology

4. Is there a process for approving the advanced mathematics instructional materials?

*Check **one** circle only.*

- ○ Yes
- ○ No

If Yes…

Please describe the process, and what materials (e.g., textbooks, workbooks, online materials) must be approved through this process:

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Exhibit D-15. TIMSS Advanced 2015 Math Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Mathematics - Instructional Materials and Use of Technology

5. A. Does the curriculum contain statements/policies about the use of technology (e.g., computers, tablets, calculators) in advanced mathematics instruction?

*Check **one** circle only.*

- ○ Yes
- ○ No

If Yes...
What are the statements/policies?

Comments:

B. Does the curriculum contain statements/policies about student use of technological aids (e.g., computers, tablets, calculators) in advanced mathematics tests or examinations?

*Check **one** circle only.*

- ○ Yes
- ○ No

If Yes...
What are the statements/policies?

Comments:

Exhibit D-15. TIMSS Advanced 2015 Math Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Mathematics - Examinations

Examinations

6. A. Does an educational authority in your country (e.g., National Ministry of Education) administer examinations to students in these advanced mathematics programs/tracks that have consequences for individual students, such as entry to a university?

*Check **one** circle only.*

- ○ Yes
- ○ No

If Yes....
B. Please describe the secondary school grades at which the exams are given to students in each of these programs/tracks and the purpose of each exam.

Examples of information reported for TIMSS Advanced 2008 can be found in the third and fifth columns of Exhibit 1.6 on pages 38-39 of the 2008 report. Click here to view

C. What is the nature and format of the examinations, and do they have an oral component?

Examples of information reported for TIMSS Advanced 2008 can be found in the fourth column of Exhibit 1.6 on pages 38-39 of the 2008 report. Click here to view

D. Additional comments on the examination system

Examples of information reported for TIMSS Advanced 2008 can be found in the sixth column of Exhibit 1.6 on pages 38-39 of the 2008 report. Click here to view

Exhibit D-15. TIMSS Advanced 2015 Math Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Mathematics - Advanced Mathematics Topics Covered

Advanced Mathematics Topics Covered

7. According to the curriculum, should the students in the advanced mathematics programs/tracks being assessed by TIMSS Advanced have been taught each of the following topics by the end of the year (in the current course or before)?

If part of a topic does not apply [e.g., logarithmic expressions in part A topic (a)], please explain in the comment field.

*Check **one** circle for each line.*

A. Algebra	**Yes**	**No**
a) Operations with exponential, logarithmic, polynomial, rational, and radical expressions	○	○
b) Operations with complex numbers	○	○
c) Evaluating algebraic expressions (e.g., exponential, logarithmic, polynomial, rational, and radical)	○	○
d) The nth term of arithmetic and geometric sequences and the sums of finite and infinite series	○	○
e) Linear, simultaneous, and quadratic equations and inequalities; radical equations, logarithmic, and exponential equations	○	○
f) Slopes, y-axis intercepts, and points of intersection of straight lines	○	○
g) Equivalent representations of functions, including composite functions, as ordered pairs, tables, graphs, formulas, or words	○	○
h) Properties of functions including domain and range	○	○

Comments:

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Exhibit D-15. TIMSS Advanced 2015 Math Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Mathematics - Advanced Mathematics Topics Covered

7. (continued)
According to the curriculum, should the students in the advanced mathematics programs/tracks being assessed by TIMSS Advanced have been taught each of the following topics by the end of the year (in the current course or before)?

If part of a topic does not apply [e.g., logarithmic expressions in part A topic (a)], please explain in the comment field.

*Check **one** circle for each line.*

B. Calculus	**Yes**	**No**
a) Limits of functions	○	○
b) Conditions for continuity and differentiability of functions	○	○
c) Differentiation of functions (including polynomial, exponential, logarithmic, trigonometric, rational, and radical functions); differentiation of products, quotients, and composite functions	○	○
d) Using derivatives to solve problems (e.g., in optimization and rates of change)	○	○
e) Using first and second derivatives to determine slope and local extrema of functions	○	○
f) Using derivatives to determine points of inflection of functions	○	○
g) Integrating functions (including polynomial, exponential, trigonometric, and rational functions); evaluating definite integrals, including calculation of areas	○	○

Comments:

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Exhibit D-15. TIMSS Advanced 2015 Math Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Mathematics - Advanced Mathematics Topics Covered

7. (continued)
According to the curriculum, should the students in the advanced mathematics programs/tracks being assessed by TIMSS Advanced have been taught each of the following topics by the end of the year (in the current course or before)?

If part of a topic does not apply [e.g., logarithmic expressions in part A topic (a)], please explain in the comment field.

*Check **one** circle for each line.*

C. Geometry	**Yes**	**No**
a) Properties of geometric figures in two and three dimensions	○	○
b) Properties of vectors and their sums and differences	○	○
c) Trigonometric properties of triangles (sine, cosine, and tangent)	○	○
d) Trigonometric functions and their graphs	○	○

Comments:

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Exhibit D-15. TIMSS Advanced 2015 Math Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Mathematics - Advanced Mathematics Topics Covered

8. How is the implementation of the advanced mathematics curriculum evaluated?

*Check **one** circle for each line.*

	Yes	No
a) Visits by inspectors	○	○
b) Research programs	○	○
c) School self-evaluation	○	○
d) National or regional examinations	○	○
e) Other Please specify below:	○	○

Comments:

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Exhibit D-15. TIMSS Advanced 2015 Math Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Mathematics - Recruitment to TIMSS Advanced Programs/Tracks

Recruitment to TIMSS Advanced Programs/Tracks

9. A. Does your country sponsor national programs to encourage students to study advanced mathematics?

*Check **one** circle only.*

- ○ Yes
- ○ No

If Yes...

B. Does your country implement any of the following programs to promote the study of advanced mathematics?

	*Check **one** circle for each line.*	
	Yes	**No**
a) School partnerships with industry	○	○
b) School collaborations with universities	○	○
c) Contests/competitions in advanced mathematics	○	○
d) Other	○	○
Please specify:		

If applicable, please describe the programs implemented in your country to promote the study of advanced mathematics:

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Exhibit D-15. TIMSS Advanced 2015 Math Curriculum Questionnaire—Continued

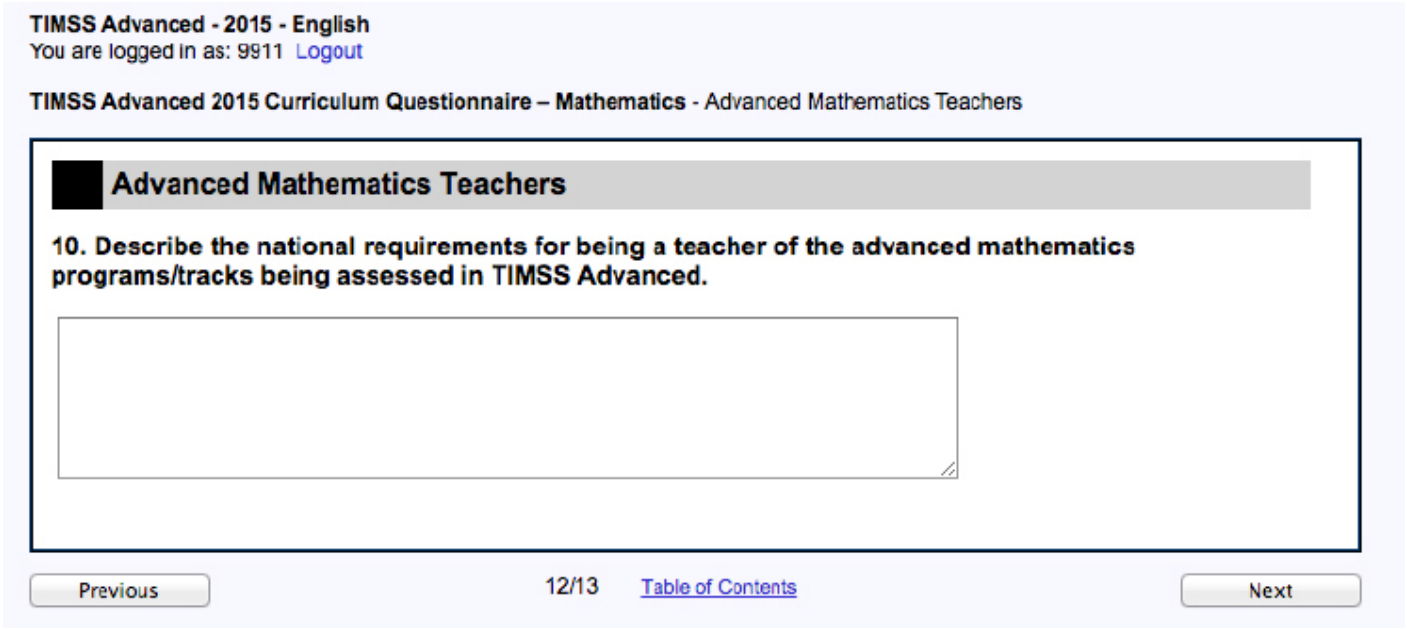


Exhibit D-15. TIMSS Advanced 2015 Math Curriculum Questionnaire—Continued

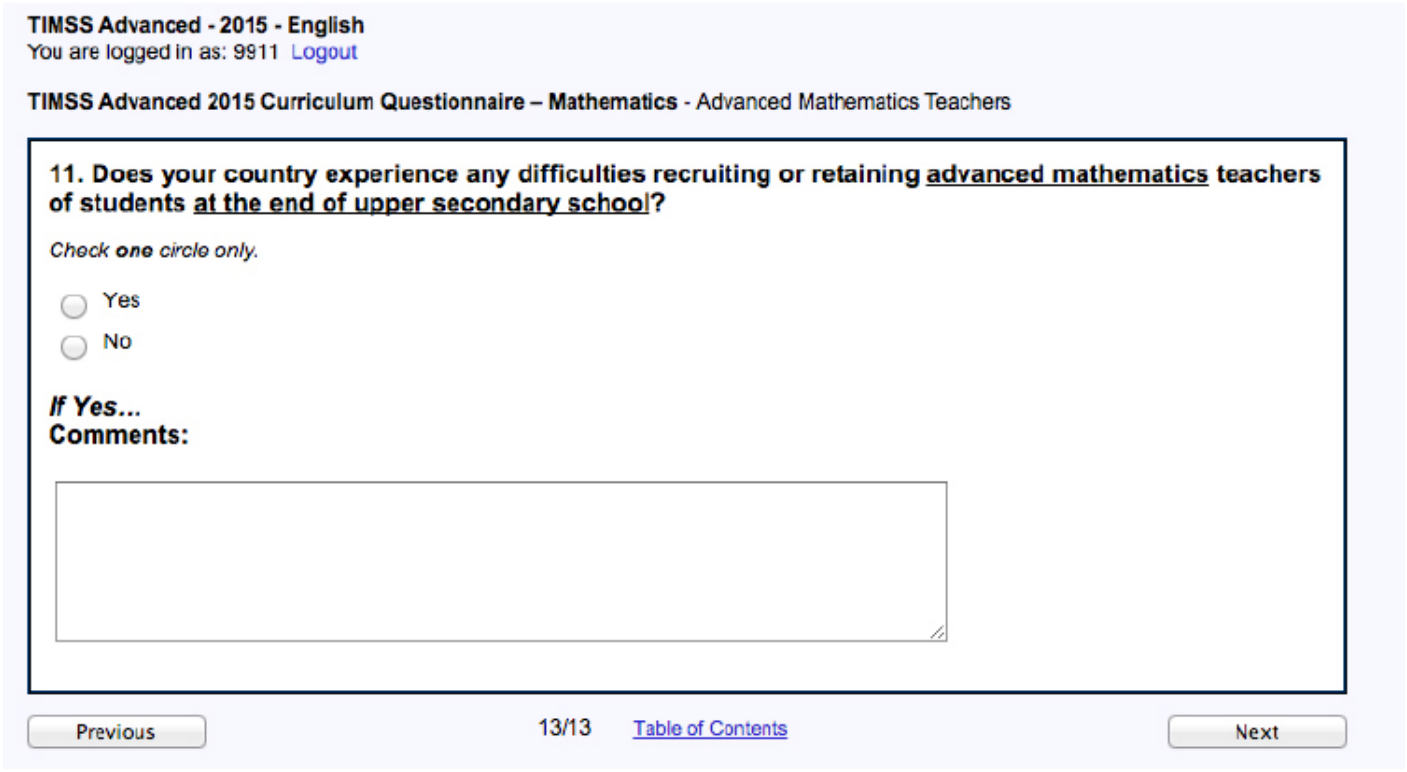
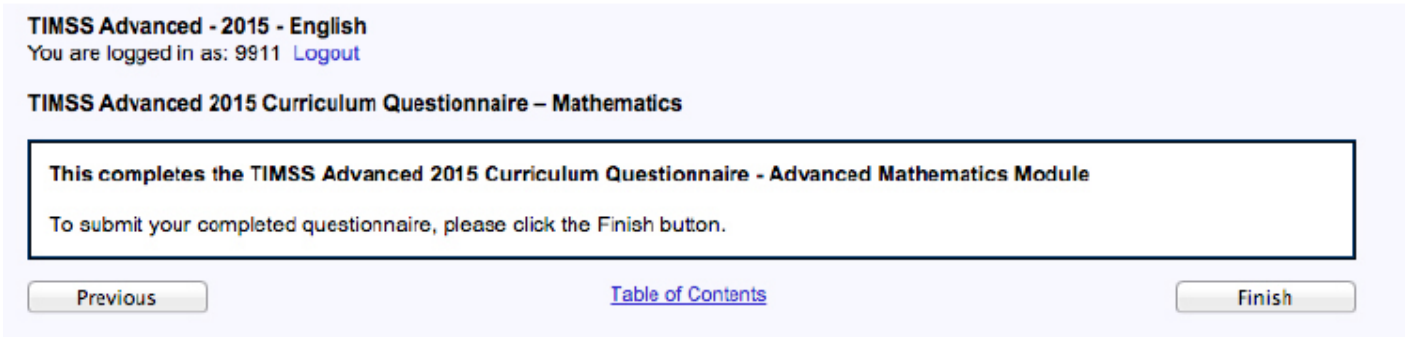
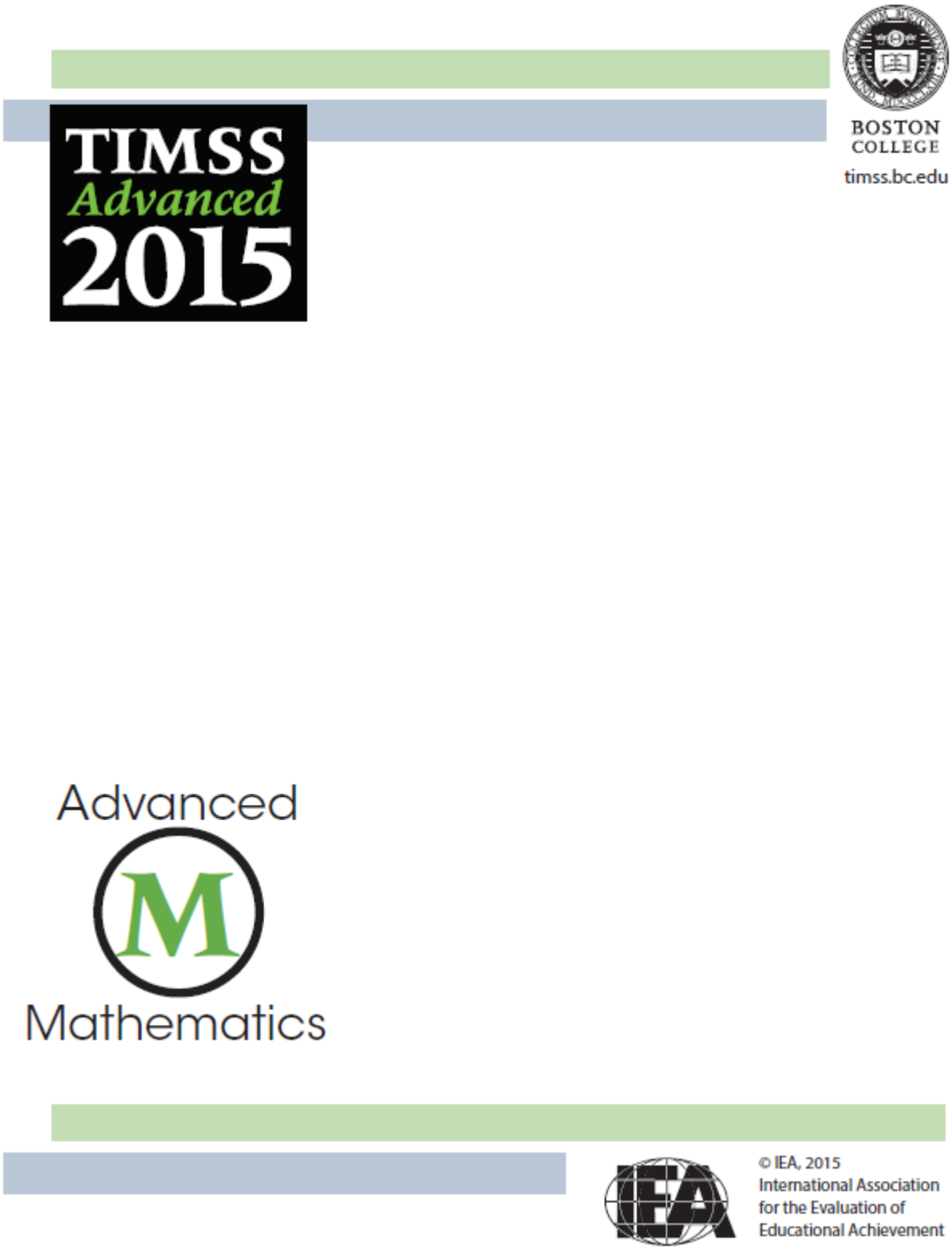


Exhibit D-15. TIMSS Advanced 2015 Math Curriculum Questionnaire—Continued




TIMSS
Advanced
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BOSTON
COLLEGE
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Advanced
M
Mathematics
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Educational Achievement

TIMSS Advanced 2015

TIMSS Advanced 2015 Curriculum Questionnaire—Physics

P

Physics

TIMSS & PIRLS International Study Center
Lynch School of Education, Boston College

Exhibit D-16. TIMSS Advanced 2015 Physics Curriculum Questionnaire—Continued

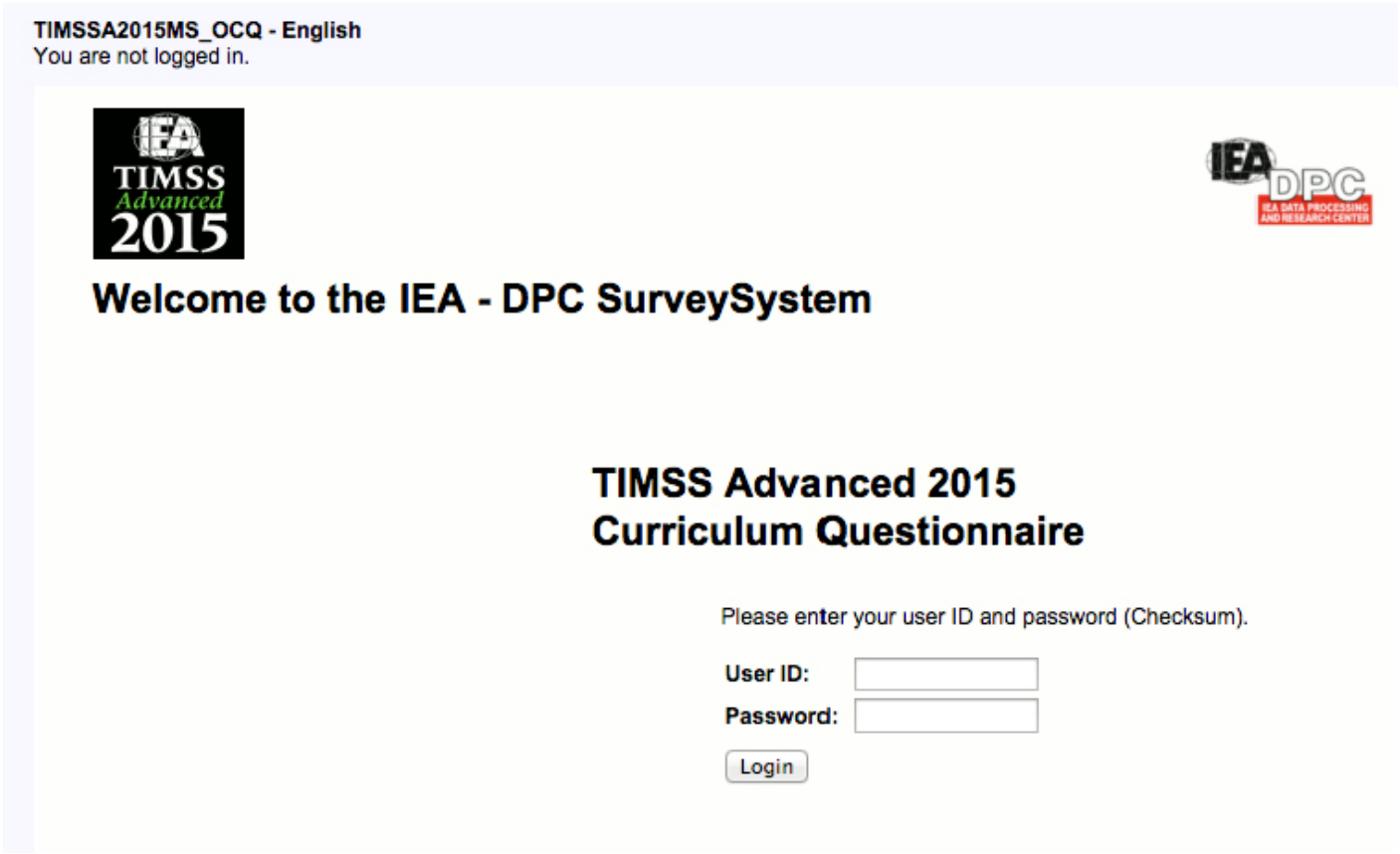
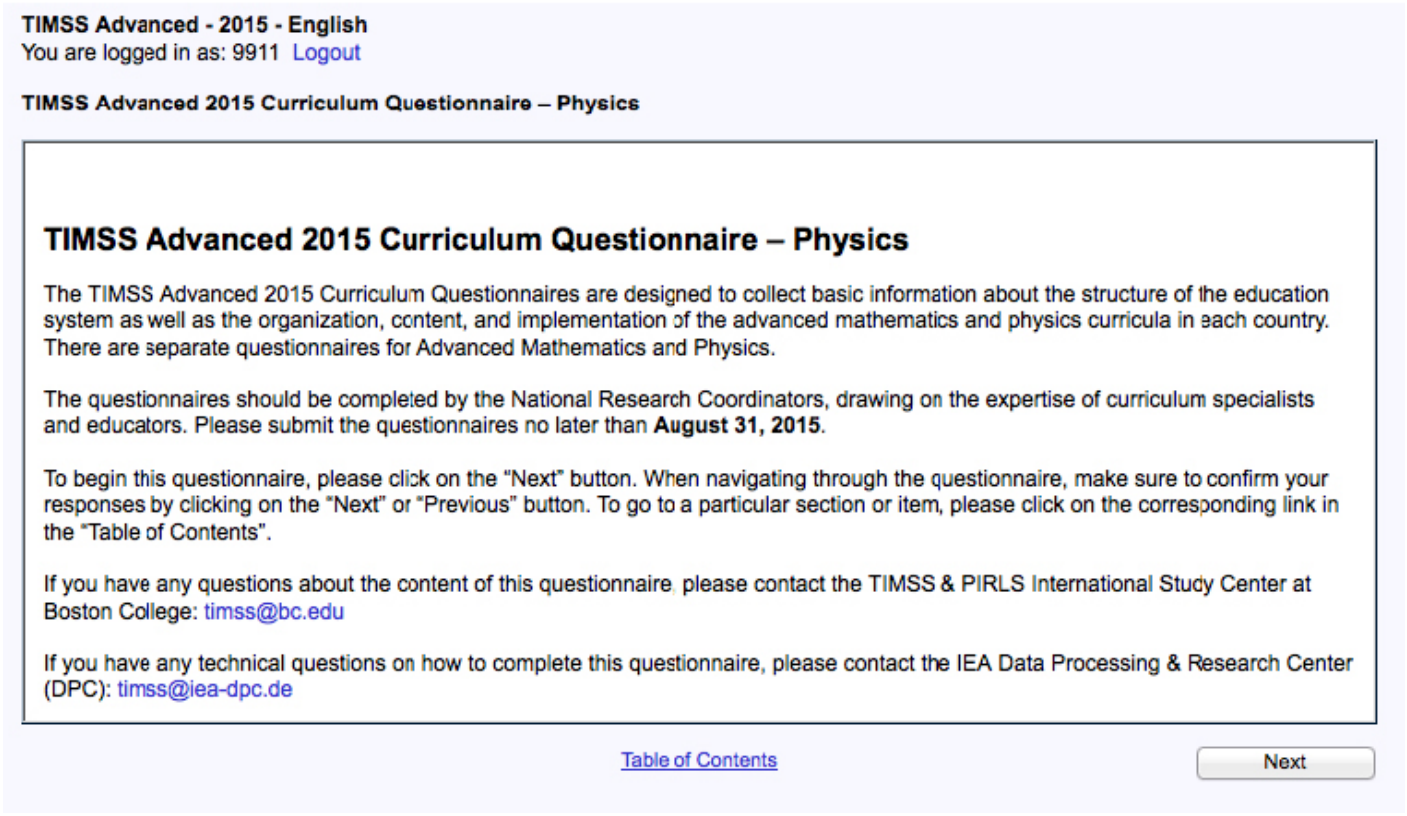


Exhibit D-16. TIMSS Advanced 2015 Physics Curriculum Questionnaire—Continued



TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Physics

TIMSS Advanced 2015 Curriculum Questionnaire – Physics

The TIMSS Advanced 2015 Curriculum Questionnaires are designed to collect basic information about the structure of the education system as well as the organization, content, and implementation of the advanced mathematics and physics curricula in each country. There are separate questionnaires for Advanced Mathematics and Physics.

The questionnaires should be completed by the National Research Coordinators, drawing on the expertise of curriculum specialists and educators. Please submit the questionnaires no later than **August 31, 2015**.

To begin this questionnaire, please click on the "Next" button. When navigating through the questionnaire, make sure to confirm your responses by clicking on the "Next" or "Previous" button. To go to a particular section or item, please click on the corresponding link in the "Table of Contents".

If you have any questions about the content of this questionnaire please contact the TIMSS & PIRLS International Study Center at Boston College: timss@bc.edu

If you have any technical questions on how to complete this questionnaire, please contact the IEA Data Processing & Research Center (DPC): timss@iea-dpc.de

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Exhibit D-16. TIMSS Advanced 2015 Physics Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Physics – About the Physics Programs (Tracks)

About the Physics Programs (Tracks)

This questionnaire refers to the national physics curriculum that was in effect for the students assessed in TIMSS Advanced 2015—the curriculum that covers physics instruction for the majority of students in these programs or tracks. If you do not have a national curriculum, please summarize for your state or provincial curricula.

1. A. Describe the physics programs/tracks assessed by TIMSS Advanced 2015. How do the programs/tracks fit into the overall curriculum from the first grade through the final year? How do they relate with programs at the university level, if at all (e.g., is participation a prerequisite for studying certain fields such as engineering or medicine)?

Examples of information reported for TIMSS Advanced 2008 can be found in the second column of Exhibit 7.1 on pages 220-221 of the 2008 report. *Click here to view*

B. How many years are students in these programs/tracks, and at which grade do they start?

Examples of information reported for TIMSS Advanced 2008 can be found in the third column of Exhibit 7.1 on pages 220-221 of the 2008 report. *Click here to view*

C. What is the total amount of class time in physics for the students in the physics programs/tracks?

Examples of information reported for TIMSS Advanced 2008 can be found in the fourth column of Exhibit 7.1 on pages 220-221 of the 2008 report. *Click here to view*

hours per year (1 hour = 60 minutes)

Comments:

Exhibit D-16. TIMSS Advanced 2015 Physics Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Physics - Criteria for Admission

Criteria for Admission

2. A. What are the criteria for admission to these physics programs/tracks?

Examples of information reported for TIMSS Advanced 2008 can be found in the fifth column of Exhibit 7.1 on pages 220-221 of the 2008 report. *Click here to view*

B. Are there any prerequisite courses for students taking these physics programs/tracks?

*Check **one** circle only.*

- ○ Yes
- ○ No

If Yes…
Please explain:

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Exhibit D-16. TIMSS Advanced 2015 Physics Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Physics - Physics Curriculum

Physics Curriculum

3. A. Summarize the physics curriculum that was in effect for the students assessed in TIMSS Advanced 2015. (750 words)

If applicable, please reference your country's curricular documents.

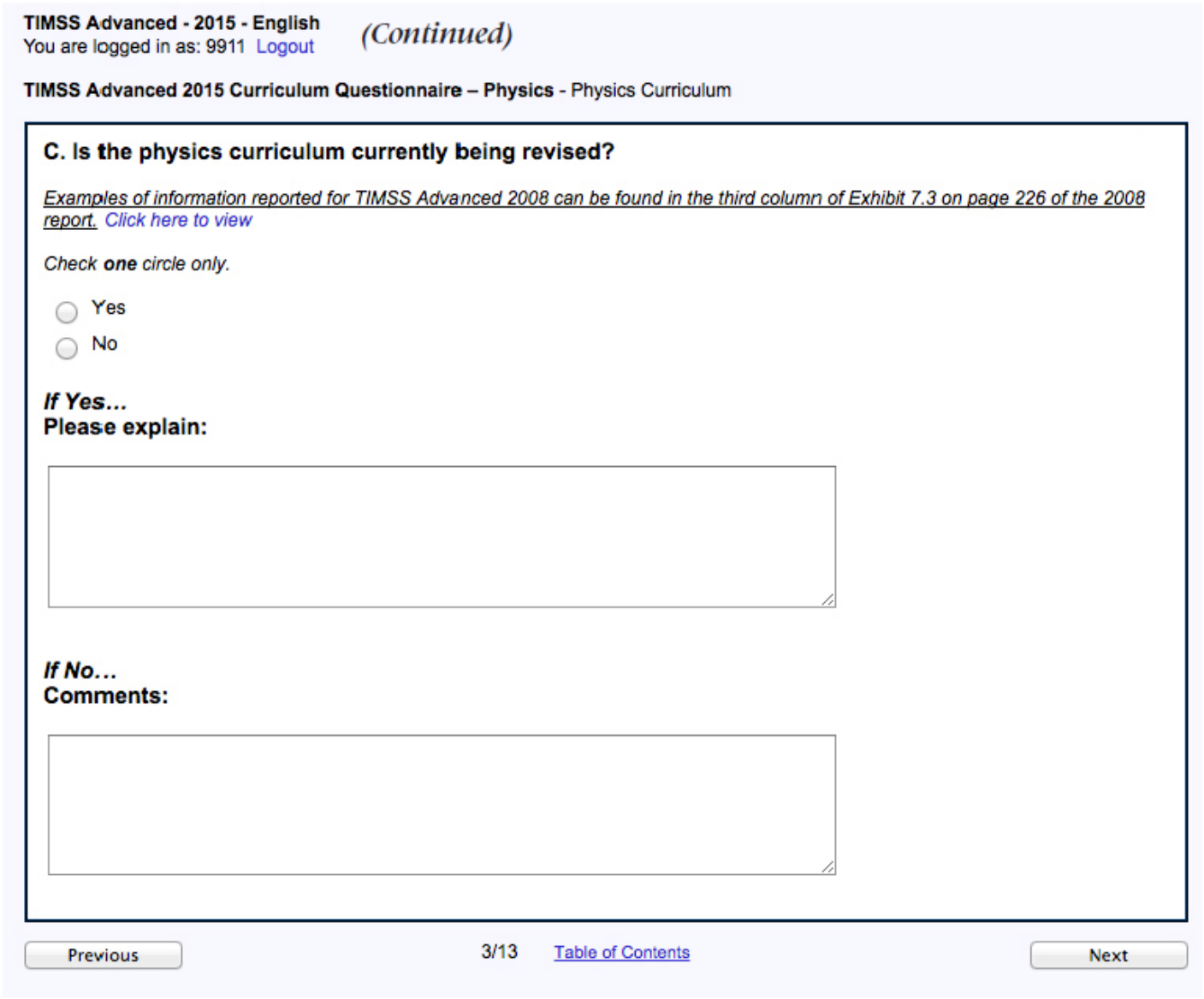
B. In what year was the physics curriculum introduced?

Examples of information reported for TIMSS Advanced 2008 can be found in the second column of Exhibit 7.3 on page 226 of the 2008 report. *Click here to view*

Comments:

(Continued on Next Page)

Exhibit D-16. TIMSS Advanced 2015 Physics Curriculum Questionnaire—Continued



TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

(Continued)

TIMSS Advanced 2015 Curriculum Questionnaire – Physics - Physics Curriculum

C. Is the physics curriculum currently being revised?

Examples of information reported for TIMSS Advanced 2008 can be found in the third column of Exhibit 7.3 on page 226 of the 2008 report. Click here to view

*Check **one** circle only.*

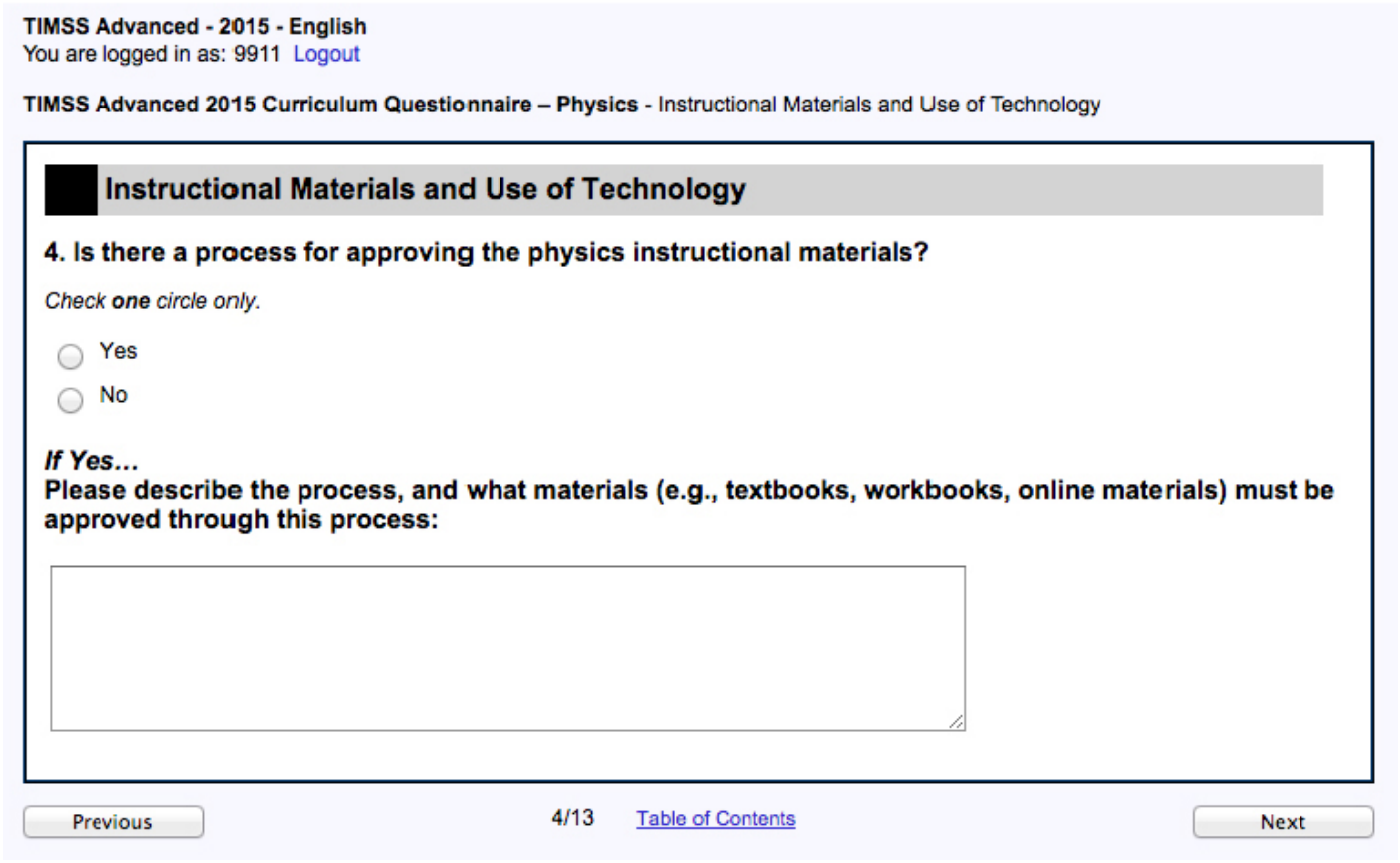
- ○ Yes
- ○ No

If Yes…
Please explain:

If No…
Comments:

Previous 3/13 Table of Contents Next

Exhibit D-16. TIMSS Advanced 2015 Physics Curriculum Questionnaire—Continued



TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Physics - Instructional Materials and Use of Technology

Instructional Materials and Use of Technology

4. Is there a process for approving the physics instructional materials?

*Check **one** circle only.*

- ○ Yes
- ○ No

If Yes…
Please describe the process, and what materials (e.g., textbooks, workbooks, online materials) must be approved through this process:

Previous 4/13 Table of Contents Next

Exhibit D-16. TIMSS Advanced 2015 Physics Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Physics - Instructional Materials and Use of Technology

5. A. Does the curriculum contain statements/policies about the use of technology (e.g., computers, tablets, calculators) in physics instruction?

*Check **one** circle only.*

- ○ Yes
- ○ No

If Yes...
What are the statements/policies?

Comments:

B. Does the curriculum contain statements/policies about student use of technological aids (e.g., computers, tablets, calculators) in physics tests or examinations?

*Check **one** circle only.*

- ○ Yes
- ○ No

If Yes...
What are the statements/policies?

Comments:

Exhibit D-16. TIMSS Advanced 2015 Physics Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Physics - Examinations

Examinations

6. A. Does an educational authority in your country (e.g., National Ministry of Education) administer examinations to students in these physics programs/tracks that have consequences for individual students, such as entry to a university?

*Check **one** circle only.*

- ○ Yes
- ○ No

If Yes….
B. Please describe the secondary school grades at which the exams are given to students in each of these programs/tracks and the purpose of each exam.

Examples of information reported for TIMSS Advanced 2008 can be found in the third and fifth columns of Exhibit 7.6 on pages 230-231 of the 2008 report. Click here to view

C. What is the nature and format of the examinations, and do they have an oral component?

Examples of information reported for TIMSS Advanced 2008 can be found in the fourth column of Exhibit 7.6 on pages 230-231 of the 2008 report. Click here to view

D. Additional comments on the examination system

Examples of information reported for TIMSS Advanced 2008 can be found in the sixth column of Exhibit 7.6 on pages 230-231 of the 2008 report. Click here to view

Exhibit D-16. TIMSS Advanced 2015 Physics Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Physics – Physics Topics Covered

Physics Topics Covered

7. According to the curriculum, should the students in the physics programs/tracks being assessed by TIMSS Advanced have been taught each of the following topics by the end of the year (in the current course or before)?

If part of a topic does not apply [e.g., expansion of solids and liquids in relation to temperature change in part A topic (i)], please explain in the comment field.

*Check **one** circle for each line.*

A. Mechanics and Thermodynamics	**Yes**	**No**
a) Applying Newton's laws and laws of motion	○	○
b) Forces, including frictional force, acting on a body	○	○
c) Forces acting on a body moving in a circular path; the body's centripetal acceleration, speed, and circling time	○	○
d) The law of gravitation in relation to the movement of celestial objects	○	○
e) Kinetic and potential energy; conservation of mechanical energy	○	○
f) The law of conservation of momentum; elastic and inelastic collisions	○	○
g) The first law of thermodynamics	○	○
h) Heat transfer and specific heat capacities	○	○
i) The law of ideal gases; expansion of solids and liquids in relation to temperature change	○	○

Comments:

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Exhibit D-16. TIMSS Advanced 2015 Physics Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Physics - Physics Topics Covered

7. (continued)
According to the curriculum, should the students in the physics programs/tracks being assessed by TIMSS Advanced have been taught each of the following topics by the end of the year (in the current course or before)?

If part of a topic does not apply [e.g., expansion of solids and liquids in relation to temperature change in part A topic (i)], please explain in the comment field.

*Check **one** circle for each line.*

B. Electricity and Magnetism	**Yes**	**No**
a) Electrostatic attraction or repulsion between isolated charged particles—Coulomb's law	○	○
b) Charged particles in an electric field	○	○
c) Electrical circuits; using Ohm's law and Joule's law	○	○
d) Charged particles in a magnetic field	○	○
e) Relationship between magnetism and electricity; magnetic fields around electric conductors; electromagnetic induction	○	○
f) Faraday's and Lenz's laws of induction	○	○

Comments:

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Exhibit D-16. TIMSS Advanced 2015 Physics Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Physics – Physics Topics Covered

7. (continued)
According to the curriculum, should the students in the physics programs/tracks being assessed by TIMSS Advanced have been taught each of the following topics by the end of the year (in the current course or before)?

If part of a topic does not apply [e.g., expansion of solids and liquids in relation to temperature change in part A topic (i)], please explain in the comment field.

*Check **one** circle for each line.*

C. Wave Phenomena and Atomic/Nuclear Physics	**Yes**	**No**
a) Mechanical waves; the relationship between speed, frequency, and wavelength	○	○
b) Electromagnetic radiation; wavelength and frequency of various types of waves (radio, infrared, visible light, x-rays, gamma rays)	○	○
c) Thermal radiation, temperature, and wavelength	○	○
d) Reflection, refraction, interference, and diffraction	○	○
e) The structure of the atom and its nucleus; atomic number and atomic mass; electromagnetic emission and absorption and the behavior of electrons	○	○
f) Wave-particle duality and the photoelectric effect; types of nuclear reactions and their role in nature (e.g., in stars) and society; radioactive isotopes	○	○
g) Mass-energy equivalence in nuclear reactions and particle transformations	○	○

Comments:

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Exhibit D-16. TIMSS Advanced 2015 Physics Curriculum Questionnaire—Continued

TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Physics - Physics Topics Covered

8. How is the implementation of the physics curriculum evaluated?

*Check **one** circle for each line.*

	Yes	No
a) Visits by inspectors	○	○
b) Research programs	○	○
c) School self-evaluation	○	○
d) National or regional examinations	○	○
e) Other Please specify below:	○	○

Comments:

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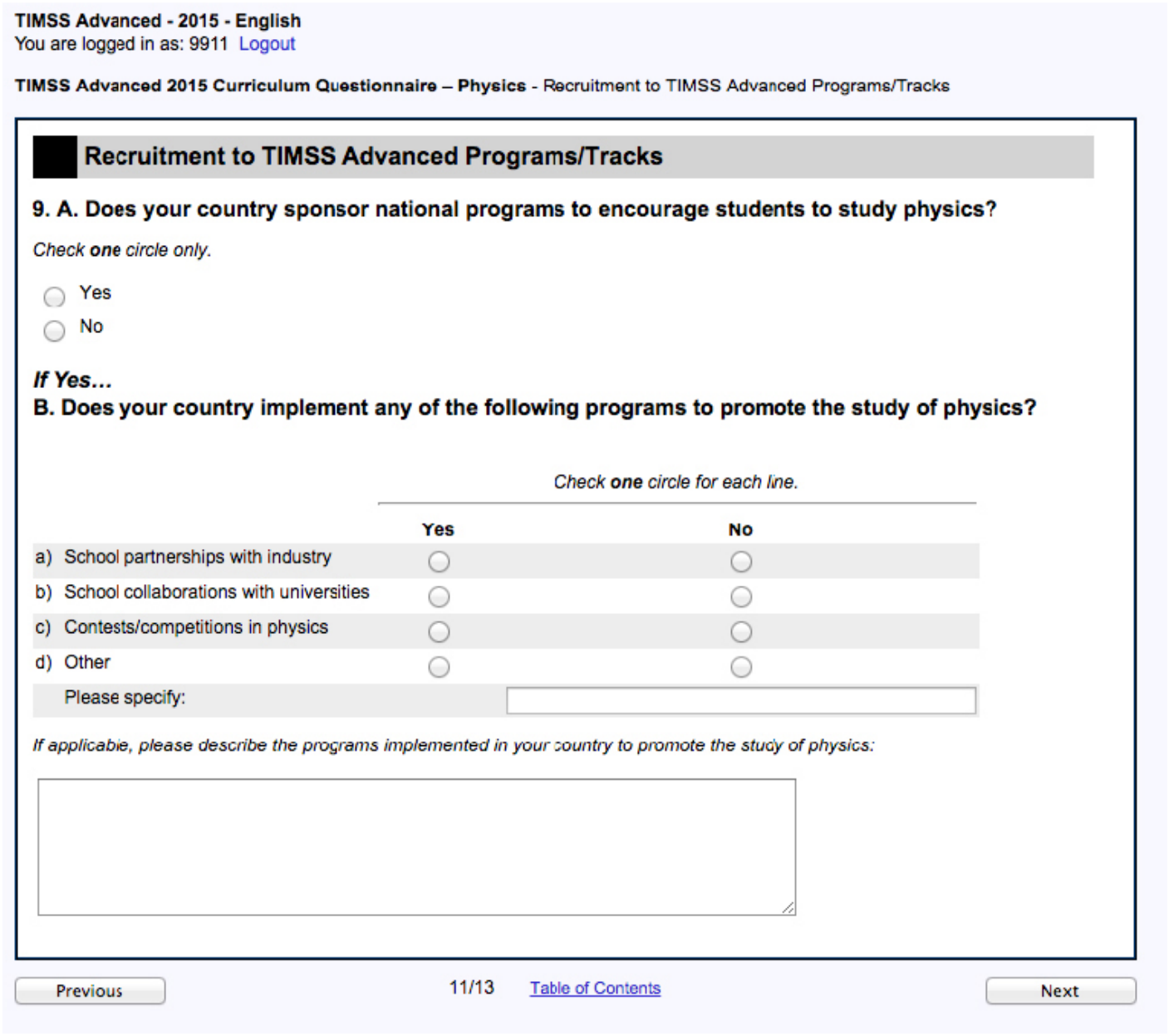
Exhibit D-16. TIMSS Advanced 2015 Physics Curriculum Questionnaire—Continued



TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Physics - Recruitment to TIMSS Advanced Programs/Tracks

Recruitment to TIMSS Advanced Programs/Tracks

9. A. Does your country sponsor national programs to encourage students to study physics?

*Check **one** circle only.*

- ○ Yes
- ○ No

If Yes…

B. Does your country implement any of the following programs to promote the study of physics?

*Check **one** circle for each line.*

	Yes	No
a) School partnerships with industry	○	○
b) School collaborations with universities	○	○
c) Contests/competitions in physics	○	○
d) Other	○	○
Please specify:		

If applicable, please describe the programs implemented in your country to promote the study of physics:

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Exhibit D-16. TIMSS Advanced 2015 Physics Curriculum Questionnaire—Continued

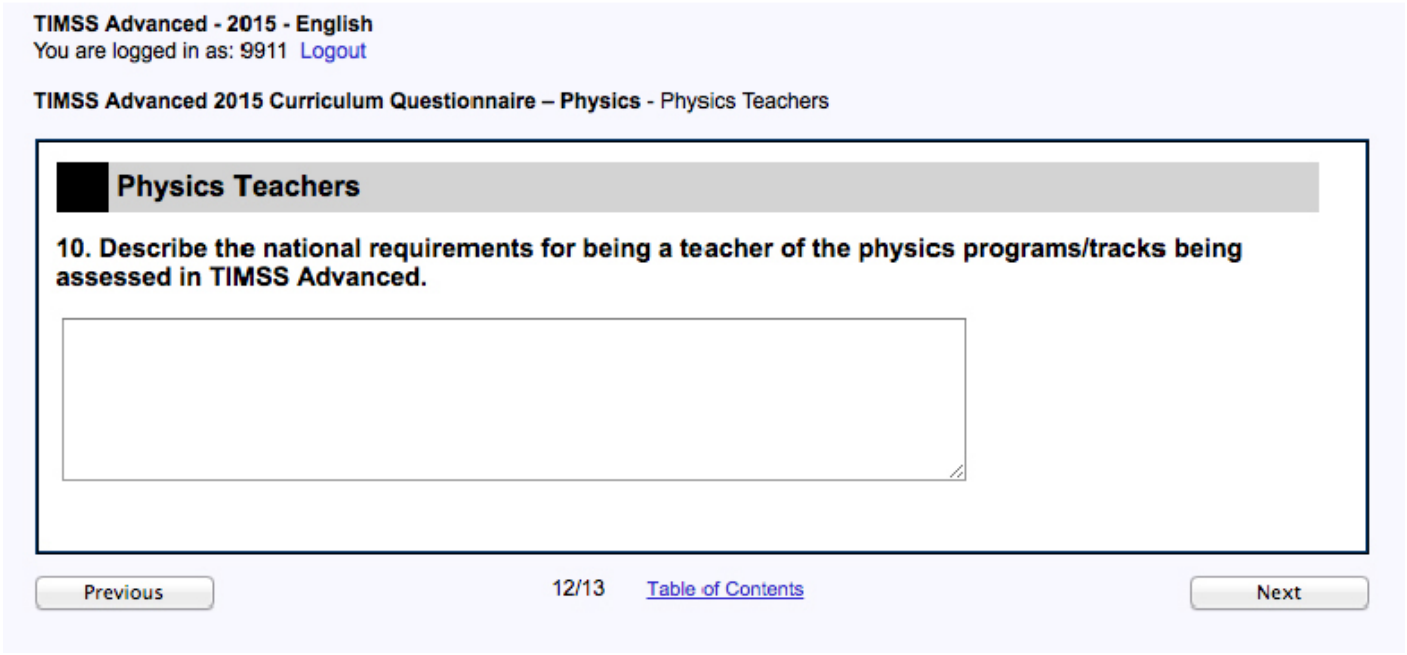
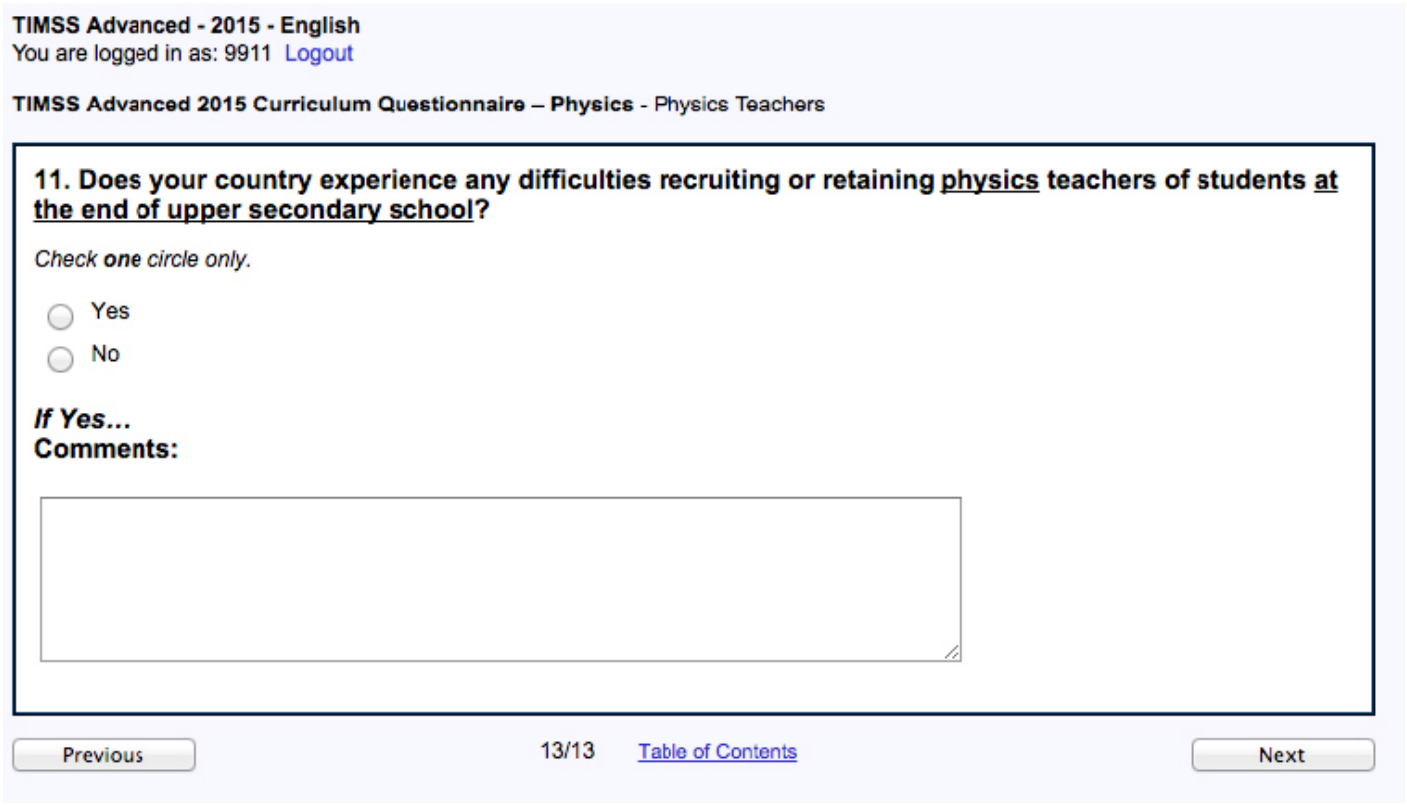


Exhibit D-16. TIMSS Advanced 2015 Physics Curriculum Questionnaire—Continued



TIMSS Advanced - 2015 - English
You are logged in as: 9911 Logout

TIMSS Advanced 2015 Curriculum Questionnaire – Physics - Physics Teachers

11. Does your country experience any difficulties recruiting or retaining physics teachers of students at the end of upper secondary school?

*Check **one** circle only.*

- ○ Yes
- ○ No

If Yes…
Comments:

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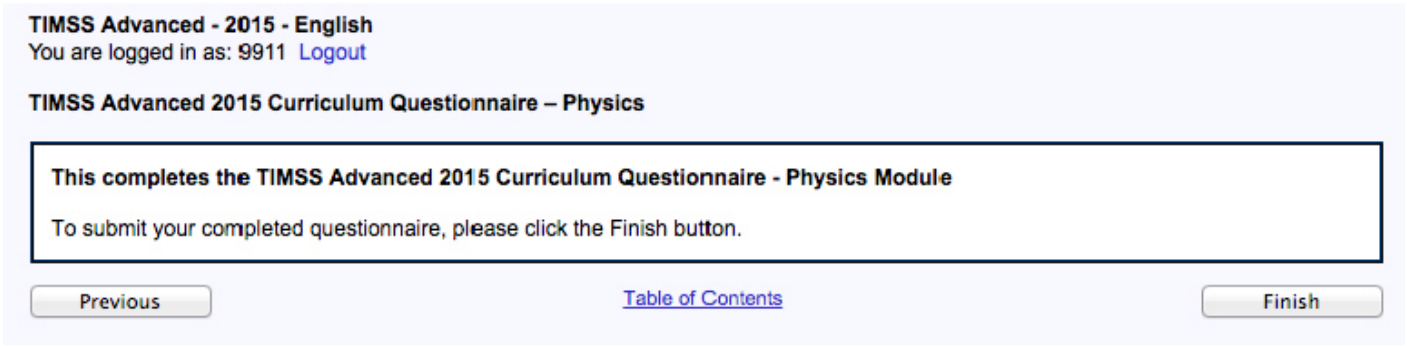
Exhibit D-16. TIMSS Advanced 2015 Physics Curriculum Questionnaire—Continued



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P
Physics

Appendix E

TIMSS 2015 and TIMSS Advanced 2015 Questionnaire Adaptations

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APPENDIX E: TIMSS 2015 AND TIMSS ADVANCED 2015 QUESTIONNAIRE ADAPTATIONS

Contents

Exhibit E-1. TIMSS 2015 Grade 4 School Questionnaire

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
ScQ-02	**What is the total enrollment of <fourth grade> students in your school as of <first day of month TIMSS testing begins, 2015>?** *Write in the number.* _____ students	ScQ-02	**What is the total enrollment of fourth-grade students in your school as of March 1, 2015?** _____ students *Write in the number*	
		ScQ-04	**Around the 1st of October 2014, what percentage of students at this school were eligible to receive free or reduced-price lunches through the National School Lunch Program?** _____ percentage of students *Write in the number.*	
ScQ-04	**Approximately what percentage of students in your school have <language of test> as their native language?** *Check **one** circle only.* 1. More than 90% 2. 76 to 90% 3. 51 to 75% 4. 26 to 50% 5. 25% or less	ScQ-05	**Approximately what percentage of students in your school have English as their native language?** *Fill in **one** circle only.* 1. More than 90% 2. 76 to 90% 3. 51 to 75% 4. 26 to 50% 5. 25% or less	
		ScQ-06	**Of the students currently enrolled in your school, what percentage has been identified as limited-English proficient (LEP)/English language learners (ELL)?** *Fill in **one** circle only.* 1. 0% 2. 1-5% 3. 6-10% 4. 11-25% 5. 26-50% 6. 51-75% 7. 76-90% 8. Over 90%	

Exhibit E-1. TIMSS 2015 Grade 4 School Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		ScQ-07	**What type of school is this?** *Fill in **one** circle only.* 1. Regular public school 2. A regular public school with a magnet program 3. A magnet school or school with a special program emphasis (e.g., Montessori, science/math school, performing arts school, talented/gifted school, foreign language immersion school) 4. Special education: a school that primarily serves students with disabilities 5. Alternative: a school designed to address the needs of students, typically at risk of educational failure, which cannot be met in regular schools 6. Vocational 7. Charter school 8. Private (independent) 9. Private (religiously affiliated) 10. Other	
		ScQ-09	**Which best characterizes the average income level of the school's immediate area?** *Fill in one circle only.* 1. High 2. Medium 3. Low	
ScQ-08A	**For the <fourth grade> students in your school:** **How many <u>days per year</u> is your school open for instruction?** *Write in the number.* _____days	ScQ-12A	**For the fourth-grade students in your school:** **How many <u>days per year</u> is your school open for instruction?** _____days *Write in the number.*	
ScQ-08B	**What is the <u>total instructional time</u>, excluding breaks, in a <u>typical day</u>?** *Write in the number of minutes per day. Please convert the number of hours into minutes.* _____minutes	ScQ-12B	**What is the <u>total instructional time</u>, excluding breaks, in a <u>typical day</u>?** _____hours _____minutes *Write in the number of hours and minutes per day.*	1hr-->60min

Exhibit E-1. TIMSS 2015 Grade 4 School Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
ScQ-09A	**Does your school provide a place where students can work on their schoolwork before or after school?** *Check **one** circle only.* 1.Yes 2. No (If No, go to #10)	ScQ-13A	**Does your school provide a place where students can work on their schoolwork before or after school?** *Fill in **one** circle only.* 1.Yes 2. No (If No, go to question 14)	
ScQ-10	**As a general school policy, is student achievement used to assign <fourth grade> students to classes (e.g., streaming, tracking, setting)?** *Check **one** circle for each line.* 1. Yes 2. No	ScQ-14	**As a general school policy, is student achievement used to assign fourth-grade students to classes (e.g., streaming, tracking, setting)?** *Fill in only **one** circle for each row.* 1. Yes 2. No	
ScQ-11	**How many computers (including tablets) does your school have for use by <fourth grade> students?** *Write in the number.* _____computers	ScQ-15	**How many computers (including tablets) does your school have for use by fourth-grade students?** _____computers *Write in the number.*	
ScQ-12A	**Does your school have a science laboratory that can be used by <fourth grade> students?** *Check **one** circle only.* 1. Yes 2. No	ScQ-16A	**Does your school have a science laboratory that can be used by fourth-grade students?** *Fill in **one** circle only.* 1. Yes 2. No	
ScQ-13	**Does your school have a school library?** *Check **one** circle only.* 1. Yes 2. No *(If No, go to #14)*	ScQ-17	**Does your school have a school library?** *Fill in **one** circle only.* 1. Yes 2. No *(If No, go to question 18)*	
ScQ-16	**To what degree is each of the following a problem among <fourth grade> students in your school?** *Check **one** circle for each line.* 1. Not a problem 2. Minor problem 3. Moderate problem 4. Serious problem	ScQ-20	**To what degree is each of the following a problem among fourth-grade students in your school?** *Fill in only **one** circle for each row.* 1. Not a problem 2. Minor problem 3. Moderate problem 4. Serious problem	

Exhibit E-1. TIMSS 2015 Grade 4 School Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		ScQ-22	**In your school, are any of the following used to evaluate the practice of fourth-grade teachers?** *Fill in only **one** circle for each row.* 1. Yes 2. No	
		ScQ-22a	Observations by the principal or senior staff	
		ScQ-22b	Observations by inspectors or other persons external to the school	
		ScQ-22c	Student achievement	
		ScQ-22d	Teacher peer review	
ScQ-18	**About how many of the students in your school can do the following when they begin the <first grade> of primary/elementary school?** *Check **one** circle for each line.* 1. Less than 25% 2. 25–50% 3. 51–75% 4. More than 75%	ScQ-23	**About how many of the students in your school can do the following when they begin the first grade of primary/elementary school?** *Fill in only **one** circle for each row.* 1. Less than 25% 2. 25–50% 3. 51–75% 4. More than 75%	
ScQ-19	**By the end of this school year, how many years will you have been a principal altogether?** *Please **round** to the nearest whole number.* _____years	ScQ-24	**By the end of this school year, how many years altogether will you have been a principal?** _____years *Please **round** to the nearest whole number.*	
ScQ-21	**What is the highest level of formal education you have completed?** *Check **one** circle only.* 1. Did not complete <Bachelor's or equivalent level—ISCED Level 6> 2. <Bachelor's or equivalent level—ISCED Level 6> 3. <Master's or equivalent level—ISCED Level 7> 4. <Doctor or equivalent level—ISCED Level 8>	ScQ-26	**What is the highest level of formal education you have completed?** *Fill in **one** circle only.* 1. Did not complete Bachelor's degree (4-year college program) 2. Bachelor's degree (4-year college program) 3. Master's degree or professional degree (MD, DDS, lawyer, minister) 4. Doctorate (Ph.D., or Ed.D.)	Nat -> Int 1 -> 1 2 -> 2 3 -> 3 4 -> 4
ScQ-22a	<Master's or equivalent level—ISCED Level 7>	ScQ-27a	Master's degree or professional degree (MD, DDS, lawyer, minister)	
ScQ-22b	<Doctor or equivalent level—ISCED Level 8>	ScQ-27b	Doctorate (Ph.D., or Ed.D.)	

Exhibit E-2. TIMSS 2015 Grade 4 Teacher Questionnaire

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		TQG-01	**What year did you start teaching?** _____ *Please write in a year.*	
TQG-01	**By the end of this school year, how many years will you have been teaching altogether?** *Please **round** to the nearest whole number.* _____ years	TQG-02	**At the end of this school year, how many years will you have taught altogether?** _____ years *Please **round** to the nearest whole number.*	
TQG-04	**What is the highest level of formal education you have completed?** *Check **one** circle only.* 1. Did not complete <Upper secondary education—ISCED Level 3> 2. <Upper secondary education—ISCED Level 3> *(If you have not completed <post-secondary or tertiary education>, go to #G6)* 3. <Post-secondary, non-tertiary education—ISCED Level 4> 4. <Short-cycle tertiary education—ISCED Level 5> 5. <Bachelor's or equivalent level—ISCED Level 6> 6. <Master's or equivalent level—ISCED Level 7> 7. <Doctor or equivalent level—ISCED Level 8>	TQG-05	**What is the highest level of formal education you have completed?** *Fill in **one** circle only.* 1. Did not complete high school 2. High school graduate *(If you have not completed more than high school, go to question 7)* 3. Associate's degree (2-year college program) 4. Bachelor's degree (4-year college program) 5. Master's degree or professional degree (MD, DDS, lawyer, minister) 6. Doctorate (Ph.D., or Ed.D.)	Nat -> Int 1 -> 1 2 -> 2 3 -> 4 4 -> 5 5 -> 6 6 -> 7 International Category 4 (ISCED Level 4) is not administered
TQG-05A	**During your <post-secondary> education, what was your major or main area(s) of study?** *Check **one** circle for each line.* 1. Yes 2. No	TQG-06A	**During your college or university education, what was your major or main area(s) of study?** *Fill in only **one** circle for each row.* 1. Yes 2. No	
TQG-05Ae	<language of test>	TQG-06Ae	English	
TQG-05B	**If your major or main area of study was education, did you have a <specialization> in any of the following?** *Check **one** circle for each line.* 1. Yes 2. No	TQG-06B	**If your major or main area of study was education, did you have a specialization in any of the following?** *Fill in only **one** circle for each row.* 1. Yes 2. No	

Exhibit E-2. TIMSS 2015 Grade 4 Teacher Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
TQG-12B	**How many of the students in #G12A are in <fourth grade>?** *Write in the number.* _____ <fourth grade> students	TQG-13B	**How many of the students in question 13A are in fourth grade?** _____ fourth-grade students *Write in the number.*	
TQG-13	**How many <fourth grade> students experience difficulties understanding <u>spoken</u> <language of test>?** *Write in the number.* _____ students in this class	TQG-14	**How many fourth-grade students experience difficulties understanding <u>spoken</u> English?** _____ students in this class *Write in the number.*	
TQM-05A	**Do the students in this class have computers (including tablets) available to use during their mathematics lessons?** *Check **one** circle only.* 1. Yes 2. No *(If No, go to #M6)*	TQM-21A	**Do the students in this class have computers (including tablets) available to use during their mathematics lessons?** *Fill in **one** circle only.* 1. Yes 2. No *(If No, go to question 22)*	
TQM-06	**The following list includes the main topics addressed by the TIMSS mathematics test. Choose the response that best describes when the students in this class have been taught each topic. If a topic was in the curriculum before the <<u>fourth grade</u>>, please choose "Mostly taught before this year." If a topic was taught half this year but not yet completed, please choose "Mostly taught this year." If a topic is not in the curriculum, please choose "Not yet taught or just introduced."** *Check **one** circle for each line.* 1. Mostly taught before this year 2. Mostly taught this year 3. Not yet taught or just introduced	TQM-22	**The following list includes the main topics addressed by the TIMSS mathematics test. Choose the response that best describes when the students in this class have been taught each topic. If a topic was in the curriculum before the <u>fourth grade</u>, please choose "Mostly taught before this year." If a topic was taught half this year but not yet completed, please choose "Mostly taught this year." If a topic is not in the curriculum, please choose "Not yet taught or just introduced."** *Fill in only **one** circle for each row.* 1. Mostly taught before this year 2. Mostly taught this year 3. Not yet taught or just introduced	
TQM-07A	**How often do you usually assign mathematics homework to the students in this class?** *Check **one** circle only.* 1. I do not assign mathematics homework *(Go to #M8)* 2. Less than once a week 3. 1 or 2 times a week 4. 3 or 4 times a week 5. Every day	TQM-23A	**How often do you usually assign mathematics homework to the students in this class?** *Fill in **one** circle only.* 1. I do not assign mathematics homework *(Go to question 24)* 2. Less than once a week 3. 1 or 2 times a week 4. 3 or 4 times a week 5. Every day	

Exhibit E-2. TIMSS 2015 Grade 4 Teacher Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
TQM-08c	National or regional achievement tests	TQM-24c	State or district achievement tests	
TQM-10	**In the past two years, how many hours in total have you spent in formal <in-service/professional development> (e.g., workshops, seminars, etc.) for mathematics?** *Check **one** circle only.* 1. None 2. Less than 6 hours 3. 6–15 hours 4. 16–35 hours 5. More than 35 hours	TQM-26	**In the past two years, how many hours in total have you spent in formal in-service/professional development (e.g., workshops, seminars) for mathematics?** *Fill in **one** circle only.* 1. None 2. Less than 6 hours 3. 6–15 hours 4. 16–35 hours 5. More than 35 hours	
TQM-11	**How well prepared do you feel you are to teach the following mathematics topics?** **If a topic is not in the <fourth grade> curriculum or you are not responsible for teaching this topic, please choose "Not applicable."** *Check **one** circle for each line.* 1. Not applicable 2. Very well prepared 3. Somewhat prepared 4. Not well prepared	TQM-27	**How well prepared do you feel you are to teach the following mathematics topics?** **If a topic is not in the fourth-grade curriculum or you are not responsible for teaching this topic, please choose "Not applicable."** *Fill in only **one** circle for each row.* 1. Not applicable 2. Very well prepared 3. Somewhat prepared 4. Not well prepared	
TQS-04A	**Do the students in this class have computers (including tablets) available to use during their science lessons?** *Check **one** circle only.* 1. Yes 2. No *(If No, go to #S5)*	TQS-31A	**Do the students in this class have computers (including tablets) available to use during their science lessons?** *Fill in **one** circle only.* 1. Yes 2. No *(If No, go to question 32)*	

Exhibit E-2. TIMSS 2015 Grade 4 Teacher Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
TQS-05	**The following list includes the main topics addressed by the TIMSS science test. Choose the response that best describes when the students in this class have been taught each topic. If a topic was in the curriculum before the <fourth grade>, please choose "Mostly taught before this year." If a topic was taught half this year but not yet completed, please choose "Mostly taught this year." If a topic is not in the curriculum, please choose "Not yet taught or just introduced."** *Check **one** circle for each line.* 1. Mostly taught before this year 2. Mostly taught this year 3. Not yet taught or just introduced	TQS-32	**The following list includes the main topics addressed by the TIMSS science test. Choose the response that best describes when the students in this class have been taught each topic. If a topic was in the curriculum before the fourth grade, please choose "Mostly taught before this year." If a topic was taught half this year but not yet completed, please choose "Mostly taught this year." If a topic is not in the curriculum, please choose "Not yet taught or just introduced."** *Fill in only **one** circle for each row.* 1. Mostly taught before this year 2. Mostly taught this year 3. Not yet taught or just introduced	
TQS-06A	**How often do you usually assign science homework to the students in this class?** *Check **one** circle only.* 1. I do not assign science homework *(Go to #S7)* 2. Less than once a week 3. 1 or 2 times a week 4. 3 or 4 times a week 5. Every day	TQS-33A	**How often do you usually assign science homework to the students in this class?** *Fill in **one** circle only.* 1. I do not assign science homework *(Go to question 34)* 2. Less than once a week 3. 1 or 2 times a week 4. 3 or 4 times a week 5. Every day	
TQS-07c	National or regional achievement tests	TQS-34c	State or district achievement tests	
TQS-09	**In the past two years, how many hours in total have you spent in formal <in-service/professional development> (e.g., workshops, seminars, etc.) for science?** *Check **one** circle only.* 1. None 2. Less than 6 hours 3. 6–15 hours 4. 16–35 hours 5. More than 35 hours	TQS-36	**In the past two years, how many hours in total have you spent in formal in-service/professional development (e.g., workshops, seminars, etc.) for science?** *Fill in **one** circle only.* 1. None 2. Less than 6 hours 3. 6–15 hours 4. 16–35 hours 5. More than 35 hours	

Exhibit E-2. TIMSS 2015 Grade 4 Teacher Questionnaire —Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
TQS-10	**How well prepared do you feel you are to teach the following science topics?** **If a topic is not in the <fourth grade> curriculum or you are not responsible for teaching this topic, please choose "Not applicable."** *Check **one** circle for each line.* 1. Not applicable 2. Very well prepared 3. Somewhat prepared 4. Not well prepared	TQS-37	**How well prepared do you feel you are to teach the following science topics?** **If a topic is not in the fourth-grade curriculum or you are not responsible for teaching this topic, please choose "Not applicable."** *Fill in only **one** circle for each row.* 1. Not applicable 2. Very well prepared 3. Somewhat prepared 4. Not well prepared	

Exhibit E-3. TIMSS 2015 Grade 4 Student Questionnaire

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		SQG-01B	**Are you Hispanic or Latino?** *Fill in **one** oval only.* 1. Yes, I am Hispanic or Latino 2. No, I am not Hispanic or Latino	
		SQG-01C	**Which of the following best describes you?** *Fill in ovals for **all** that apply.* 1. White 2. Black or African American 3. Asian 4. American Indian or Alaska Native 5. Native Hawaiian or other Pacific Islander	
SQG-03	**How often do you speak <language of test> at home?** *Fill **one** circle only.* 1. I always speak <language of test> at home 2. I almost always speak <language of test> at home 3. I sometimes speak <language of test> and sometimes speak another language at home 4. I never speak <language of test> at home	SQG-03A	**How often do you speak English at home?** *Fill in **one** oval only.* 1. I always speak English at home *If **Always**, please go to question 4.* 2. I almost always speak English at home 3. I sometimes speak English and sometimes speak another language at home 4. I never speak English at home *If **Almost always**, **Sometimes**, **Never**, please go to question 3B.*	
		SQG-03B	**What language do you speak at home (other than English)?** *Fill in **one** oval only.* 1. Spanish 2. Other Please specify _____	
SQG-05g	A gaming system (e.g., PlayStation®, Wii®, XBox®)	SQG-05g	A gaming system (e.g., PlayStation, Wii, Xbox)	
SQG-05h	<country-specific indicator of wealth>	SQG-05h	VCR, DVD, or Blu-ray player	
SQG-06A	**Was your mother (or stepmother or female guardian) born in <country>?** *Fill **one** circle only.* 1. Yes 2. No 3. I don't know	SQG-06A	**Was your mother (or stepmother or female legal guardian) born in the United States? ("United States" includes the 50 states, its territories, the District of Columbia, and U.S. military bases abroad)** *Fill in **one** oval only.* 1. Yes 2. No 3. I don't know	

Exhibit E-3. TIMSS 2015 Grade 4 Student Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
SQG-06B	**Was your father (or stepfather or male guardian) born in <country>?** *Fill **one** circle only.* 1. Yes 2. No 3. I don't know	SQG-06B	**Was your father (or stepfather or male legal guardian) born in the United States?** *Fill in **one** oval only.* 1. Yes 2. No 3. I don't know	
SQG-07	**Were you born in <country>?** *Fill **one** circle only.* 1. Yes 2. No	SQG-07	**Were you born in the United States?** *Fill in **one** oval only.* 1. Yes 2. No	
		SQG-08	**The following questions ask about activities you do <u>outside of school.</u>** *Fill in only **one** oval for each row.* 1. Yes 2. No	
		SQG-08a	Do you play on a sports team outside of school?	
		SQG-08b	Do you often play a musical instrument outside of school?	
		SQG-08c	Are you studying something in a class outside of school?	
		SQG-08d	Do you belong to a club outside of school (like Boy/Girl Scouts, 4-H, or Boys and Girls Club)?	
		SQG-09	**Are you preparing for or have you participated in a science club, a science fair, or a science competition?** *Fill in **one** oval only.* 1. Yes 2. No	
		SQG-10	**Have you ever repeated a grade in elementary school?** *Fill in **one** oval only.* 1. Yes 2. No	
		SQG-11B	**How many days were you absent from school in the last month?** *Fill in **one** oval only.* 1. None 2. 1 or 2 days 3. 3 or 4 days 4. 5 to 10 days 5. More than 10 days	

Exhibit E-3. TIMSS 2015 Grade 4 Student Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		SQMS-22	**How hard was this test compared to most other tests you have taken this year in school?** *Fill in **one** oval only.* 1. Easier than other tests 2. About as hard as other tests 3. Harder than other tests 4. Much harder than other tests	
		SQMS-23	**How hard did you try on this test compared to how hard you tried on most other tests you have taken this year in school?** *Fill in **one** oval only.* 1. Not as hard as on other tests 2. About as hard as on other tests 3. Harder than on other tests 4. Much harder than on other tests	
		SQMS-24	**How important was it to you to do well on this test?** *Fill in **one** oval only.* 1. Not very important 2. Somewhat important 3. Important 4. Very important	

Exhibit E-4. TIMSS 2015 Grade 8 School Questionnaire

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
ScQ-01	**What is the total enrollment of students in your school as of <first day of month TIMSS testing begins, 2015>?** *Write in the number.* _____ students	ScQ-01	**What is the total enrollment of students in your school as of March 1, 2015?** _____ students *Write in the number.*	
ScQ-02	**What is the total enrollment of <eighth grade> students in your school as of <first day of month TIMSS testing begins, 2015>?** *Write in the number.* _____ students	ScQ-02	**What is the total enrollment of eighth-grade students in your school as of March 1, 2015** _____ students *Write in the number.*	
		ScQ-04	**Around the 1st of October 2014, what percentage of students at this school were eligible to receive free or reduced-price lunches through the National School Lunch Program?** _____ percentage of students *Write in the number.*	
ScQ-04	**Approximately what percentage of students in your school have <language of test> as their native language?** *Check **one** circle only.* 1. More than 90% 2. 76 to 90% 3. 51 to 75% 4. 26 to 50% 5. 25% or less	ScQ-05	**Approximately what percentage of students in your school have English as their native language?** *Fill in **one** circle only.* 1. More than 90% 2. 76 to 90% 3. 51 to 75% 4. 26 to 50% 5. 25% or less	
		ScQ-06	**Of the students currently enrolled in your school, what percentage has been identified as limited-English proficient (LEP)/English language learners (ELL)?** *Fill in **one** circle only.* 1. 0% 2. 1-5% 3. 6-10% 4. 11-25% 5. 26-50% 6. 51-75% 7. 76-90% 8. Over 90%	

Exhibit E-4. TIMSS 2015 Grade 8 School Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		ScQ-07	**What type of school is this?** *Fill in **one** circle only.* 1. Regular public school 2. A regular public school with a magnet program 3. A magnet school or school with a special program emphasis (e.g., Montessori, science/math school, performing arts school, talented/gifted school, foreign language immersion school) 4. Special education: a school that primarily serves students with disabilities 5. Alternative: a school designed to address the needs of students, typically at risk of educational failure, which cannot be met in regular schools 6. Vocational 7. Charter school 8. Private (independent) 9. Private (religiously affiliated) 10. Other	
		ScQ-09	**Which best characterizes the average income level of the school's immediate area?** *Fill in **one** circle only.* 1. High 2. Medium 3. Low	
ScQ-07A	**For the <eighth grade> students in your school:** **How many <u>days per year</u> is your school open for instruction?** *Write in the number.* _____days	ScQ-11A	**For the eighth-grade students in your school:** **How many <u>days per year</u> is your school open for instruction?** _____days *Write in the number.*	
ScQ-07B	**What is the <u>total instructional time</u>, excluding breaks, in a <u>typical day</u>?** *Write in the number of minutes per day. Please convert the number of hours into minutes.* _____minutes	ScQ-11B	**What is the <u>total instructional time</u>, excluding breaks, in a <u>typical day</u>?** _____hours _____minutes *Write in the number of hours and minutes per day.*	

Exhibit E-4. TIMSS 2015 Grade 8 School Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
ScQ-08A	**Does your school provide a place where students can work on their schoolwork before or after school?** *Check **one** circle only.* 1. Yes 2. No *(If No, go to #9)*	ScQ-12A	**Does your school provide a place where students can work on their schoolwork before or after school?** *Fill in **one** circle only.* 1. Yes 2. No *(If No, go to question 13)*	
ScQ-09	**As a general school policy, is student achievement used to assign <eighth grade> students to classes (e.g., streaming, tracking, setting)?** *Check **one** circle for each line.* 1. Yes 2. No	ScQ-13	**As a general school policy, is student achievement used to assign eighth-grade students to classes (e.g., streaming, tracking, setting)?** *Fill in only **one** circle for each row.* 1. Yes 2. No	
ScQ-10	**How many computers (including tablets) does your school have for use by <eighth grade> students?** *Write in the number.* _____computers	ScQ-14	**How many computers (including tablets) does your school have for use by eighth-grade students?** _____computers *Write in the number.*	
ScQ-11A	**Does your school have a science laboratory that can be used by <eighth grade> students?** *Check **one** circle only.* 1. Yes 2. No	ScQ-15A	**Does your school have a science laboratory that can be used by eighth-grade students?** *Fill in **one** circle only.* 1. Yes 2. No	
ScQ-12	**Does your school have a school library?** *Check **one** circle only.* 1. Yes 2. No *(If No, go to #13)*	ScQ-16	**Does your school have a school library?** *Fill in **one** circle only.* 1. Yes 2. No *(If No, go to question 17)*	
ScQ-15	**To what degree is each of the following a problem among <eighth grade> students in your school?** *Check **one** circle for each line.* 1. Not a problem 2. Minor problem 3. Moderate problem 4. Serious problem	ScQ-19	**To what degree is each of the following a problem among eighth-grade students in your school?** *Fill in only **one** circle for each row.* 1. Not a problem 2. Minor problem 3. Moderate problem 4. Serious problem	
		ScQ-20	**In your school, are any of the following used to evaluate the practice of eighth-grade mathematics teachers?** *Fill in only **one** circle for each row.* 1. Yes 2. No	

Exhibit E-4. TIMSS 2015 Grade 8 School Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		ScQ-20a	Observations by the principal or senior staff	
		ScQ-20b	Observations by inspectors or other persons external to the school	
		ScQ-20c	Student achievement	
		ScQ-20d	Teacher peer review	
		ScQ-21	**In your school, are any of the following used to evaluate the practice of eighth-grade science teachers?** *Fill in only **one** circle for each row.* 1. Yes 2. No	
		ScQ-21a	Observations by the principal or senior staff	
		ScQ-21b	Observations by inspectors or other persons external to the school	
		ScQ-21c	Student achievement	
		ScQ-21d	Teacher peer review	
ScQ-16	**How difficult was it to fill <eighth grade> teaching vacancies for this school year for the following subjects?** *Check **one** circle for each line.* 1. Were no vacancies in this subject 2. Easy to fill vacancies 3. Somewhat difficult 4. Very difficult	ScQ-22	**How difficult was it to fill eighth-grade teaching vacancies for this school year for the following subjects?** *Fill in only **one** circle for each row.* 1. Were no vacancies in this subject 2. Easy to fill vacancies 3. Somewhat difficult 4. Very difficult	
ScQ-17	**Does your school currently use any incentives (e.g., pay, housing, signing bonus, smaller classes) to recruit or retain <eighth grade> teachers in the following fields?** *Check **one** circle for each line.* 1. Yes 2. No	ScQ-23	**Does your school currently use any incentives (e.g., pay, housing, signing bonus, smaller classes) to recruit or retain eighth-grade teachers in the following fields?** *Fill in only **one** circle for each row.* 1. Yes 2. No	
ScQ-19	**By the end of this school year, how many years will you have been a principal altogether?** *Please **round** to the nearest whole number.* _____years	ScQ-25	**By the end of this school year, how many years altogether will you have been a principal?** _____years *Please **round** to the nearest whole number.*	

Exhibit E-4. TIMSS 2015 Grade 8 School Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
ScQ-21	**What is the highest level of formal education you have completed?** *Check **one** circle only.* 1. Did not complete <Bachelor's or equivalent level—ISCED Level 6> 2. <Bachelor's or equivalent level—ISCED Level 6> 3. <Master's or equivalent level—ISCED Level 7> 4. <Doctor or equivalent level—ISCED Level 8>	ScQ-27	**What is the highest level of formal education you have completed?** *Fill in **one** circle only.* 1. Did not complete Bachelor's degree (4-year college program) 2. Bachelor's degree (4-year college program) 3. Master's degree or professional degree (MD, DDS, lawyer, minister) 4. Doctorate (Ph.D., or Ed.D.)	Nat -> Int 1 -> 1 2 -> 2 3 -> 3 4 -> 4
ScQ-22a	<Master's or equivalent level—ISCED Level 7>	ScQ-28a	Master's degree or professional degree (MD, DDS, lawyer, minister)	
ScQ-22b	<Doctor or equivalent level—ISCED Level 8>	ScQ-28b	Doctorate (Ph.D., or Ed.D.)	

Exhibit E-5. TIMSS 2015 Grade 8 Teacher Math Questionnaire

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		TQG-01	**What year did you start teaching?** _____ *Please write in a year.*	
TQG-01	**By the end of this school year, how many years will you have been teaching altogether?** *Please **round** to the nearest whole number.* _____ years	TQG-02	**At the end of this school year, how many years will you have taught altogether?** _____ years *Please **round** to the nearest whole number.*	
TQG-04	**What is the highest level of formal education you have completed?** *Check **one** circle only.* 1. Did not complete <Upper secondary education—ISCED Level 3> 2. <Upper secondary education—ISCED Level 3> *(If you have not completed <post-secondary or tertiary education>, go to #G6)* 3. <Post-secondary, non-tertiary education—ISCED Level 4> 4. <Short-cycle tertiary education—ISCED Level 5> 5. <Bachelor's or equivalent level—ISCED Level 6> 6. <Master's or equivalent level—ISCED Level 7> 7. <Doctor or equivalent level—ISCED Level 8>	TQG-05	**What is the highest level of formal education you have completed?** *Fill in **one** circle only.* 1. Did not complete high school 2. High school graduate *(If you have not completed more than high school, go to question 7)* 3. Associate's degree (2-year college program) 4. Bachelor's degree (4-year college program) 5. Master's degree or professional degree (MD, DDS, lawyer, minister) 6. Doctorate (Ph.D., or Ed.D.)	Nat -> Int 1 -> 1 2 -> 2 3 -> 4 4 -> 5 5 -> 6 6 -> 7 International Category 4 (ISCED Level 4) is not administered
TQG-05	**During your <post-secondary> education, what was your major or main area(s) of study?** *Check **one** circle for each line.* 1. Yes 2. No	TQG-06	**During your college or university education, what was your major or main area(s) of study?** *Fill in only **one** circle for each row.* 1. Yes 2. No	
TQG-05e	<Earth Science>	TQG-06e	Earth Science	
TQM-13	**How many <eighth grade> students experience difficulties understanding spoken <language of test>?** *Write in the number.* _____ students in this class	TQM-14	**How many eighth-grade students experience difficulties understanding spoken English?** _____ students in this class *Write in the number.*	

Exhibit E-5. TIMSS 2015 Grade 8 Teacher Math Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
TQM-16	**In a typical week, how much time do you spend teaching mathematics to the students in this class?** *Write in the number of minutes per week.* *Please convert the number of hours into minutes.* _____ minutes per week	TQM-17	**In a typical week, how much time do you spend teaching mathematics to the students in this class?** _____ minutes per week *Write in the number of minutes per week.* *Please convert the number of hours into minutes.*	
		TQM-20	**Which best describes the mathematics course you are teaching to the class with the TIMSS students?** *Fill in **one** circle only.* 1. Basic or general eighth-grade math (not algebra or pre-algebra) 2. Pre-algebra or introduction to algebra 3. Two-year pre-algebra 4. Algebra I (one-year course) 5. Algebra I (first year of a two-year Algebra I course) 6. Algebra I (second year of two-year Algebra I course) 7. Geometry 8. Algebra II 9. Integrated or sequential math 10. Other math class	
TQM-19A	**Are the students in this class permitted to use calculators during mathematics lessons?** *Check **one** circle only.* 1. Yes, with unrestricted use 2. Yes, with restricted use 3. No, calculators are not permitted *(If No, go to #20)*	TQM-21A	**Are the students in this class permitted to use calculators during mathematics lessons?** *Fill in **one** circle only.* 1. Yes, with unrestricted use 2. Yes, with restricted use 3. No, calculators are not permitted *(If No, go to question 22)*	
TQM-20A	**Do the students in this class have computers (including tablets) available to use during their mathematics lessons?** *Check **one** circle only.* 1. Yes 2. No *(If No, go to #21)*	TQM-22A	**Do the students in this class have computers (including tablets) available to use during their mathematics lessons?** *Fill in **one** circle only.* 1. Yes 2. No *(If No, go to question 23)*	

Exhibit E-5. TIMSS 2015 Grade 8 Teacher Math Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
TQM-21	**The following list includes the main topics addressed by the TIMSS mathematics test. Choose the response that best describes when the students in this class have been taught each topic. If a topic was in the curriculum before the <eighth grade>, please choose "Mostly taught before this year." If a topic was taught half this year but not yet completed, please choose "Mostly taught this year." If a topic is not in the curriculum, please choose "Not yet taught or just introduced."** *Check **one** circle for each line.* 1. Mostly taught before this year 2. Mostly taught this year 3. Not yet taught or just introduced	TQM-23	**The following list includes the main topics addressed by the TIMSS mathematics test. Choose the response that best describes when the students in this class have been taught each topic. If a topic was in the curriculum before the eighth grade, please choose "Mostly taught before this year." If a topic was taught half this year but not yet completed, please choose "Mostly taught this year." If a topic is not in the curriculum, please choose "Not yet taught or just introduced."** *Fill in only **one** circle for each row.* 1. Mostly taught before this year 2. Mostly taught this year 3. Not yet taught or just introduced	
TQM-22A	**How often do you usually assign mathematics homework to the students in this class?** *Check **one** circle only.* 1. I do not assign mathematics homework *(Go to #23)* 2. Less than once a week 3. 1 or 2 times a week 4. 3 or 4 times a week 5. Every day	TQM-24A	**How often do you usually assign mathematics homework to the students in this class?** *Fill in **one** circle only.* 1. I do not assign mathematics homework *(Go to question 25)* 2. Less than once a week 3. 1 or 2 times a week 4. 3 or 4 times a week 5. Every day	
TQM-23c	National or regional achievement tests	TQM-25c	State or district achievement tests	
TQM-25	**In the past two years, how many hours in total have you spent in formal <in-service/professional development> (e.g., workshops, seminars, etc.) for mathematics?** *Check **one** circle only.* 1. None 2. Less than 6 hours 3. 6–15 hours 4. 16–35 hours 5. More than 35 hours	TQM-27	**In the past two years, how many hours in total have you spent in formal in-service/professional development (e.g., workshops, seminars) for mathematics?** *Fill in **one** circle only.* 1. None 2. Less than 6 hours 3. 6–15 hours 4. 16–35 hours 5. More than 35 hours	

Exhibit E-5. TIMSS 2015 Grade 8 Teacher Math Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
TQM-26	**How well prepared do you feel you are to teach the following mathematics topics?** **If a topic is not in the <eighth grade> curriculum or you are not responsible for teaching this topic, please choose "Not applicable."** *Check **one** circle for each line.* 1. Not applicable 2. Very well prepared 3. Somewhat prepared 4. Not well prepared	TQM-28	**How well prepared do you feel you are to teach the following mathematics topics?** **If a topic is not in the eighth-grade curriculum or you are not responsible for teaching this topic, please choose "Not applicable."** *Fill in only **one** circle for each row.* 1. Not applicable 2. Very well prepared 3. Somewhat prepared 4. Not well prepared	

Exhibit E-6. TIMSS 2015 Grade 8 Teacher Science Questionnaire

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		TQG-01	**What year did you start teaching?** _____ *Please write in a year.*	
TQG-01	**By the end of this school year, how many years will you have been teaching altogether?** *Please **round** to the nearest whole number.* _____ years	TQG-02	**At the end of this school year, how many years will you have taught altogether?** _____ years *Please **round** to the nearest whole number.*	
TQG-04	**What is the highest level of formal education you have completed?** *Check **one** circle only.* 1. Did not complete <Upper secondary education—ISCED Level 3> 2. <Upper secondary education—ISCED Level 3> *(If you have not completed <post-secondary or tertiary education>, go to #G6)* 3. <Post-secondary, non-tertiary education—ISCED Level 4> 4. <Short-cycle tertiary education—ISCED Level 5> 5. <Bachelor's or equivalent level—ISCED Level 6> 6. <Master's or equivalent level—ISCED Level 7> 7. <Doctor or equivalent level—ISCED Level 8>	TQG-05	**What is the highest level of formal education you have completed?** *Fill in **one** circle only.* 1. Did not complete high school 2. High school graduate *(If you have not completed more than high school, go to question 7)* 3. Associate's degree (2-year college program) 4. Bachelor's degree (4-year college program) 5. Master's degree or professional degree (MD, DDS, lawyer, minister) 6. Doctorate (Ph.D., or Ed.D.)	Nat -> Int 1 -> 1 2 -> 2 3 -> 4 4 -> 5 5 -> 6 6 -> 7 International Category 4 (ISCED Level 4) is not administered
TQG-05	**During your <post-secondary> education, what was your major or main area(s) of study?** *Check **one** circle for each line.* 1. Yes 2. No	TQG-06	**During your college or university education, what was your major or main area(s) of study?** *Fill in only **one** circle for each row.* 1. Yes 2. No	
TQG-05e	<Earth Science>	TQG-06e	Earth Science	
TQS-13	**How many <eighth grade> students experience difficulties understanding spoken <language of test>?** *Write in the number.* _____ students in this class	TQS-14	**How many eighth-grade students experience difficulties understanding spoken English?** _____ students in this class *Write in the number.*	

Exhibit E-6. TIMSS 2015 Grade 8 Teacher Science Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		TQS-20	**Which best describes the science course you are teaching to the class with the TIMSS students?** *Fill in **one** circle only* 1. General science (several content areas of science taught separately) 2. Integrated science (several content areas of science combined and taught together throughout the year) 3. Life science (e.g., biology, ecosystems, human health) 4. Physical science (e.g., physics or chemistry) 5. Earth science (e.g., geology, Earth and the solar system, fossils)	
TQS-19A	**Do the students in this class have computers (including tablets) available to use during their science lessons?** *Check **one** circle only.* 1. Yes 2. No *(If No, go to #20)*	TQS-21A	**Do the students in this class have computers (including tablets) available to use during their science lessons?** *Fill in **one** circle only.* 1. Yes 2. No *(If No, go to question 22)*	
TQS-20	**The following list includes the main topics addressed by the TIMSS science test. Choose the response that best describes when the students in this class have been taught each topic. If a topic was in the curriculum before the <eighth grade>, please choose "Mostly taught before this year." If a topic was taught half this year but not yet completed, please choose "Mostly taught this year." If a topic is not in the curriculum, please choose "Not yet taught or just introduced."** *Check **one** circle for each line.* 1. Mostly taught before this year 2. Mostly taught this year 3. Not yet taught or just introduced	TQS-22	**The following list includes the main topics addressed by the TIMSS science test. Choose the response that best describes when the students in this class have been taught each topic. If a topic was in the curriculum before the eighth grade, please choose "Mostly taught before this year." If a topic was taught half this year but not yet completed, please choose "Mostly taught this year." If a topic is not in the curriculum, please choose "Not yet taught or just introduced."** *Fill in only **one** circle for each row.* 1. Mostly taught before this year 2. Mostly taught this year 3. Not yet taught or just introduced	

Exhibit E-6. TIMSS 2015 Grade 8 Teacher Science Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
TQS-20Cd	Electric circuits (flow of current; types of circuits - parallel/series) and properties and uses of permanent magnets and electromagnets	TQS-22Cd	Electric circuits (flow of current; types of circuits -- parallel/series) and properties and uses of permanent magnets and electromagnets	
TQS-20Dd	Earth in the solar system and the universe (phenomena on Earth - day/night, tides, phases of moon, eclipses, seasons; physical features of Earth compared to other bodies)	TQS-22Dd	Earth in the solar system and the universe (phenomena on Earth -- day/night, tides, phases of moon, eclipses, seasons; physical features of Earth compared to other bodies)	
TQS-21A	**How often do you usually assign science homework to the students in this class?** *Check **one** circle only.* 1. I do not assign science homework *(Go to #22)* 2. Less than once a week 3. 1 or 2 times a week 4. 3 or 4 times a week 5. Every day	TQS-23A	**How often do you usually assign science homework to the students in this class?** *Fill in **one** circle only.* 1. I do not assign science homework *(Go to question 24)* 2. Less than once a week 3. 1 or 2 times a week 4. 3 or 4 times a week 5. Every day	
TQS-22c	National or regional achievement tests	TQS-24c	State or district achievement tests	
TQS-24	**In the past two years, how many hours in total have you spent in formal <in-service/professional development> (e.g., workshops, seminars, etc.) for science?** *Check **one** circle only.* 1. None 2. Less than 6 hours 3. 6–15 hours 4. 16–35 hours 5. More than 35 hours	TQS-26	**In the past two years, how many hours in total have you spent in formal in-service/professional development (e.g., workshops, seminars) for science?** *Fill in **one** circle only.* 1. None 2. Less than 6 hours 3. 6–15 hours 4. 16–35 hours 5. More than 35 hours	
TQS-25	**How well prepared do you feel you are to teach the following science topics?** **If a topic is not in the <eighth grade> curriculum or you are not responsible for teaching this topic, please choose "Not applicable."** *Check **one** circle for each line.* 1. Not applicable 2. Very well prepared 3. Somewhat prepared 4. Not well prepared	TQS-27	**How well prepared do you feel you are to teach the following science topics?** **If a topic is not in the eighth-grade curriculum or you are not responsible for teaching this topic, please choose "Not applicable."** *Fill in only **one** circle for each row.* 1. Not applicable 2. Very well prepared 3. Somewhat prepared 4. Not well prepared	
TQS-25Cd	Electric circuits (flow of current; types of circuits - parallel/series) and properties and uses of permanent magnets and electromagnets	TQS-27Cd	Electric circuits (flow of current; types of circuits -- parallel/series) and properties and uses of permanent magnets and electromagnets	

Exhibit E-6. TIMSS 2015 Grade 8 Teacher Science Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
TQS-25Dd	Earth in the solar system and the universe (phenomena on Earth - day/night, tides, phases of moon, eclipses, seasons; physical features of Earth compared to other bodies)	TQS-27Dd	Earth in the solar system and the universe (phenomena on Earth -- day/night, tides, phases of moon, eclipses, seasons; physical features of Earth compared to other bodies)	

Exhibit E-7. TIMSS 2015 Grade 8 Student Questionnaire

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		SQIS-01B	**Are you Hispanic or Latino?** *Fill in **one** oval only.* 1. Yes, I am Hispanic or Latino 2. No, I am not Hispanic or Latino	
		SQIS-01C	**Which of the following best describes you?** *Fill in ovals for **all** that apply.* 1. White 2. Black or African American 3. Asian 4. American Indian or Alaska Native 5. Native Hawaiian or other Pacific Islander	
SQIS-03	**How often do you speak <language of test> at home?** *Fill **one** circle only.* 1. Always 2. Almost always 3. Sometimes 4. Never	SQIS-03a	**How often do you speak English at home?** *Fill in **one** oval only.* 1. Always *If **Always**, please go to question 4.* 2. Almost always 3. Sometimes 4. Never *If **Almost always**, **Sometimes**, **Never**, please go to question 3B.*	
		SQIS-03b	**What language do you speak at home (other than English)?** *Fill in **one** oval only.* 1. Spanish 2. Other Please specify _____	
		SQIS-04	**The following questions ask about activities you do <u>outside of school</u>.** *Fill in only **one** oval for each row* 1. Yes 2. No	
		SQIS-04a	Do you play on a sports team outside of school?	
		SQIS-04b	Do you often play a musical instrument outside of school?	
		SQIS-04c	Are you studying something in a class outside of school?	
		SQIS-04d	Do you belong to a club outside of school (like Boy/Girl Scouts, 4-H, or Boys and Girls Club)?	
		SQIS-05	**In this school year, are you preparing for or have you participated in any of the following activities?** *Fill in only **one** oval for each row.* 1. Yes 2. No	
		SQIS-05a	Science fair	

Exhibit E-7. TIMSS 2015 Grade 8 Student Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		SQIS-05b	Science club	
		SQIS-05c	Science competition	
SQIS-06f	Your own mobile phone	SQIS-08f	Your own cell phone	
SQIS-06g	A gaming system (e.g., PlayStation®, Wii®, XBox®)	SQIS-08g	A gaming system (e.g., PlayStation, Wii, Xbox)	
SQIS-06h	<country-specific indicator of wealth>	SQIS-08h	VCR, DVD, or Blu-ray player	
SQIS-07A	**What is the highest level of education completed by your mother (or stepmother or female guardian)?** *Fill **one** circle only.* 1. Some <Primary education— ISCED Level 1 or Lower secondary education—ISCED Level 2> or did not go to school 2. <Lower secondary education—ISCED Level 2> 3. <Upper secondary education—ISCED Level 3> 4. <Post-secondary, non-tertiary education—ISCED Level 4> 5. <Short-cycle tertiary education—ISCED Level 5> 6. <Bachelor's or equivalent level—ISCED Level 6> 7. <Postgraduate degree: Master's—ISCED Level 7 or Doctor—ISCED Level 8> 8. I don't know	SQIS-09A	**What is the highest level of education completed by your mother (or stepmother or female legal guardian)?** *Fill in **one** oval only.* 1. Less than high school 2. Some high school 3. High school graduate 4. Associate's degree (2-year college program) 5. Bachelor's degree (4-year college program) 6. Master's degree or professional degree (MD, DDS, lawyer, minister) 7. Doctorate (Ph.D., or Ed.D.) 8. I don't know	Nat -> Int 1 -> 1 2 -> 2 3 -> 3 4 -> 5 5 -> 6 6 -> 7 7 -> 7 8 -> 8 International Category 4 (ISCED Level 4) is not administered
SQIS-07B	**What is the highest level of education completed by your father (or stepfather or male guardian)?** *Fill **one** circle only.* 1. Some <Primary education— ISCED Level 1 or Lower secondary education—ISCED Level 2> or did not go to school 2. <Lower secondary education—ISCED Level 2> 3. <Upper secondary education—ISCED Level 3> 4. <Post-secondary, non-tertiary education—ISCED Level 4> 5. <Short-cycle tertiary education—ISCED Level 5> 6. <Bachelor's or equivalent level—ISCED Level 6> 7. <Postgraduate degree: Master's—ISCED Level 7 or Doctor—ISCED Level 8> 8. I don't know	SQIS-09B	**What is the highest level of education completed by your father (or stepfather or male legal guardian)?** *Fill in **one** oval only.* 1. Less than high school 2. Some high school 3. High school graduate 4. Associate's degree (2-year college program) 5. Bachelor's degree (4-year college program) 6. Master's degree or professional degree (MD, DDS, lawyer, minister) 7. Doctorate (Ph.D., or Ed.D.) 8. I don't know	Nat -> Int 1 -> 1 2 -> 2 3 -> 3 4 -> 5 5 -> 6 6 -> 7 7 -> 7 8 -> 8 International Category 4 (ISCED Level 4) is not administered

Exhibit E-7. TIMSS 2015 Grade 8 Student Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
	How far in your education do you expect to go? *Fill **one** circle only.* 1. Finish <Lower secondary education—ISCED Level 2> 2. Finish <Upper secondary education—ISCED Level 3> 3. Finish <Post-secondary, non-tertiary education—ISCED Level 4> 4. Finish <Short-cycle tertiary education—ISCED Level 5> 5. Finish <Bachelor's or equivalent level—ISCED Level 6> 6. Finish <Postgraduate degree: Master's—ISCED Level 7 or Doctor—ISCED Level 8>	SQIS-10	**How far in your education do you expect to go?** *Fill in **one** oval only.* 1. Finish middle school 2. Finish high school 3. Finish Associate's degree (2-year college program) 4. Finish Bachelor's degree (4-year college program) 5. Finish Master's degree or professional degree (MD, DDS, lawyer, minister) 6. Finish Doctorate (Ph.D., or Ed.D.)	Nat -> Int 1 -> 1 2 -> 2 3 -> 4 4 -> 5 5 -> 6 6 -> 6 International Category 4 (ISCED Level 4) is not administered
SQIS-09A	**Was your mother (or stepmother or female guardian) born in <country>?** *Fill **one** circle only.* 1. Yes 2. No 3. I don't know	SQIS-11A	**Was your mother (or stepmother or female legal guardian) born in the United States? ("United States" includes the 50 states, its territories, the District of Columbia, and U.S. military bases abroad)** *Fill in **one** oval only.* 1. Yes 2. No 3. I don't know	
SQIS-09B	**Was your father (or stepfather or male guardian) born in <country>?** *Fill **one** circle only.* 1. Yes 2. No 3. I don't know	SQIS-11B	**Was your father (or stepfather or male legal guardian) born in the United States?** *Fill in **one** oval only.* 1. Yes 2. No 3. I don't know	
SQIS-10A	**Were you born in <country>?** *Fill **one** circle only.* 1. Yes *(If Yes, go to #11)* 2. No	SQIS-12A	**Were you born in the United States?** *Fill in **one** oval only.* 1. Yes *(If Yes, go to question 13)* 2. No	
SQIS-10B	**If No,** **If you were not born in <country>, how old were you when you came to <country>?** *Fill **one** circle only.* 1. Older than 10 years old 2. 5 to 10 years old 3. Younger than 5 years old	SQIS-12B	**If No,** **If you were not born in the United States, how old were you when you came to the United States?** *Fill in **one** oval only.* 1. Older than 10 years old 2. 5 to 10 years old 3. Younger than 5 years old	

Exhibit E-7. TIMSS 2015 Grade 8 Student Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		SQIS-13B	**How many days were you absent from school in the last month?** *Fill in **one** oval only.* 1. None 2. 1 or 2 days 3. 3 or 4 days 4. 5 to 10 days 5. More than 10 days	
		SQIS-14	**Have you ever repeated a grade?** *Fill in only **one** oval for each row.* 1. Yes 2. No	
		SQIS-14A	In elementary school	
		SQIS-14A	In middle or junior high school	
SQIS-20c	I need to do well in mathematics to get into the <university> of my choice	SQIS-23c	I need to do well in mathematics to get into the college or university of my choice	
SQIS-24c	I need to do well in science to get into the <university> of my choice	SQIS-27c	I need to do well in science to get into the college or university of my choice	
		SQIS-30	**How hard was this test compared to most other tests you have taken this year in school?** *Fill in **one** oval only.* 1. Easier than other tests 2. About as hard as other tests 3. Harder than other tests 4. Much harder than other tests	
		SQIS-31	**How hard did you try on this test compared to how hard you tried on most other tests you have taken this year in school?** *Fill in **one** oval only.* 1. Not as hard as on other tests 2. About as hard as on other tests 3. Harder than on other tests 4. Much harder than on other tests	
		SQIS-32	**How important was it to you to do well on this test?** *Fill in **one** oval only.* 1. Not very important 2. Somewhat important 3. Important 4. Very important	

Exhibit E-8. TIMSS Advanced 2015 School Questionnaire

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
ScQ-01	**What is the total enrollment of students in your school as of <first day of month TIMSS Advanced testing begins, 2015>?** *Write in the number.* _____ students	ScQ-01	**What is the total enrollment of students in your school as of March 1, 2015?** _____ students *Write in the number.*	
ScQ-02	**What is the total enrollment of <twelfth grade> students in your school as of <first day of month TIMSS Advanced testing begins, 2015>?** *Write in the number.* _____ students	ScQ-02	**What is the total enrollment of twelfth-grade students in your school as of March 1, 2015?** _____ students *Write in the number.*	
		ScQ-04	**Around the 1st of October 2014, what percentage of students at this school were eligible to receive free or reduced-price lunches through the National School Lunch Program?** _____ percentage of students *Write in the number.*	
ScQ-04	**Approximately what percentage of students in your school have <language of test> as their native language?** *Check **one** circle only.* 1. More than 90% 2. 76 to 90% 3. 51 to 75% 4. 26 to 50% 5. 25% or less	ScQ-05A	**Approximately what percentage of students in your school have English as their native language?** *Fill in **one** circle only.* 1. More than 90% 2. 76 to 90% 3. 51 to 75% 4. 26 to 50% 5. 25% or less	
		ScQ-05B	**Of the students currently enrolled in your school, what percentage has been identified as limited-English proficient (LEP)/English language learners (ELL)?** *Fill in **one** circle only.* 1. 0% 2. 1-5% 3. 6-10% 4. 11-25% 5. 26-50% 6. 51-75% 7. 76-90% 8. Over 90%	

Exhibit E-8. TIMSS Advanced 2015 School Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		ScQ-06	**What type of school is this?** *Fill in **one** circle only.* 1. Regular public school 2. A regular public school with a magnet program 3. A magnet school or school with a special program emphasis (e.g., Montessori, science/math school, performing arts school, talented/gifted school, foreign language immersion school) 4. Special education: a school that primarily serves students with disabilities 5. Alternative: a school designed to address the needs of students, typically at risk of educational failure, which cannot be met in regular schools 6. Vocational 7. Charter school 8. Private (independent) 9. Private (religiously affiliated) 10. Other	
ScQ-06	**What percentage of <twelfth grade> students in your school are taking each of the following?** *Write in the percent.* ____%	ScQ-08	**What percentage of twelfth-grade students in your school are taking each of the following?** _____% *Write in the percent.*	
ScQ-06a	<Advanced Mathematics>	ScQ-08A	Advanced mathematics, such as calculus courses	
ScQ-06b	<Physics>	ScQ-08B	Advanced physics, such as college preparatory physics or AP Physics	
		ScQ-09	**Does your school have a special program or track to prepare students for courses such as calculus or advanced physics?** *Fill in **one** circle only.* 1. Yes 2. No	
SCQ-07	**For the <twelfth grade> students in your school:**	ScQ-10	**For the twelfth-grade students in your school:**	

Exhibit E-8. TIMSS Advanced 2015 School Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
ScQ-11	**To what degree is each of the following a problem among <twelfth grade> students in your school?** *Check **one** circle for each line.* 1. Not a problem 2. Minor problem 3. Moderate problem 4. Serious problem	ScQ-13	**To what degree is each of the following a problem among twelfth-grade students in your school?** *Fill in only **one** circle for each row.* 1. Not a problem 2. Minor problem 3. Moderate problem 4. Serious problem	
ScQ-12	**How difficult was it to fill <twelfth grade> teaching vacancies for this school year for the following subjects?** *Check **one** circle for each line.* 1. Were no vacancies in this subject 2. Easy to fill vacancies 3. Somewhat difficult 4. Very difficult	ScQ-14	**How difficult was it to fill the teaching vacancies for this school year for the following subjects?** *Fill in only **one** circle for each row.* 1. Were no vacancies in this subject 2. Easy to fill vacancies 3. Somewhat difficult 4. Very difficult	
ScQ-12a	Advanced mathematics	ScQ-14A	Advanced mathematics, such as calculus	
ScQ-12b	Physics	ScQ-14B	Advanced physics, such as college preparatory physics or AP Physics	
ScQ-13	**Does your school currently use any incentives (e.g., pay, housing, signing bonus, smaller classes) to recruit or retain <twelfth grade> teachers in the following fields?** *Check **one** circle for each line.* 1. Yes 2. No	ScQ-15	**Does your school currently use any incentives (e.g., pay, housing, signing bonus, smaller classes) to recruit or retain teachers in the following fields?** *Fill in only **one** circle for each row.* 1. Yes 2. No	
ScQ-13a	Advanced mathematics	ScQ-15A	Advanced mathematics, such as calculus	
ScQ-13b	Physics	ScQ-15B	Advanced physics, such as college preparatory physics or AP Physics	
ScQ-15	**By the end of this school year, how many years will you have been a principal altogether?** *Please **round** to the nearest whole number.* _____ years	ScQ-17	**By the end of this school year, how many years altogether will you have been a principal?** _____years *Please **round** to the nearest whole number.*	

Exhibit E-8. TIMSS Advanced 2015 School Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
ScQ-17	**What is the highest level of formal education you have completed?** *Check **one** circle only.* 1. Did not complete <Bachelor's or equivalent level—ISCED Level 6> 2. <Bachelor's or equivalent level—ISCED Level 6> 3. <Master's or equivalent level—ISCED Level 7> 4. <Doctor or equivalent level—ISCED Level 8>	ScQ-19	**What is the highest level of formal education you have completed?** *Fill in only **one** circle only.* 1. Did not complete Bachelor's degree (4-year college program) 2. Bachelor's degree (4-year college program) 3. Master's degree or professional degree (MD, DDS, lawyer, minister) 4. Doctorate (Ph.D., or Ed.D.)	Nat -> Int 1 -> 1 2 -> 2 3 -> 3 4 -> 4
ScQ-18a	<Master's or equivalent level—ISCED Level 7>	ScQ-20a	Master's degree or professional degree (MD, DDS, lawyer, minister)	
ScQ-18b	<Doctor or equivalent level—ISCED Level 8>	ScQ-20b	Doctorate (Ph.D., or Ed.D.)	
ScQ-08A	**Does your school have a school library?** *Check **one** circle only.* 1. Yes 2. No **(If No, go to #9)**		Not Administered	
ScQ-08B	**If Yes,** **<u>Approximately</u> how many books (print and digital) with different titles does your school library have (exclude magazines and periodicals)?** *Check **one** circle in each column.* 1. 250 or fewer 2. 251-500 3. 501-2,000 4. 2,001-5,000 5. 5,001-10,000 6. More than 10,000		Not Administered	
ScQ-08Ba	Print		Not Administered	
ScQ-08Bb	Digital		Not Administered	
ScQ-08C	**<u>Approximately</u> how many titles of magazines and other periodicals (print and digital) does your school library have?** *Check **one** circle in each column.* 1. 0 2. 1-5 3. 6-10 4. 11-30 5. 31 or more		Not Administered	

Exhibit E-8. TIMSS Advanced 2015 School Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
ScQ-08Ca	Print		Not Administered	
ScQ-08Cb	Digital		Not Administered	

Exhibit E-9. TIMSS Advanced 2015 Teacher Math Questionnaire

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		TQG-01A	**What year did you start teaching?** _____ *Please write in a year.*	
TQG-01	**By the end of this school year, how many years will you have been teaching altogether?** *Please **round** to the nearest whole number.* _____ years	TQG-01B	**At the end of this school year, how many years will you have taught altogether?** _____ years *Please **round** to the nearest whole number.*	
TQG-04	**What is the highest level of formal education you have completed?** *Check **one** circle only.* 1. Did not complete <tertiary> education **(If you have not completed <tertiary> education, go to #6)** 2. <Short-cycle tertiary education—ISCED Level 5> 3. <Bachelor's or equivalent level—ISCED Level 6> 4. <Master's or equivalent level—ISCED Level 7> 5. <Doctor or equivalent level—ISCED Level 8>	TQG-04	**What is the highest level of formal education you have completed?** *Fill in **one** circle only.* 1. Did not complete a college degree (If you have not completed more than a college degree, go to question 6) 2. Associate's degree (2-year college program) 3. Bachelor's degree (4-year college program) 4. Master's degree or professional degree (MD, DDS, lawyer, minister) 5. Doctorate (Ph.D., or Ed.D.)	Nat -> Int 1 -> 1 2 -> 2 3 -> 3 4 -> 4 5 -> 5
TQG-05	**During your <post-secondary> education, what was your major or main area(s) of study?** *Check **one** circle for each line.* 1. Yes 2. No	TQG-05	**During your college or university education, what was your major or main area(s) of study?** *Fill in only **one** circle for each row.* 1. Yes 2. No	
TQG-05e	<Earth Science>	TQG-05e	Earth Science	
TQG-13	**How many students in this class experience difficulties understanding spoken <language of test>?** *Write in the number.* _____ students in this class	TQG-13	**How many students in this class experience difficulties understanding spoken English?** _____ students in this class *Write in the number.*	

Exhibit E-9. TIMSS Advanced 2015 Teacher Math Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
TQM-20A	**Do the students in this class have computers, tablets, calculators, or smartphones available to use during their advanced mathematics lessons?** *Check **one** circle only.* 1. Yes 2. No **(If No, go to #21)**	TQM-20A	**Do the students in this class have computers, tablets, calculators, or smartphones available to use during their advanced mathematics lessons?** *Fill in **one** circle only.* 1. Yes 2. No **(If No, go to question 21)**	
TQM-22A	**Do you assign mathematics homework to this class?** *Check **one** circle only.* 1. Yes 2. No **(If No, go to #23)**	TQM-22A	**Do you assign mathematics homework to this class?** *Fill in **one** circle only.* 1. Yes 2. No **(If No, go to question 23)**	
TQM-24	**In the past two years, how many hours in total have you spent in formal <in-service/professional development> (e.g., workshops, seminars, etc.) for mathematics?** *Check **one** circle only.* 1. None 2. Less than 6 hours 3. 6–15 hours 4. 16–35 hours 5. More than 35 hours	TQM-24	**In the past two years, how many hours in total have you spent in formal in-service/professional development (e.g., workshops, seminars) for mathematics?** *Fill in **one** circle only.* 1. None 2. Less than 6 hours 3. 6–15 hours 4. 16–35 hours 5. More than 35 hours	
TQM-26A	**Are you a member of <professional organization for mathematics teachers>?** *Check **one** circle only.* 1. Yes 2. No	TQM-26A	**Are you a member of the National Council of Teachers of Mathematics (NCTM) or the Mathematics Association of America (MAA)?** *Fill in **one** circle only.* 1. Yes 2. No	
TQM-26B	**In the past two years, have you regularly participated in activities sponsored by <professional organization for mathematics teachers>?** *Check **one** circle only.* 1. Yes 2. No	TQM-26B	**In the past two years, have you regularly participated in activities sponsored by the National Council of Teachers of Mathematics (NCTM) or the Mathematics Association of America (MAA)?** *Fill in **one** circle only.* 1. Yes 2. No	

Exhibit E-10. TIMSS Advanced 2015 Teacher Physics Questionnaire

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		TQG-01A	**What year did you start teaching?** _____ *Please write in a year.*	
TQG-01	**By the end of this school year, how many years will you have been teaching altogether?** *Please **round** to the nearest whole number.* _____ years	TQG-01B	**At the end of this school year, how many years will you have taught altogether?** _____ years *Please **round** to the nearest whole number.*	
TQG-04	**What is the highest level of formal education you have completed?** *Check **one** circle only.* 1. Did not complete <tertiary> education **(If you have not completed <tertiary> education, go to #6)** 2. <Short-cycle tertiary education—ISCED Level 5> 3. <Bachelor's or equivalent level—ISCED Level 6> 4. <Master's or equivalent level—ISCED Level 7> 5. <Doctor or equivalent level—ISCED Level 8>	TQG-04	**What is the highest level of formal education you have completed?** *Fill in **one** circle only.* 1. Did not complete a college degree (If you have not completed more than a college degree, go to question 6) 2. Associate's degree (2-year college program) 3. Bachelor's degree (4-year college program) 4. Master's degree or professional degree (MD, DDS, lawyer, minister) 5. Doctorate (Ph.D., or Ed.D.)	Nat -> Int 1 -> 1 2 -> 2 3 -> 3 4 -> 4 5 -> 5
TQG-05	**During your <post-secondary> education, what was your major or main area(s) of study?** *Check **one** circle for each line.* 1. Yes 2. No	TQG-05	**During your college or university education, what was your major or main area(s) of study?** *Fill in only **one** circle for each row.* 1. Yes 2. No	
TQG-05e	<Earth Science>	TQG-05e	Earth Science	
TQG-13	**How many students in this class experience difficulties understanding spoken <language of test>?** *Write in the number.* _____ students in this class	TQG-13	**How many students in this class experience difficulties understanding spoken English?** _____ students in this class *Write in the number.*	

Exhibit E-10. TIMSS Advanced 2015 Teacher Physics Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
TQP-20A	**Do the students in this class have computers, tablets, calculators, or smartphones available to use during their physics lessons?** *Check **one** circle only.* 1. Yes 2. No **(If No, go to #21)**	TQP-20A	**Do the students in this class have computers, tablets, calculators, or smartphones available to use during their physics lessons?** *Fill in **one** circle only.* 1. Yes 2. No **(If No, go to question 21)**	
TQP-23A	**Do you assign physics homework to this class?** *Check **one** circle only.* 1. Yes 2. No **(If No, go to #24)**	TQP-23A	**Do you assign physics homework to this class?** *Fill in **one** circle only.* 1. Yes 2. No **(If No, go to question 24)**	
TQP-25	**In the past two years, how many hours in total have you spent in formal <in-service/professional development> (e.g., workshops, seminars, etc.) for physics?** *Check **one** circle only.* 1. None 2. Less than 6 hours 3. 6–15 hours 4. 16–35 hours 5. More than 35 hours	TQP-25	**In the past two years, how many hours in total have you spent in formal in-service/professional development (e.g., workshops, seminars) for physics?** *Fill in **one** circle only.* 1. None 2. Less than 6 hours 3. 6–15 hours 4. 16–35 hours 5. More than 35 hours	
TQP-27A	**Are you a member of <professional organization for physics teachers>?** *Check **one** circle only.* 1. Yes 2. No	TQP-27A	**Are you a member of the National Science Teachers Association (NSTA) or the American Association of Physics Teachers (AAPT)?** *Fill in **one** circle only.* 1. Yes 2. No	
TQP-27B	**In the past two years, have you regularly participated in activities sponsored by <professional organization for physics teachers>?** *Check **one** circle only.* 1. Yes 2. No	TQP-27B	**In the past two years, have you regularly participated in activities sponsored by the National Science Teachers Association (NSTA) or the American Association of Physics Teachers (AAPT)?** *Fill in **one** circle only.* 1. Yes 2. No	

Exhibit E-11. TIMSS Advanced 2015 Student Math Questionnaire

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		SQG-01B	**Are you Hispanic or Latino?** *Fill in **one** oval only.* 1. Yes, I am Hispanic or Latino 2. No, I am not Hispanic or Latino	
		SQG-01C	**Which of the following best describes you?** *Fill in ovals for **all** that apply.* 1. White 2. Black or African American 3. Asian 4. American Indian or Alaska Native 5. Native Hawaiian or other Pacific Islander	
SQG-02	**When were you born?** *Fill the circles next to the month and year you were born.*	SQG-02	**When were you born?** *Fill in the ovals next to the month and year you were born.*	
SQG-03	**How often do you speak <language of test> at home?** *Fill **one** circle only.* 1. Always 2. Almost always 3. Sometimes 4. Never	SQG-03	**How often do you speak English at home?** *Fill in **one** oval only.* 1. Always *If **Always**, please go to question 4.* 2. Almost always 3. Sometimes 4. Never *If **Almost always**, **Sometimes**, **Never**, please go to question 3B.*	
		SQG-03B	**What language do you speak at home (other than English)?** *Fill in **one** oval only.* 1. Spanish 2. Other Please specify _____	
		SQG-04	**How many days were you absent from school in the last month?** *Fill in **one** oval only.* 1. None 2. 1 or 2 days 3. 3 or 4 days 4. 5 to 10 days 5. More than 10 days	
		SQG-05	**Have you ever repeated a grade?** *Fill in only **one** oval for each row.* 1. Yes 2. No	
		SQG-05a	In elementary school	
		SQG-05b	In middle or junior high school	
		SQG-05c	In high school	

Exhibit E-11. TIMSS Advanced 2015 Student Math Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
SQG-06e	A gaming system (e.g., PlayStation®, Wii®, XBox®)	SQG-08e	A gaming system (e.g., PlayStation, Wii, Xbox)	
SQG-06h	<country-specific indicator of wealth>	SQG-08h	Your own car	
SQG-07A	**What is the highest level of education completed by your mother (or stepmother or female guardian)?** *Fill **one** circle only.* 1. Some <Primary education—ISCED Level 1 or Lower secondary education—ISCED Level 2> or did not go to school 2. <Lower secondary education—ISCED Level 2> 3. <Upper secondary education—ISCED Level 3> 4. <Post-secondary, non-tertiary education—ISCED Level 4> 5. <Short-cycle tertiary education—ISCED Level 5> 6. <Bachelor's or equivalent level—ISCED Level 6> 7. <Master's or equivalent level—ISCED Level 7> 8. <Doctor or equivalent level—ISCED Level 8> 9. I don't know	SQG-09A	**What is the highest level of education completed by your mother (or stepmother or female legal guardian)?** *Fill in **one** oval only.* 1. Less than high school 2. Some high school 3. High school graduate 4. Associate's degree (2-year college program) 5. Bachelor's degree (4-year college program) 6. Master's degree or professional degree (MD, DDS, lawyer, minister) 7. Doctorate (Ph.D., or Ed.D.) 8. I don't know	Nat -> Int 1 -> 1 2 -> 2 3 -> 3 4 -> 5 5 -> 6 6 -> 7 7 -> 8 8 -> 9 International Category 4 (ISCED Level 4) is not administered
SQG-07B	**What is the highest level of education completed by your father (or stepfather or male guardian)?** *Fill **one** circle only.* 1. Some <Primary education—ISCED Level 1 or Lower secondary education—ISCED Level 2> or did not go to school 2. <Lower secondary education—ISCED Level 2> 3. <Upper secondary education—ISCED Level 3> 4. <Post-secondary, non-tertiary education—ISCED Level 4> 5. <Short-cycle tertiary education—ISCED Level 5> 6. <Bachelor's or equivalent level—ISCED Level 6> 7. <Master's or equivalent level—ISCED Level 7> 8. <Doctor or equivalent level—ISCED Level 8> 9. I don't know	SQG-09B	**What is the highest level of education completed by your father (or stepfather or male legal guardian)?** *Fill in **one** oval only.* 1. Less than high school 2. Some high school 3. High school graduate 4. Associate's degree (2-year college program) 5. Bachelor's degree (4-year college program) 6. Master's degree or professional degree (MD, DDS, lawyer, minister) 7. Doctorate (Ph.D., or Ed.D.) 8. I don't know	Nat -> Int 1 -> 1 2 -> 2 3 -> 3 4 -> 5 5 -> 6 6 -> 7 7 -> 8 8 -> 9 International Category 4 (ISCED Level 4) is not administered

Exhibit E-11. TIMSS Advanced 2015 Student Math Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
SQG-08	**What kind of work do your father (or stepfather or male guardian) and mother (or stepmother or female guardian) do for their main jobs? For each, fill the circle for the job category that best describes what he/she does. Each category has a few examples to help you decide the correct category. If your father or mother is not working now, think about the last job he/she had.** *Fill **one** circle in each column.* 1. Has never worked for pay 2. Small Business Owner Includes owners of small businesses (fewer than 25 employees) such as retail shops, services, restaurants 3. Clerk Includes office clerks; secretaries; typists; data entry operators; customer service clerks 4. Service or Sales Worker Includes travel attendants; restaurant service workers; personal care workers; protective service workers; junior military and police; salespersons; street vendors 5. Skilled Agricultural or Fishery Worker Includes farmers; forestry workers; fishery workers; hunters and trappers 6. Craft or Trade Worker Includes builders, carpenters, plumbers, electricians, metal workers; machine mechanics; handicraft workers 7. Plant or Machine Operator Includes plant and machine operators; assembly-line operators; motor-vehicle drivers 8. General Laborers Includes domestic helpers and cleaners; building caretakers; messengers, porters, and doorkeepers; farm, fishery, agricultural, and construction workers	SQG-10	**What kind of work do your father (or stepfather or male legal guardian) and mother (or stepmother or female legal guardian) do for their main jobs? For each, fill in the oval for the job category that best describes what he/she does. Each category has a few examples to help you decide the correct category. If your father or mother is not working now, think about the last job he/she had.** *Fill in only **one** oval for each column.* 1. Has never worked for pay 2. Small Business Owner Includes owners of small businesses (fewer than 25 employees) such as retail shops, services, restaurants 3. Clerk Includes office clerks; secretaries; typists; data entry operators; customer service clerks 4. Service or Sales Worker Includes travel attendants; restaurant service workers; personal care workers; protective service workers; enlisted military and police; salespersons; street vendors 5. Skilled Agricultural or Fishery Worker Includes farmers; forestry workers; fishery workers; hunters and trappers 6. Craft or Trade Worker Includes builders, carpenters, plumbers, electricians, metal workers; machine mechanics; handicraft workers 7. Plant or Machine Operator Includes plant and machine operators; assembly-line operators; motor-vehicle drivers 8. General Laborers Includes domestic helpers and cleaners; building caretakers; messengers, porters, and doorkeepers; farm, fishery, agricultural, and construction workers	

Exhibit E-11. TIMSS Advanced 2015 Student Math Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
SQG-08 (Continued)	9. Corporate Manager or Senior Official Includes corporate managers such as managers of large companies (25 or more employees) or managers of departments within large companies; legislators or senior government officials; senior officials of special-interest organizations; military officers 10. Professional Includes scientists; mathematicians; computer scientists; architects; engineers; life science and health professionals; teachers; legal professionals; social scientists; writers and artists; religious professionals 11. Technician or Associate Professional Includes science, engineering, and computer associates and technicians; life science and health technicians and assistants; teacher aides; finance and sales associate professionals; business service agents; administrative assistants 12. I don't know	SQG-10 (Continued)	9. Corporate Manager or Senior Official Includes corporate managers such as managers of large companies (25 or more employees) or managers of departments within large companies; legislators or senior government officials; senior officials of special-interest organizations; military officers 10. Professional Includes scientists; mathematicians; computer scientists; architects; engineers; life science and health professionals; teachers; legal professionals; social scientists; writers and artists; religious professionals 11. Technician or Associate Professional Includes science, engineering, and computer associates and technicians; life science and health technicians and assistants; teacher aides; finance and sales associate professionals; business service agents; administrative assistants 12. I don't know	
SQG-09	**How far in your education do you expect to go?** *Fill **one** circle only.* 1. <Upper secondary education—ISCED Level 3> 2. <Post-secondary, non-tertiary education—ISCED Level 4> 3. <Short-cycle tertiary education—ISCED Level 5> 4. <Bachelor's or equivalent level—ISCED Level 6> 5. <Master's or equivalent level—ISCED Level 7> 6. <Doctor or equivalent level—ISCED Level 8>	SQG-11	**How far in your education do you expect to go?** *Fill in **one** oval only.* 1. High school 2. Associate's degree (2-year college program) 3. Bachelor's degree (4-year college program) 4. Master's degree or professional degree (MD, DDS, lawyer, minister) 5. Doctorate (Ph.D., or Ed.D.)	Nat -> Int 1 -> 1 2 -> 3 3 -> 4 4 -> 5 5 -> 6 International Category 2 (ISCED Level 4) is not administered
SQG-11h	Actuarial Sciences	SQG-13h	Actuarial Sciences (i.e., uses mathematical and statistical methods to assess risk)	

Exhibit E-11. TIMSS Advanced 2015 Student Math Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
SQG-12A	**Was your mother (or stepmother or female guardian) born in <country>?** *Fill **one** circle only.* 1. Yes 2. No 3. I don't know	SQG-14A	**Was your mother (or stepmother or female legal guardian) born in the United States? ("United States" includes the 50 states, its territories, the District of Columbia, and U.S. military bases abroad.)** *Fill in **one** oval only.* 1. Yes 2. No 3. I don't know	
SQG-12B	**Was your father (or stepfather or male guardian) born in <country>?** *Fill **one** circle only.* 1. Yes 2. No 3. I don't know	SQG-14B	**Was your father (or stepfather or male legal guardian) born in the United States?** *Fill in **one** oval only.* 1. Yes 2. No 3. I don't know	
SQG-13A	**Were you born in <country>?** *Fill **one** circle only.* 1. Yes 2. No **(If Yes, go to #14)**	SQG-15A	**Were you born in the United States?** *Fill in **one** oval only.* 1. Yes ***(If Yes, go to question 16)*** 2. No	
SQG-13B	**If No,** **If you were not born in <country>, how old were you when you came to <country>?** *Fill **one** circle only.* 1. Older than 15 years old 2. 11 to 15 years old 3. 5 to 10 years old 4. Younger than 5 years old	SQG-15B	**If No,** **If you were not born in the United States how old were you when you came to the United States?** *Fill **one** circle only.* 1. Older than 15 years old 2. 11 to 15 years old 3. 5 to 10 years old 4. Younger than 5 years old	
SQM-16A	**During the school year, do you work at a paid job on a regular basis?** *Fill **one** circle only.* 1. Yes 2. No **(If No, go to #17)**	SQM-18A	**During the school year, do you work at a paid job on a regular basis?** *Fill in **one** oval only.* 1. Yes 2. No **(If No, go to question 19)**	
SQM-17A	**During the last 12 months, have you attended extra lessons or tutoring not provided by the school in advanced mathematics?** *Fill **one** circle only.* 1. Yes 2. No **(If No, go to #18)**	SQM-19A	**During the last 12 months, have you attended extra lessons or tutoring not provided by the school in advanced mathematics?** *Fill in **one** oval only.* 1. Yes 2. No **(If No, go to question 20)**	
SQM-21e	Doing well in mathematics will help me get into the <university> of my choice	SQM-23e	Doing well in mathematics will help me get into the college or university of my choice	

Exhibit E-11. TIMSS Advanced 2015 Student Math Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		SQM-24	**How hard was this test compared to most other tests you have taken this year in school?** *Fill in **one** oval only.* 1. Easier than other tests 2. About as hard as other tests 3. Harder than other tests 4. Much harder than other tests	
		SQM-25	**How hard did you try on this test compared to how hard you tried on most other tests you have taken this year in school?** *Fill in **one** oval only.* 1. Not as hard as on other tests 2. About as hard as on other tests 3. Harder than on other tests 4. Much harder than on other tests	
		SQM-26	**How important was it to you to do well on this test?** *Fill in **one** oval only.* 1. Not very important 2. Somewhat important 3. Important 4. Very important	
		SQM-27	**In what grade did you complete any of the courses listed below?** *Fill in **one** or **more** ovals in each row.* 1. Never 2. Grade 8 or earlier 3. Grade 9 4. Grade 10 5. Grade 11 6. Grade 12	
		SQM-27A	Algebra I course	
		SQM-27B	Geometry course	
		SQM-27C	Algebra II course, with or without trigonometry	
		SQM-27D	Trigonometry (as a separate course)	
		SQM-27E	Pre-calculus course (also called introductory analysis)	
		SQM-27F	Calculus course	
		SQM-27G	Probability or statistics course	
		SQM-27H	Integrated mathematics 1 (first year of a multi-year course)	
		SQM-27I	Integrated mathematics 2 (second year of a multi-year course)	
		SQM-27J	Integrated mathematics 3 (third year of a multi-year course)	

Exhibit E-11. TIMSS Advanced 2015 Student Math Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		SQM-27k	Integrated mathematics 4 (fourth year of a multi-year course)	
		SQM-27L	Other advanced mathematics course	
		SQM-28	**Please indicate if you have taken or are currently enrolled in any of the following Advanced Placement (AP) courses. Have taken or are enrolled in:** *Fill in only **one** oval for each row.* *1. Yes* *2. No*	
		SQM-28A	Advanced Placement (AP) Calculus AB	
		SQM-28B	Advanced Placement (AP) Calculus BC	
		SQM-28C	Advanced Placement (AP) Statistics	
		SQM-29	**Are you currently enrolled in or have you taken any online mathematics courses?** *Fill in **one** oval only.* 1. No 2. Yes, but not for credit 3. Yes, for high school credit 4. Yes, for college credit 5. Yes, for both high school and college credit	
		SQM-30	**Are you currently enrolled in or have you taken an International Baccalaureate (IB) mathematics course?** *Fill in one **oval** only.* 1. Yes 2. No	

Exhibit E-11. TIMSS Advanced 2015 Student Math Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		SQM-31	**During this school year, which of the following have you done?** *Fill in ovals for **all** that apply.* 1. Taken the SAT or ACT College Entrance Exams 2. Submitted the Free Application for Federal Student Aid (FAFSA) 3. Applied to a 2-year college 4. Been accepted to a 2-year college 5. Applied to a 4-year college 6. Been accepted to a 4-year college 7. Talked with a military recruiter or contacted a ROTC program 8. Enlisted in the military or enrolled in a ROTC program 9. Applied for a full-time job 10. Been interviewed for a full-time job 11. None of the above	
		SQM-34	**During this school year, did you participate in any of these extracurricular activities?** *Fill in ovals for **all** that apply* 1. Sports 2. Performing arts 3. Academic clubs 4. Vocational/professional clubs 5. Honor societies 6. Publications 7. Student government 8. Service clubs 9. Hobby clubs	

Exhibit E-12. TIMSS Advanced 2015 Student Physics Questionnaire

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		SQG-01B	**Are you Hispanic or Latino?** *Fill in **one** oval only.* 1. Yes, I am Hispanic or Latino 2. No, I am not Hispanic or Latino	
		SQG-01C	**Which of the following best describes you?** *Fill in ovals for **all** that apply.* 1. White 2. Black or African American 3. Asian 4. American Indian or Alaska Native 5. Native Hawaiian or other Pacific Islander	
SQG-02	**When were you born?** *Fill the circles next to the month and year you were born.*	SQG-02	**When were you born?** *Fill in the ovals next to the month and year you were born.*	
SQG-03	**How often do you speak <language of test> at home?** *Fill **one** circle only.* 1. Always 2. Almost always 3. Sometimes 4. Never	SQG-03	**How often do you speak English at home?** *Fill in **one** oval only.* 1. Always *If **Always**, please go to question 4.* 2. Almost always 3. Sometimes 4. Never *If **Almost always**, **Sometimes**, **Never**, please go to question 3B.*	
		SQG-03B	**What language do you speak at home (other than English)?** *Fill in **one** oval only.* 1. Spanish 2. Other Please specify _____	
		SQG-04	**How many days were you absent from school in the last month?** *Fill in **one** oval only.* 1. None 2. 1 or 2 days 3. 3 or 4 days 4. 5 to 10 days 5. More than 10 days	
		SQG-05	**Have you ever repeated a grade?** *Fill in only **one** oval for each row.* 1. Yes 2. No	
		SQG-05a	In elementary school	
		SQG-05b	In middle or junior high school	
		SQG-05c	In high school	

Exhibit E-12. TIMSS Advanced 2015 Student Physics Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
SQG-06e	A gaming system (e.g., PlayStation®, Wii®, XBox®)	SQG-08e	A gaming system (e.g., PlayStation, Wii, Xbox)	
SQG-06h	<country-specific indicator of wealth>	SQG-08h	Your own car	
SQG-07A	**What is the highest level of education completed by your mother (or stepmother or female guardian)?** *Fill **one** circle only.* 1. Some <Primary education—ISCED Level 1 or Lower secondary education—ISCED Level 2> or did not go to school 2. <Lower secondary education—ISCED Level 2> 3. <Upper secondary education—ISCED Level 3> 4. <Post-secondary, non-tertiary education—ISCED Level 4> 5. <Short-cycle tertiary education—ISCED Level 5> 6. <Bachelor's or equivalent level—ISCED Level 6> 7. <Master's or equivalent level—ISCED Level 7> 8. <Doctor or equivalent level—ISCED Level 8> 9. I don't know	SQG-09A	**What is the highest level of education completed by your mother (or stepmother or female legal guardian)?** *Fill in **one** oval only.* 1. Less than high school 2. Some high school 3. High school graduate 4. Associate's degree (2-year college program) 5. Bachelor's degree (4-year college program) 6. Master's degree or professional degree (MD, DDS, lawyer, minister) 7. Doctorate (Ph.D., or Ed.D.) 8. I don't know	Nat -> Int 1 -> 1 2 -> 2 3 -> 3 4 -> 5 5 -> 6 6 -> 7 7 -> 8 8 -> 9 International Category 4 (ISCED Level 4) is not administered
SQG-07B	**What is the highest level of education completed by your father (or stepfather or male guardian)?** *Fill **one** circle only.* 1. Some <Primary education—ISCED Level 1 or Lower secondary education—ISCED Level 2> or did not go to school 2. <Lower secondary education—ISCED Level 2> 3. <Upper secondary education—ISCED Level 3> 4. <Post-secondary, non-tertiary education—ISCED Level 4> 5. <Short-cycle tertiary education—ISCED Level 5> 6. <Bachelor's or equivalent level—ISCED Level 6> 7. <Master's or equivalent level—ISCED Level 7> 8. <Doctor or equivalent level—ISCED Level 8> 9. I don't know	SQG-09B	**What is the highest level of education completed by your father (or stepfather or male legal guardian)?** *Fill in **one** oval only.* 1. Less than high school 2. Some high school 3. High school graduate 4. Associate's degree (2-year college program) 5. Bachelor's degree (4-year college program) 6. Master's degree or professional degree (MD, DDS, lawyer, minister) 7. Doctorate (Ph.D., or Ed.D.) 8. I don't know	Nat -> Int 1 -> 1 2 -> 2 3 -> 3 4 -> 5 5 -> 6 6 -> 7 7 -> 8 8 -> 9 International Category 4 (ISCED Level 4) is not administered

Exhibit E-12. TIMSS Advanced 2015 Student Physics Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
SQG-08	**What kind of work do your father (or stepfather or male guardian) and mother (or stepmother or female guardian) do for their main jobs? For each, fill the circle for the job category that best describes what he/she does. Each category has a few examples to help you decide the correct category. If your father or mother is not working now, think about the last job he/she had.** *Fill **one** circle in each column.* 1. Has never worked for pay 2. Small Business Owner Includes owners of small businesses (fewer than 25 employees) such as retail shops, services, restaurants 3. Clerk Includes office clerks; secretaries; typists; data entry operators; customer service clerks 4. Service or Sales Worker Includes travel attendants; restaurant service workers; personal care workers; protective service workers; junior military and police; salespersons; street vendors 5. Skilled Agricultural or Fishery Worker Includes farmers; forestry workers; fishery workers; hunters and trappers 6. Craft or Trade Worker Includes builders, carpenters, plumbers, electricians, metal workers; machine mechanics; handicraft workers 7. Plant or Machine Operator Includes plant and machine operators; assembly-line operators; motor-vehicle drivers 8. General Laborers Includes domestic helpers and cleaners; building caretakers; messengers, porters, and doorkeepers; farm, fishery, agricultural, and construction workers	SQG-10	**What kind of work do your father (or stepfather or male legal guardian) and mother (or stepmother or female legal guardian) do for their main jobs? For each, fill in the oval for the job category that best describes what he/she does. Each category has a few examples to help you decide the correct category. If your father or mother is not working now, think about the last job he/she had.** *Fill in only **one** oval for each column.* 1. Has never worked for pay 2. Small Business Owner Includes owners of small businesses (fewer than 25 employees) such as retail shops, services, restaurants 3. Clerk Includes office clerks; secretaries; typists; data entry operators; customer service clerks 4. Service or Sales Worker Includes travel attendants; restaurant service workers; personal care workers; protective service workers; enlisted military and police; salespersons; street vendors 5. Skilled Agricultural or Fishery Worker Includes farmers; forestry workers; fishery workers; hunters and trappers 6. Craft or Trade Worker Includes builders, carpenters, plumbers, electricians, metal workers; machine mechanics; handicraft workers 7. Plant or Machine Operator Includes plant and machine operators; assembly-line operators; motor-vehicle drivers 8. General Laborers Includes domestic helpers and cleaners; building caretakers; messengers, porters, and doorkeepers; farm, fishery, agricultural, and construction workers	

Exhibit E-12. TIMSS Advanced 2015 Student Physics Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
SQG-08 (Continued)	9. Corporate Manager or Senior Official Includes corporate managers such as managers of large companies (25 or more employees) or managers of departments within large companies; legislators or senior government officials; senior officials of special-interest organizations; military officers 10. Professional Includes scientists; mathematicians; computer scientists; architects; engineers; life science and health professionals; teachers; legal professionals; social scientists; writers and artists; religious professionals 11. Technician or Associate Professional Includes science, engineering, and computer associates and technicians; life science and health technicians and assistants; teacher aides; finance and sales associate professionals; business service agents; administrative assistants 12. I don't know	SQG-10 (Continued)	9. Corporate Manager or Senior Official Includes corporate managers such as managers of large companies (25 or more employees) or managers of departments within large companies; legislators or senior government officials; senior officials of special-interest organizations; military officers 10. Professional Includes scientists; mathematicians; computer scientists; architects; engineers; life science and health professionals; teachers; legal professionals; social scientists; writers and artists; religious professionals 11. Technician or Associate Professional Includes science, engineering, and computer associates and technicians; life science and health technicians and assistants; teacher aides; finance and sales associate professionals; business service agents; administrative assistants 12. I don't know	
SQG-09	**How far in your education do you expect to go?** *Fill **one** circle only.* 1. <Upper secondary education—ISCED Level 3> 2. <Post-secondary, non-tertiary education—ISCED Level 4> 3. <Short-cycle tertiary education—ISCED Level 5> 4. <Bachelor's or equivalent level—ISCED Level 6> 5. <Master's or equivalent level—ISCED Level 7> 6. <Doctor or equivalent level—ISCED Level 8>	SQG-11	**How far in your education do you expect to go?** *Fill in **one** oval only.* 1. High school 2. Associate's degree (2-year college program) 3. Bachelor's degree (4-year college program) 4. Master's degree or professional degree (MD, DDS, lawyer, minister) 5. Doctorate (Ph.D., or Ed.D.)	Nat -> Int 1 -> 1 2 -> 3 3 -> 4 4 -> 5 5 -> 6 International Category 2 (ISCED Level 4) is not administered
SQG-11h	Actuarial Sciences	SQG-13h	Actuarial Sciences (i.e., uses mathematical and statistical methods to assess risk)	

Exhibit E-12. TIMSS Advanced 2015 Student Physics Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
SQG-12A	**Was your mother (or stepmother or female guardian) born in <country>?** *Fill **one** circle only.* 1. Yes 2. No 3. I don't know	SQG-14A	**Was your mother (or stepmother or female legal guardian) born in the United States? ("United States" includes the 50 states, its territories, the District of Columbia, and U.S. military bases abroad.)** *Fill in **one** oval only.* 1. Yes 2. No 3. I don't know	
SQG-12B	**Was your father (or stepfather or male guardian) born in <country>?** *Fill **one** circle only.* 1. Yes 2. No 3. I don't know	SQG-14B	**Was your father (or stepfather or male legal guardian) born in the United States?** *Fill in **one** oval only.* 1. Yes 2. No 3. I don't know	
SQG-13A	**Were you born in <country>?** *Fill **one** circle only.* 1. Yes 2. No **(If Yes, go to #14)**	SQG-15A	**Were you born in the United States?** *Fill in **one** oval only.* 1. Yes ***(If Yes, go to question 16)*** 2. No	
SQG-13B	**If No,** **If you were not born in <country>, how old were you when you came to <country>?** *Fill **one** circle only.* 1. Older than 15 years old 2. 11 to 15 years old 3. 5 to 10 years old 4. Younger than 5 years old	SQG-15B	**If No,** **If you were not born in the United States how old were you when you came to the United States?** *Fill **one** circle only.* 1. Older than 15 years old 2. 11 to 15 years old 3. 5 to 10 years old 4. Younger than 5 years old	
SQP-16A	**During the school year, do you work at a paid job on a regular basis?** *Fill **one** circle only.* 1. Yes 2. No **(If No, go to #17)**	SQP-18A	**During the school year, do you work at a paid job on a regular basis?** *Fill in **one** oval only.* 1. Yes 2. No **(If No, go to question 19)**	
SQP-17A	**During the last 12 months, have you attended extra lessons or tutoring not provided by the school in physics?** *Fill **one** circle only.* 1. Yes 2. No **(If No, go to #18)**	SQP-19A	**During the last 12 months, have you attended extra lessons or tutoring not provided by the school in physics?** *Fill in **one** oval only.* 1. Yes 2. No **(If No, go to question 20)**	

Exhibit E-12. TIMSS Advanced 2015 Student Physics Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
SQP-17B	**If Yes,** **Why do you attend these extra lessons or tutoring?** *Fill **one** circle for each line.* 1. Yes 2. No	SQP-19B	If Yes, Why did you attend these extra lessons or tutoring? *Fill in only **one** oval for each row.* 1. Yes 2. No	
SQP-21e	Doing well in physics will help me get into the <university> of my choice	SQP-23e	Doing well in physics will help me get into the college or university of my choice	
		SQP-25	**How hard did you try on this test compared to how hard you tried on most other tests you have taken this year in school?** *Fill in **one** oval only.* 1. Not as hard as on other tests 2. About as hard as on other tests 3. Harder than on other tests 4. Much harder than on other tests	
		SQP-26	**How important was it to you to do well on this test?** *Fill in **one** oval only.* 1. Not very important 2. Somewhat important 3. Important 4. Very important	
		SQP-27	**In what grade did you complete any of the courses listed below?** *Fill in **one** or **more** ovals in each row.* 1. Never 2. Grade 8 or earlier 3. Grade 9 4. Grade 10 5. Grade 11 6. Grade 12	
		SQP-27A	General or unified science	
		SQP-27B	Earth and space science	
		SQP-27C	Life science (other than biology)	
		SQP-27D	Physical science (other than chemistry or physics)	
		SQP-27E	First-year biology	
		SQP-27F	Second-year biology	
		SQP-27G	First-year chemistry	
		SQP-27H	Second-year chemistry	
		SQP-27I	First-year physics	
		SQP-27J	Second-year physics	
		SQP-27k	Engineering and technology	
		SQP-27L	Other advanced science course	

Exhibit E-12. TIMSS Advanced 2015 Student Physics Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		SQP-28	**Please indicate if you have taken or are currently enrolled in any of the following Advanced Placement (AP) courses. Have taken or are enrolled in:** *Fill in only **one** oval for each row.* *1. Yes* ***2.** No*	
		SQP-28A	Advanced Placement (AP) Biology	
		SQP-28B	Advanced Placement (AP) Environmental Science	
		SQP-28C	Advanced Placement (AP) Chemistry	
		SQP-28D	Advanced Placement (AP) Physics B or C	
		SQP-28E	Advanced Placement (AP) Computer Science A or AB	
		SQP-29	**Are you currently enrolled in or have you taken any online science courses?** *Fill in **one** oval only* 1. No 2. Yes, but not for credit 3. Yes, for high school credit 4. Yes, for college credit 5. Yes, for both high school and college credit	
		SQP-30	**Are you currently enrolled in or have you taken an International Baccalaureate (IB) physics course?** *Fill in **one** oval only* 1. Yes 2. No	

Exhibit E-12. TIMSS Advanced 2015 Student Physics Questionnaire—Continued

Questions that Require National Adaptations				
2015 International Version		2015 U.S. Adapted Version		
International Item Number	Item	National Item Number	Item	Recoding instructions
		SQP-31	**During this school year, which of the following have you done?** *Fill in ovals for **all** that apply.* 1. Taken the SAT or ACT College Entrance Exams 2. Submitted the Free Application for Federal Student Aid (FAFSA) 3. Applied to a 2-year college 4. Been accepted to a 2-year college 5. Applied to a 4-year college 6. Been accepted to a 4-year college 7. Talked with a military recruiter or contacted a ROTC program 8. Enlisted in the military or enrolled in a ROTC program 9. Applied for a full-time job 10. Been interviewed for a full-time job 11. None of the above	
		SQP-34	**During this school year, did you participate in any of these extracurricular activities?** *Fill in ovals for **all** that apply* 1. Sports 2. Performing arts 3. Academic clubs 4. Vocational/professional clubs 5. Honor societies 6. Publications 7. Student government 8. Service clubs 9. Hobby clubs	

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Appendix F

TIMSS 2015 Nonresponse Bias Analysis: Grades 4 and 8

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APPENDIX F: TIMSS 2015 NONRESPONSE BIAS ANALYSIS: GRADES 4 AND 8

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APPENDIX F: TIMSS 2015 NONRESPONSE BIAS ANALYSIS: GRADES 4 AND 8

1. INTRODUCTION

The Trends in International Mathematics and Science Study (TIMSS) is a large international comparative study of the knowledge, skills, and competencies of fourth- and eighth-grade students in the domains of mathematics and science. The study was carried out in more than 50 education systems, including the United States. The student population sampled in TIMSS is defined as all students in each country or other education system who were enrolled in the grade that represents four and eight years of schooling, counting from the first year of ISCED Level 1, provided that the mean age at the time of testing is at least 9.5 and 13.5 years. In most participating nations, including the United States, this corresponds to all fourth-graders and eighth-graders.

The U.S. TIMSS 2015 study, supported by the National Center for Education Statistics (NCES), utilized a two-stage stratified cluster sampling design. The first stage made use of a systematic probability-proportionate-to-size technique to select schools. Though efforts were made to secure the participation of all schools selected in the first stage, it was anticipated that not all schools would choose to participate. Therefore, as each school was selected in the sample, the two neighboring schools in the sorted sampling frame (immediately preceding and following it) were designated as replacement schools. The sampling frame was sorted by explicit strata and secondarily by implicit strata, so the replacement schools were within the same strata as the original school. If an original school refused to participate, the first replacement was then contacted. If that school also refused to participate, the second school was then contacted.

The second stage of sampling consisted of selecting classrooms within sampled schools. At the classroom level, TIMSS sampled intact mathematics classes that were available to students in the target grades. Where feasible, two classrooms were selected per school in the United States. In schools containing only one class, this class was selected. The TIMSS 2015 national data collection was fielded in March, April, and May 2015.

There were 300 schools in the original sample at grade 4 (hereafter referred to as TIMSS-4). Of these 300 sampled schools, 295 were determined to be eligible[1] (the eligible original school sample) containing at least one fourth-grade class, and of these, 228 participated (the participating original sample) for an initial weighted response rate of 77.5 percent. An additional 22 replacement schools participated for a total of 250 participating schools after replacement (the participating final sample). The weighted response rate increased to 84.6 percent. The school participation rates for this report are summarized in table F-1.

There were 300 schools in the original sample at grade 8 (hereafter referred to as TIMSS-8). Of these 300 sampled schools, 293 were determined to be eligible[2] (the eligible original school sample) containing at least one eighth-grade class, and of these, 229 participated (the participating original sample) for an initial weighted response rate of 78.4 percent. An additional 17 substitute schools participated for a total of 246 participating schools after replacement (the participating final sample). The weighted response rate increased to 84.0 percent.

[1] Of the 300 original schools selected for the sample, there were 5 excluded or ineligible schools at grade 4.
[2] Of the 300 original schools selected for the sample, there were 7 ineligible schools at grade 8.

The weighted student response rate for TIMSS-4 was 95.8 percent. The weighted student response rate for TIMSS-8 was 94.0 percent.

Table F-1. Selected characteristics for the nonresponse bias analysis of the U.S. TIMSS grade 4 and 8 final school samples: 2015

			Number of participating schools		Percent	
Grade	Schools in original sample	Eligible schools in sample	Before replacement	After replacement	School participation rate before replacement, Weighted	School participation rate after replacement, Weighted
4	300	295	228	250	77.5	84.6
8	300	293	229	246	78.4	84.0

SOURCE: International Association for the Evaluation of Education Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

The National Center for Education Statistics (NCES) standards for assessment surveys stipulate that a nonresponse bias analysis is required at any stage of data collection when the weighted unit response rate is less than 85 percent (before replacement). Since the U.S. TIMSS 2015 weighted school response rates before replacement are below 85 percent, NCES requires an investigation into the potential magnitude of nonresponse bias at the school level in the U.S. sample. Since the U.S. TIMSS 2015 weighted student response rates are above 85 percent, a nonresponse bias analysis at the student level is not required. The methodology used to investigate nonresponse bias in the TIMSS-4 and TIMSS-8 U.S. samples is provided in chapter 2 of this appendix, and the results are provided in chapters 3 and 4.

2. METHODOLOGY

To measure the potential nonresponse bias at the school level, the characteristics of participating schools were compared to those of the total eligible sample of schools. This was conducted in a way so that the tests of statistical significance that were applied account for the fact that the participating schools are a subset of the eligible schools, and not a distinct group.

The general approach taken involves an analysis in three parts as described below.

- Analysis of the participating original sample: The distribution for TIMSS-4 of the participating original school sample (N=228) was compared with that of the total eligible original school sample (N=295). The distribution for TIMSS-8 of the participating original school sample (N=229) was compared with that of the total eligible original school sample (N=293).The participating original sample is the sample before substitution. In each sample, schools were weighted by their school base weights and their estimated grade 4 or 8 enrollment, excluding any nonresponse adjustment factor. The base weight for each original school is the reciprocal of its selection probability.

- Analysis of the participating final sample with substitutes: The distribution for TIMSS-4 of the participating final school sample (N=250), which includes 22 participating substitutes that were used as replacements for nonresponding schools from the eligible original sample, was compared to the total eligible final school sample (N=295). The distribution for TIMSS-8 of the participating final school sample (N=246), which includes 17 participating substitutes that were used as replacements for nonresponding schools from the eligible original sample, was compared to the total eligible final school sample (N=293). The total eligible final sample includes the participating final sample plus those original nonrespondents that were not replaced by substitutes. Again, schools were weighted by their school base weights and their estimated grade 4 or 8 enrollment for both the eligible sample and the participating schools. The base weight for each substitute school is set to the base weight of the original school that it replaced.

- Analysis of the nonresponse adjusted final sample with substitutes: The same sets of schools were compared as in the second analysis, but this time, when analyzing the participating final schools alone, schools were weighted by their school base weights and their estimated grade 4 or 8 enrollment with school nonresponse adjustments applied. The international weighting procedures form nonresponse adjustment classes by cross-classifying the explicit and implicit stratification variables.

The first analysis indicates the potential for nonresponse bias that was introduced through school nonresponse. The second analysis suggests the remaining potential for nonresponse bias after the mitigating effects of substitution have been accounted for. The third analysis indicates the potential for bias after accounting for the mitigating effects of both substitution and nonresponse weight adjustments. Both the second and third analyses, however, may provide an overly optimistic scenario, resulting from the fact that substitution and nonresponse adjustments may correct somewhat for deficiencies in the characteristics examined here, but there is no guarantee that they are equally as effective for other characteristics and, in particular, for student achievement.

Participating TIMSS schools and the total eligible TIMSS school sample were compared on as many school sampling frame characteristics as possible that might provide information about the presence of nonresponse bias. Comparing frame characteristics between participating schools and the total eligible school sample is not an ideal measure of nonresponse bias if the characteristics are unrelated or weakly related to more substantive items in the survey; however, often it is the only approach available since other data are not available for nonparticipating schools. While the school-level characteristics used in these analyses are limited to those available in the sampling frame, each of the variables had a demonstrated relationship to achievement in previous TIMSS cycles.

Frame characteristics for public schools were from the 2012-13 Common Core of Data (CCD) and, for private schools, from the 2011-12 Private School Universe Survey (PSS).

The following categorical variables were available in the sampling frame for all schools:

- School control—indicates whether the school is under public control (operated by publicly elected or appointed officials) or private control (operated by privately elected or appointed officials and derives its major source of funds from private sources);
- Locale—urban-centric locale code (i.e., central city, suburb, town, rural);
- Census region—Northeast, Midwest, South and West (see Section 5. Technical Notes for state listing); and
- Poverty level[3]—for public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the national free and reduced-price lunch (FRPL) program, and a low poverty school is defined as one in which fewer than 50 percent are eligible.

The following continuous variables were available in the sampling frame for all schools:

- Estimated number of grade 4 or grade 8 students enrolled;
- Total number of students; and
- Percentage of students in seven race/ethnicity categories (White, non-Hispanic; Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander and two or more races).[4]

An additional continuous variable, the percentage of students eligible to participate in the FRPL program, was available only for public schools. The poverty level variable mentioned among the categorical variable is the recoded version of this continuous variable.[5]

For categorical variables, the distribution of frame characteristics for participating schools was compared with the distribution for all eligible schools. The hypothesis of independence between the characteristic and participation status was tested using a Rao-Scott modified Chi-square statistic at the 5 percent level

[3] The sample frame did not contain a direct measure of poverty. No free or reduced-price lunch (FRPL) program data were available for private schools, thus all private schools are treated as low-poverty schools.
[4] Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin.
[5] The continuous variable percentage of students eligible to participate in the FRPL program is missing for private schools; however, private schools are treated as low poverty for the categorical variable poverty level.

(Rao and Thomas 2003). For continuous variables, summary means were calculated and the difference between means was tested using a *t* test. The *p* values for the tests are presented in the tables that follow. The statistical significance of differences between participants and the total eligible sample is identical to that which would result from comparing participants and nonparticipants, since all significance tests account for the fact that the participants are a subset of the full sample. The bias and relative bias are also shown in each table. The bias is calculated as the difference between the respective estimates for the participants and the eligible sample. The relative bias is calculated as the bias divided by the estimate from the eligible sample. The relative bias is a measure of the size of the bias compared to the eligible sample estimate.

In addition to these tests, logistic regression models were used to provide a multivariate analysis that examined the conditional independence of these school characteristics as predictors of participation. The logistic regression compared frame characteristics for participating schools with non-participating schools which is effectively the same as comparing to the eligible same as in the bivariate analysis. It may be that only one or two variables are actually related to participation status. However, if these variables are also related to the other variables examined in the analyses, then other variables, which are not related to participation status, will appear as significant in simple bivariate tables. Dummy variables were created for each component of the categorical variables so that each component was included separately. The last component of each categorical variable is used as the reference category. The *p* value of a dummy variable indicates whether there is a significant difference at the 5 percent level from the effect of the (omitted) reference category. It is not possible to include all the frame characteristics in a single model because the seven race/ethnicity variables are linearly dependent (i.e., they sum up to 100 percent for every school). Therefore, two models were used. In the first model, six race/ethnicities (Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander; and two or more races) were included in the model with "percentage White, non-Hispanic" as the omitted category. In addition, an *F* test was used to determine whether the parameter estimates of these six characteristics were simultaneously equal to zero. In the second model, the summed percentage of the six race/ethnicities (Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander; and two or more races) replaced the six race/ethnicity variables with "percentage White, non-Hispanic" again as the omitted category. The second model permits the analysis of differences in the percentages of White, non-Hispanic students, which is not possible in the first model. All other frame characteristics were included in both models.

The logistic regression was performed using WesVar® (Westat 2007) and replicate weights to properly account for the complex sample design. The JK2 method was used to create the replicate weights (Westat 2007).

3. RESULTS—TIMSS GRADE 4

3.1 Original Respondent Sample

This section presents the nonresponse bias analysis based on the original sample of 295 eligible schools for TIMSS-4. The distribution of the participating original sample was compared to the schools in the total eligible original sample. School base weights were used for both the eligible sample and the participating schools. The unweighted school response rate for TIMSS-4 was 77.3 percent before replacement, with 228 out of 295 schools participating. The weighted response rate was 77.5 percent before replacement.

3.1.1 Categorical Variables (TIMSS-4)

The distribution of participating and eligible schools by the four characteristics is shown in table F-2. The Chi-square statistics for school control, census region and poverty are significant and suggest that there is evidence of relationships with participation in the assessment. In particular, public schools were overrepresented among participating schools (94.3 vs. 91.3 percent, respectively), and private schools were underrepresented among participating schools (5.7 vs. 8.7 percent, respectively). Similarly, schools in the Northeast were underrepresented among participating schools relative to eligible schools (11.3 vs. 16.5 percent, respectively), while schools in the South were overrepresented among participating schools (44.1 vs. 38.4 percent, respectively). Lastly, high-poverty schools were overrepresented among participating schools (53.2 vs. 49.3 percent, respectively), and low-poverty schools were underrepresented among participating schools (46.8 vs. 50.7 percent, respectively). There are no statistically significant relationships between participation status and locale in table F-2.

Table F-2. Percentage distribution of eligible and participating schools in the U.S. TIMSS fourth-grade original sample, by selected categorical variables: 2015

	Sample schools				
School characteristic	Eligible (percent) (N=295)	Participating (percent) (N=228)	Bias	Relative bias	Chi-square *p* value
School control					0.006
Public	91.3	94.3	3.05	0.033	
Private	8.7	5.7	-3.05	-0.350	
Locale					0.499
Central city	31.8	33.3	1.47	0.046	
Suburb	39.3	37.3	-2.04	-0.052	
Town	10.9	11.4	0.52	0.048	
Rural	18.0	18.0	0.05	0.003	
Census region					0.000
Northeast	16.5	11.3	-5.17	-0.314	
Midwest	21.3	22.2	0.88	0.041	
South	38.4	44.1	5.65	0.147	
West	23.8	22.5	-1.36	-0.057	

See notes at end of table.

Table F-2. Percentage distribution of eligible and participating schools in the U.S. TIMSS fourth-grade original sample, by selected categorical variables: 2015—Continued

School characteristic	Sample schools: Eligible (percent) (N=295)	Sample schools: Participating (percent) (N=228)	Bias	Relative bias	Chi-square *p* value
Poverty level					0.006
High	49.3	53.2	3.91	0.079	
Low	50.7	46.8	-3.91	-0.077	

NOTE: Detail may not sum to totals because of rounding. Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low-poverty schools. Eligible schools contained at least one fourth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 4 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

3.1.2 Continuous Variables (TIMSS-4)

Summary means for each continuous variable for participating and eligible schools are shown in tables F-3, F-4 and F-5. One participating and one nonparticipating school had missing values for race/ethnicity, and these schools were dropped from the analysis in table F-4. No data on FRPL eligibility were available for private schools, so private schools are not included in the FRPL analysis.

There were no statistically significant differences between participating and eligible schools with respect to student enrollment and race/ethnicity percentage (tables F-3 and F-4). Participating schools had a higher mean percentage of free or reduced-price lunch students than the eligible sample (54.2 vs. 52.5 percent, respectively; table F-5). Additionally, the absolute value of the relative bias for Hawaiian/Pacific Islander is greater than 10 percent, though this is due mostly to the eligible percentage being less than 1.0 percent, as the absolute bias is small (table F-4).

Table F-3. Mean enrollment of various characteristics for eligible and participating schools in the U.S. TIMSS fourth-grade original sample: 2015

Student enrollment	Sample schools: Eligible (mean) (N=295)	Sample schools: Participating (mean) (N=228)	Bias	Relative bias	*T* test *p* value
Total school	564.4	560.3	-4.07	-0.007	0.696
Fourth grade enrollment	94.9	93.0	-1.87	-0.020	0.419

NOTE: Eligible schools contained at least one fourth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 4 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table F-4. Mean percentage of various characteristics for eligible and participating schools in the U.S. TIMSS fourth-grade original sample, by race/ethnicity: 2015

Race/Ethnicity	Sample schools: Eligible (mean) (N=293)	Sample schools: Participating (mean) (N=227)	Bias	Relative bias	*T* test *p* value
White, non-Hispanic	49.9	48.7	-1.17	-0.023	0.225
Black, non-Hispanic	14.7	15.5	0.86	0.059	0.221
Hispanic	25.1	25.9	0.76	0.030	0.321
Asian	4.7	4.4	-0.28	-0.060	0.311
American Indian or Alaska Native	1.7	1.7	-0.07	-0.040	0.830
Hawaiian/Pacific Islander	0.5	0.4	-0.11	-0.233	0.523
Multiracial	3.4	3.5	0.01	0.001	0.974

NOTE: Information on race/ethnicity is missing for two of the 295 eligible and one of the 228 participating schools in the sample. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Eligible schools contained at least one fourth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 4 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table F-5. Mean percentage of students eligible for free or reduced-price lunch, in eligible and participating public schools in the U.S. TIMSS fourth-grade original sample: 2015

Students	Sample schools: Eligible (percent) (N=269)	Sample schools: Participating (percent) (N=215)	Bias	Relative bias	*t* test *p* value
Percentage of students eligible for free or reduced-price lunch	52.5	54.2	1.71	0.033	0.032

NOTE: In contrast to the eighth-grade sample, information on the percentage of students eligible for free or reduced-price lunch is available for all the eligible public schools in the fourth-grade sample. Eligible schools contained at least one fourth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 4 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

3.1.3 Logistic Regression Model (TIMSS-4)

To examine the joint relationship of various characteristics to school nonresponse, the analysis used a logistic regression model with participation status as the binary dependent variable and frame characteristics as predictor variables. Since public and private schools were modeled together using the variables available for all schools, the percentage of students eligible for free or reduced-price lunch was not included in the main logistic regression analysis.

Standard errors and tests of hypotheses for the full model parameter estimates are presented in table F-6 (with six race/ethnicity variables) and table F-7 (with summed race/ethnicity percentage). Private schools are treated as low poverty for the categorical variable poverty level. Private schools, South region and fourth grade enrollment were significant predictors of school participation in table F-6. The negative parameter estimates indicate that relative to public schools, private schools were somewhat

underrepresented among the participating schools, and the fourth grade enrollment in participating schools was smaller than in all eligible schools. The positive parameter estimate indicates that relative to schools in the West region, schools in the South region were somewhat overrepresented among the participating schools. The *F* test statistic to determine whether the race/ethnicity characteristics are simultaneously equal to 0 was 0.55 with a *p* value of 0.738, which indicates that no significant relationship with participation was detected.

Private schools, Northeast region, and South region were significant predictors of school participation in table F-7. The negative parameter estimate indicates that relative to schools in the West region, schools in the Northeast region were somewhat underrepresented among the participating schools.

Because the percentage of students eligible for free or reduced-price lunch was not included in the main logistic regression analysis, a separate analysis with public schools only was conducted. To include free or reduced-price lunch eligibility in a model, public schools were modeled separately using a model with the summed race/ethnicity percentage and adding the percentage of students eligible for free or reduced-price lunch. Since poverty is derived from the percentage of students eligible for free or reduced-price lunch, an interaction term[6] was also included in the model. Standard errors and tests of hypotheses for the full model parameter estimates are presented in table F-8. The Northeast region, South region, and fourth grade enrollment were significant predictors of school participation among public schools only.

Table F-6. Logistic regression model parameters (with six race/ethnicity variables) using the U.S. TIMSS fourth-grade original school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H_0: parameter = 0	*p* value
Intercept	1.672	0.8428	1.9838	0.0509
Private school	-2.050	0.6395	-3.2059	0.0020
Central city	0.435	0.7093	0.6129	0.5418
Suburb	-0.290	0.6895	-0.4203	0.6754
Town	-0.110	0.5990	-0.1834	0.8550
Northeast	-0.570	0.4450	-1.2808	0.2042
Midwest	0.809	0.5099	1.5869	0.1167
South	1.705	0.4763	3.5796	0.0006
High poverty	0.347	0.5335	0.6498	0.5178
Total school enrollment	-0.001	0.0008	-0.6284	0.5316
Fourth grade enrollment	-0.005	0.0025	-2.1575	0.0342
Black, non-Hispanic	-0.013	0.0114	-1.1277	0.2630
Hispanic	0.000	0.0093	0.0246	0.9805
Asian	-0.007	0.0186	-0.3681	0.7139
American Indian or Alaska Native	-0.017	0.0127	-1.3754	0.1731
Hawaiian/Pacific Islander	0.000	0.2840	0.0004	0.9997
Multiracial	0.020	0.0427	0.4662	0.6425

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 4 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

[6] The interaction term can be interpreted as indicating whether the marginal effect of a one percentage-point increase in FRPL is diminished or amplified for schools above the 50 percent cut point, relative to those below the cut point.

Table F-7. Logistic regression model parameters (with summed race/ethnicity percentage) using the U.S. TIMSS fourth-grade original school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H0: parameter = 0	*p* value
Intercept	1.894	0.7854	2.4112	0.0184
Private school	-1.900	0.6423	-2.9581	0.0041
Central city	0.382	0.6974	0.5477	0.5855
Suburb	-0.363	0.6714	-0.5409	0.5902
Town	-0.089	0.5958	-0.1494	0.8816
Northeast	-0.812	0.3764	-2.1565	0.0342
Midwest	0.511	0.5081	1.0063	0.3175
South	1.400	0.3928	3.5635	0.0006
High poverty	0.348	0.4957	0.7030	0.4843
Total school enrollment	0.000	0.0007	-0.5640	0.5744
Fourth grade enrollment	-0.005	0.0026	-1.8969	0.0617
Summed race/ethnicity percentage	-0.006	0.0081	-0.6983	0.4871

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Summed race/ethnicity percentage includes Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander; and two or more races. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 4 enrollment.

SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table F-8. Logistic regression model parameters (with summed race/ethnicity percentage) using the U.S. TIMSS fourth-grade original public school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H0: parameter = 0	*p* value
Intercept	1.103	1.0737	1.0274	0.3075
Central city	0.315	0.7152	0.4401	0.6612
Suburb	-0.492	0.6745	-0.7294	0.4681
Town	0.196	0.6648	0.2953	0.7686
Northeast	-0.869	0.4078	-2.1321	0.0363
Midwest	0.312	0.4935	0.6324	0.5290
South	1.378	0.4557	3.0249	0.0034
High poverty	1.474	1.6272	0.9056	0.3680
Free or reduced-price lunch eligibility	0.027	0.0187	1.4198	0.1598
High poverty * free or reduced-price lunch eligibility	-0.032	0.0298	-1.0595	0.2928
Total school enrollment	0.000	0.0011	0.1539	0.8781
Fourth grade enrollment	-0.006	0.0026	-2.4737	0.0156
Summed race/ethnicity percentage	-0.008	0.0088	-0.8904	0.3761

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program. Black includes African American, and Hispanic includes Latino. Summed race/ethnicity percentage includes Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander; and two or more races. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 4 enrollment.

SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

3.2 Participating Final Sample with Substitutes

This section presents the nonresponse bias analysis based on the final sample of 295 eligible schools for TIMSS-4 including participating substitute schools. The distribution of the participating final sample was compared to the schools in the total eligible final sample. The total eligible final sample includes participating final sample plus those original nonrespondents who were not replaced by substitutes. School base weights were used for both the eligible sample and the participating schools. Through the use of substitute schools, the unweighted school response rate for TIMSS-4 was 84.7 percent after replacement, with 250 out of 295 schools participating. The weighted response rate was 84.6 percent after replacement.

3.2.1 Categorical Variables (TIMSS-4)

The distribution of participating and eligible schools by the four characteristics is shown in table F-9. The Chi-square statistic for census region is significant and suggests that there is evidence of a relationship with participation in the assessment. In particular, schools in the Northeast were underrepresented among participating schools relative to eligible schools (12.3 vs. 16.5 percent, respectively), while schools in the South were overrepresented among participating schools (43.0 vs. 38.4 percent, respectively). There are no statistically significant relationships between participation status and any of the other characteristics shown in table F-9. Additionally, the absolute value of the relative bias for private schools is greater than 10 percent, which indicates potential bias for school control though substantially reduced after substitution (table F-9). Note that the relative bias for private schools is much higher than for public schools due to the binary nature of the variable as the absolute bias is the same for both public and private.

Table F-9. Percentage distribution of eligible and participating schools in the U.S. TIMSS fourth-grade final sample, by selected categorical variables: 2015

	Sample schools				
School characteristic	Eligible (percent) (N=295)	Participating (percent) (N=250)	Bias	Relative bias	Chi-square *p* value
School control					0.207
Public	91.3	92.5	1.18	0.013	
Private	8.7	7.5	-1.18	-0.136	
Locale					0.942
Central city	31.8	32.0	0.14	0.004	
Suburb	39.3	38.8	-0.51	-0.013	
Town	10.9	10.8	-0.08	-0.007	
Rural	18.0	18.4	0.45	0.025	
Census region					0.000
Northeast	16.5	12.3	-4.17	-0.254	
Midwest	21.3	23.1	1.78	0.083	
South	38.4	43.0	4.54	0.118	
West	23.8	21.7	-2.14	-0.090	

See notes at end of table.

Table F-9. Percentage distribution of eligible and participating schools in the U.S. TIMSS fourth-grade final sample, by selected categorical variables: 2015—Continued

School characteristic	Sample schools: Eligible (percent) (N=295)	Sample schools: Participating (percent) (N=250)	Bias	Relative bias	Chi-square *p* value
Poverty level					0.162
High	49.3	50.9	1.65	0.033	
Low	50.7	49.1	-1.65	-0.033	

NOTE: Detail may not sum to totals because of rounding. Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Eligible schools contained at least one fourth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 4 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

3.2.2 Continuous Variables (TIMSS-4)

Summary means for each continuous variable for participating and eligible schools are shown in tables F-10, F-11, and F-12. One participating and one nonparticipating school had missing values for race/ethnicity, and these schools were dropped from the analysis in table F-11. No data on FRPL eligibility was available for private schools, and so private schools are not included in the FRPL analysis.

There were no statistically significant differences between participating and eligible schools with respect to student enrollment, race/ethnicity percentage or free or reduced-price lunch (tables F-10, F-11, and F-12). However, the absolute value of the relative bias for American Indian or Alaska Native is greater than 10 percent, though this is due mostly to the eligible percentage being less than 2.0 percent, as the absolute bias is small (table F-11).

Table F-10. Mean enrollment of various characteristics for eligible and participating schools in the U.S. TIMSS fourth-grade final sample: 2015

Student enrollment	Sample schools: Eligible (mean) (N=295)	Sample schools: Participating (mean) (N=250)	Bias	Relative bias	*t* test *p* value
Total school	559.6	565.5	5.86	0.010	0.325
Fourth grade enrollment	94.8	93.9	-0.88	-0.009	0.663

NOTE: Eligible schools contained at least one fourth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 4 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table F-11. Mean percentage of various characteristics for eligible and participating schools in the U.S. TIMSS fourth-grade final sample, by race/ethnicity: 2015

Race/ethnicity	Sample schools: Eligible (mean) (N=293)	Sample schools: Participating (mean) (N=249)	Bias	Relative bias	*t* test *p* value
White, non-Hispanic	49.8	49.5	-0.26	-0.005	0.726
Black, non-Hispanic	14.2	14.8	0.62	0.044	0.237
Hispanic	25.4	25.4	0.01	0.000	0.984
Asian	5.0	4.8	-0.23	-0.046	0.356
American Indian or Alaska Native	1.7	1.5	-0.19	-0.109	0.554
Hawaiian/Pacific Islander	0.4	0.4	0.03	0.074	0.258
Multiracial	3.4	3.4	0.02	0.006	0.855

NOTE: Information on race/ethnicity is missing for two of the 295 eligible and one of the 250 participating schools in the sample. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Eligible schools contained at least one fourth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 4 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table F-12. Mean percentage of students eligible for free or reduced-price lunch, in eligible and participating public schools in the U.S. TIMSS fourth-grade final sample: 2015

Students	Sample schools: Eligible (percent) (N=269)	Sample schools: Participating (percent) (N=231)	Bias	Relative bias	*t* test *p* value
Percentage of students eligible for free or reduced-price lunch	52.5	53.1	0.59	0.011	0.402

NOTE: In contrast to the eighth-grade sample, information on the percentage of students eligible for free or reduced-price lunch is available for all the eligible public schools in the fourth-grade sample. Eligible schools contained at least one fourth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 4 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

3.2.3 Logistic Regression Model (TIMSS-4)

To examine the joint relationship of various characteristics to school nonresponse, the analysis used a logistic regression model with participation status as the binary dependent variable and frame characteristics as predictor variables. Since public and private schools were modeled together using the variables available for all schools, the percentage of students eligible for free or reduced-price lunch was not included in the main logistic regression analysis.

Standard errors and tests of hypotheses for the full model parameter estimates are presented in table F-13 (with six race/ethnicity variables) and table F-14 (with summed race/ethnicity percentage). Private schools are treated as low poverty for the categorical variable poverty level. The Midwest region, South region, fourth grade enrollment and the percentage of American Indian or Alaska Native students were

significant predictors of school participation in table F-13. The positive parameters estimate indicates that relative to schools in the West region, schools in the Midwest and South regions were somewhat overrepresented among the participating schools. The negative parameter estimates indicate that the fourth grade enrollment and the percentage of American Indian or Alaska Native students in participating schools were smaller than in all eligible schools. The *F* test statistic to determine whether the race/ethnicity characteristics are simultaneously equal to 0 was 1.50 with a *p* value of 0.200, which indicates no significant relationship was detected with participation.

The Midwest region, South region, and fourth grade enrollment were again significant predictors of school participation in table F-14.

Because the percentage of students eligible for free or reduced-price lunch was not included in the main logistic regression analysis, a separate analysis with public schools only was conducted. To include free or reduced-price lunch eligibility in a model, public schools were modeled separately using a model with the summed race/ethnicity percentage and adding the percentage of students eligible for free or reduced-price lunch. Since poverty is derived from the percentage of students eligible for free or reduced-price lunch, an interaction term was also included in the model. Standard errors and tests of hypotheses for the full model parameter estimates are presented in table F-15. The South region and fourth grade enrollment were significant predictors of school participation. The model with the six race/ethnicity variables is not shown due to complex interactions that make the results difficult to interpret.

Table F-13. Logistic regression model parameters (with six race/ethnicity variables) using the U.S. TIMSS fourth-grade final school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H_0: parameter = 0	*p* value
Intercept	0.526	0.8932	0.5894	0.5574
Private school	-1.192	0.8078	-1.4757	0.1442
Central city	0.217	0.7992	0.2715	0.7868
Suburb	0.431	0.8067	0.5348	0.5943
Town	0.275	0.6727	0.4087	0.6840
Northeast	-0.136	0.4834	-0.2819	0.7788
Midwest	1.844	0.6126	3.0106	0.0036
South	2.551	0.6490	3.9310	0.0002
High poverty	0.168	0.5551	0.3028	0.7629
Total school enrollment	0.001	0.0010	1.3179	0.1916
Fourth grade enrollment	-0.007	0.0035	-2.1165	0.0376
Black, non-Hispanic	-0.010	0.0133	-0.7732	0.4418
Hispanic	0.003	0.0105	0.2475	0.8052
Asian	-0.010	0.0243	-0.4021	0.6888
American Indian or Alaska Native	-0.022	0.0101	-2.2175	0.0296
Hawaiian/Pacific Islander	0.439	0.3685	1.1925	0.2368
Multiracial	0.028	0.0494	0.5773	0.5655

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 4 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table F-14. Logistic regression model parameters (with summed race/ethnicity percentage) using the U.S. TIMSS fourth-grade final school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H_0: parameter = 0	*p* value
Intercept	0.916	0.807	1.1346	0.2601
Private school	-1.027	0.802	-1.2809	0.2042
Central city	0.216	0.7674	0.2811	0.7794
Suburb	0.317	0.7831	0.405	0.6866
Town	0.302	0.6684	0.4513	0.6531
Northeast	-0.598	0.419	-1.4272	0.1577
Midwest	1.372	0.6348	2.1605	0.0339
South	2.037	0.5799	3.5123	0.0008
High poverty	0.057	0.5133	0.1104	0.9124
Total school enrollment	0.002	0.0009	1.7508	0.0841
Fourth grade enrollment	-0.007	0.0034	-2.1319	0.0363
Summed race/ethnicity percentage	-0.002	0.0082	-0.2509	0.8026

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Summed race/ethnicity percentage includes Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander; and two or more races. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 4 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table F-15. Logistic regression model parameters (with summed race/ethnicity percentage) using the U.S. TIMSS fourth-grade final public school sample: 2015

Parameter	Parameter estimate	Standard error	t test for H0: parameter = 0	*p* value
Intercept	0.750	1.0463	0.7166	0.4759
Central city	0.269	0.8104	0.3317	0.7410
Suburb	0.000	0.7465	0.0001	0.9999
Town	0.540	0.7451	0.7253	0.4705
Northeast	-0.621	0.4306	-1.4428	0.1532
Midwest	1.310	0.6710	1.9527	0.0546
South	2.146	0.6237	3.4414	0.0009
High poverty	1.570	2.0725	0.7577	0.4510
Free or reduced-price lunch eligibility	0.015	0.0195	0.7907	0.4316
High poverty * free or reduced-price lunch eligibility	-0.028	0.0333	-0.8382	0.4046
Total school enrollment	0.001	0.0012	1.1061	0.2722
Fourth grade enrollment	-0.007	0.0037	-1.9935	0.0498
Summed race/ethnicity percentage	-0.006	0.0096	-0.6266	0.5329

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 4 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

3.3 Nonresponse-adjusted Final Sample with Substitutes

This section presents the nonresponse bias analysis based on the final sample of 295 eligible schools for TIMSS-4. The distribution of the participating final sample, including participating substitute schools, was compared to the schools in the total eligible final sample, just like the previous section. However, in the analyses that follow, school base weights were used for the eligible sample of schools, whereas nonresponse-adjusted weights were used for the participating schools.

3.3.1 Categorical Variables (TIMSS-4)

The distribution of participating and eligible schools by the four characteristics is shown in table F-16. There are no statistically significant relationships between participation status and any of the other characteristics shown in table F-16.

Table F-16. Percentage distribution of eligible and participating schools in the U.S. TIMSS fourth-grade nonresponse-adjusted sample, by selected categorical variables: 2015

	Sample schools				
School characteristic	Eligible (percent) (N=295)	Participating (percent) (N=250)	Bias	Relative bias	Chi-square *p* value
School control					1.000
Public	91.3	91.3	0.00	0.000	
Private	8.7	8.7	0.00	0.000	
Locale					0.831
Central city	31.8	32.7	0.84	0.026	
Suburb	39.3	39.0	-0.36	-0.009	
Town	10.9	10.3	-0.56	-0.051	
Rural	18.0	18.1	0.08	0.004	
Census region					1.000
Northeast	16.5	16.5	0.00	0.000	
Midwest	21.3	21.3	0.00	0.000	
South	38.4	38.4	0.00	0.000	
West	23.8	23.8	0.00	0.000	
Poverty level					1.000
High	49.3	49.3	0.00	0.000	
Low	50.7	50.7	0.00	0.000	

NOTE: Detail may not sum to totals because of rounding. Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Eligible schools contained at least one fourth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school nonresponse adjusted weight and by their estimated grade 4 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

3.3.2 Continuous Variables (TIMSS-4)

Summary means for each continuous variable for participating and eligible schools are shown in tables F-17, F-18 and F-19. One participating and one nonparticipating school had missing values for race/ethnicity, and these schools were dropped from the analysis in table F-18. No data on FRPL eligibility was available for private schools, and so private schools are not included in the FRPL analysis.

There were no statistically significant differences between participating and eligible schools with respect to student enrollment, race/ethnicity percentage or free or reduced-price lunch (tables F-17, F-18, and F-19). However, the absolute values of the relative bias for Hawaiian/Pacific Islander and American Indian or Alaska Native are greater than 10 percent, though this is due mostly to the eligible percentages being less than 2.0 percent, as the absolute biases are small (table F-18).

Table F-17. Mean enrollment of various characteristics for eligible and participating schools in the U.S. TIMSS fourth-grade nonresponse-adjusted sample: 2015

	Sample schools				
Student enrollment	Eligible (mean) (N=295)	Participating (mean) (N=250)	Bias	Relative bias	*t* test *p* value
Total school	559.6	563.2	3.55	0.006	0.614
Fourth grade enrollment	94.8	92.7	-2.15	-0.023	0.301

NOTE: Eligible schools contained at least one fourth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school nonresponse adjusted weight and by their estimated grade 4 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table F-18. Mean percentage of various characteristics for eligible and participating schools in the U.S. TIMSS fourth-grade nonresponse-adjusted sample, by race/ethnicity: 2015

	Sample schools				
Race/ethnicity	Eligible (mean) (N=293)	Participating (mean) (N=249)	Bias	Relative bias	*t* test *p* value
White, non-Hispanic	49.8	49.9	0.07	0.001	0.930
Black, non-Hispanic	14.2	14.2	-0.05	-0.003	0.931
Hispanic	25.4	25.5	0.05	0.002	0.944
Asian	5.0	5.1	0.04	0.007	0.906
American Indian or Alaska Native	1.7	1.5	-0.27	-0.157	0.394
Hawaiian/Pacific Islander	0.4	0.5	0.07	0.185	0.124
Multiracial	3.4	3.5	0.09	0.026	0.642

NOTE: Information on race/ethnicity is missing for two of the 295 eligible and one of the 250 participating schools in the sample. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Eligible schools contained at least one fourth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school nonresponse adjusted weight and by their estimated grade 4 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table F-19. Mean percentage of students eligible for free or reduced-price lunch, in eligible and participating public schools in the U.S. TIMSS fourth-grade nonresponse-adjusted sample: 2015

Students	Sample schools: Eligible (percent) (N=269)	Sample schools: Participating (percent) (N=231)	Bias	Relative bias	*t* test *p* value
Percentage of students eligible for free or reduced-price lunch	52.5	52.6	0.06	0.001	0.942

NOTE: In contrast to the eighth-grade sample, information on the percentage of students eligible for free or reduced-price lunch is available for all the eligible public schools in the fourth-grade sample. Eligible schools contained at least one fourth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school nonresponse adjusted weights and by their estimated grade 4 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

3.4 Summary—Grade 4

The investigation into nonresponse bias at the school level for the U.S. TIMSS-4 effort shows statistically significant relationships between response status and some of the available school characteristics that were examined in the analysis.

For original sample schools, four variables were found to be statistically significantly related to participation in the bivariate analysis: school control (table F-2); Census region (table F-2); poverty (table F-2) and free or reduced-price lunch (table F-5). Additionally, the absolute value of the relative bias for Hawaiian/Pacific Islander is greater than 10 percent, though this is due mostly to the eligible percentage being less than 2.0 percent, as the absolute bias is small (table F-4). Although each of these findings indicates some potential for nonresponse bias, when all of these factors were considered simultaneously in a regression analysis, private schools, South region and fourth grade enrollment were significant predictors of participation (table F-6). The second model showed that private schools, Northeast region, and South region were significant predictors of participation (table F-7, with summed race/ethnicity percentage). The third model showed Northeast, South regions and fourth grade enrollment were significant predictors of school participation among public schools only (table F-8).

For final sample schools (with substitutes), only Census region (table F-9) was found to be statistically significantly related to participation in the bivariate analysis. Additionally, the absolute value of the relative bias for private schools is greater than 10 percent, which indicates potential bias for school control though substantially reduced after substitution (table F-9). When all of these factors were considered simultaneously in a regression analysis, Midwest region, South region, fourth grade enrollment and the percentage of American Indian or Alaska Native students were significant predictors of participation (table F-13). The second model showed that Midwest region, South region, and fourth grade enrollment were significant predictors of participation (table F-14, with summed race/ethnicity percentage). The third model showed South region and fourth grade enrollment were a significant predictors of school participation among public schools only (table F-15).

For final sample schools with school nonresponse adjustments applied to the weights, no variables were found to be statistically significantly related to participation in the bivariate analysis. However, the absolute values of the relative bias for Hawaiian/Pacific Islander and American Indian or Alaska Native

are greater than 10 percent , though this is due mostly to the eligible percentages being less than 2.0 percent, as the absolute biases are small (table F-18). The multivariate regression analysis cannot be conducted after the school nonresponse adjustments are applied to the weights. The concept of nonresponse-adjusted weights does not apply to the nonresponding units, and, thus, we cannot conduct an analysis that compares respondents with nonrespondents using nonresponse-adjusted weights.

The results of the analyses are summarized in table F-20.

Table F-20. Characteristics with *p* values less than 0.05 and absolute relative bias greater than 10 percent, U.S. TIMSS fourth-grade schools: 2015

Analysis	Characteristics with *p* values less than 0.05	Additional characteristics with absolute relative bias greater than 10 percent
Original sample	School control, Census region, poverty, free or reduced-price lunch	Hawaiian/Pacific Islander
Regression model a	Private schools, South region, fourth grade enrollment	N/a
Regression model b	Private schools, Northeast region, South region	N/a
Regression model c	Northeast region, South region, fourth grade enrollment	N/a
Sample with substitutes	Census region	Private schools
Regression model a	South region, Midwest region, fourth grade enrollment, American Indian or Alaska Native	N/a
Regression model b	South region, Midwest region, fourth grade enrollment	N/a
Regression model c	South region, fourth grade enrollment	N/a
Nonresponse adjusted	None	Hawaiian/Pacific Islander, American Indian or Alaska Native

SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

These results suggest that there is some potential for nonresponse bias in the U.S. TIMSS-4 original sample based on the characteristics studied. It also suggests that, while there is some evidence that the use of substitute schools reduced the potential for bias, it has not reduced it substantially. However, after the application of school nonresponse adjustments, there is no evidence of resulting potential bias in the available frame variables and correlated variables in the final sample.

4. RESULTS—TIMSS GRADE 8

4.1 Original Respondent Sample

This section presents the nonresponse bias analysis based on the original sample of 293 eligible schools for TIMSS-8. The distribution of the participating original sample was compared to the schools in the total eligible original sample. School base weights were used for both the eligible sample and the participating schools. The unweighted school response rate for TIMSS-8 was 78.2 percent before replacement, with 229 out of 293 schools participating. The weighted response rate was 78.4 percent before replacement.

4.1.1 Categorical Variables (TIMSS-8)

The distribution of participating and eligible schools by the four characteristics is shown in table F-21. The Chi-square statistics for Census region and poverty are significant and suggest that there is evidence of relationships with participation in the assessment. In particular, schools in the Northeast were underrepresented among participating schools relative to eligible schools (13.9 vs. 17.0 percent, respectively), while schools in the South were overrepresented among participating schools (42.1 vs. 38.4 percent, respectively). High-poverty schools were overrepresented among participating schools (48.9 vs. 45.1 percent, respectively), and low-poverty schools were underrepresented among participating schools (51.1 vs. 54.9 percent, respectively). There are no statistically significant relationships between participation status and any of the other characteristics shown in table F-21. Additionally, the absolute value of the relative bias for private schools is greater than 10 percent, which indicates potential bias for school control, though the absolute bias is relatively small. Note that the relative bias for private schools is much higher than for public schools due to the binary nature of the variable as the absolute bias is the same for both public and private.

Table F-21. Percentage distribution of eligible and participating schools in the U.S. TIMSS eighth-grade original sample, by selected categorical variables: 2015

	Sample schools				
School characteristic	Eligible (percent) (N=293)	Participating (percent) (N=229)	Bias	Relative bias	Chi-square *p* value
School control					0.368
Public	92.0	92.9	0.84	0.009	
Private	8.0	7.1	-0.84	-0.105	
Locale					0.211
Central city	30.2	32.0	1.88	0.062	
Suburb	39.9	36.7	-3.21	-0.080	
Town	11.3	11.4	0.09	0.008	
Rural	18.6	19.8	1.23	0.066	

See notes at end of table.

Table F-21. Percentage distribution of eligible and participating schools in the U.S. TIMSS eighth-grade original sample, by selected categorical variables: 2015—Continued

School characteristic	Sample schools: Eligible (percent) (N=293)	Sample schools: Participating (percent) (N=229)	Bias	Relative bias	Chi-square *p* value
Census region					0.015
Northeast	17.0	13.9	-3.05	-0.180	
Midwest	21.6	22.0	0.37	0.017	
South	38.4	42.1	3.70	0.096	
West	23.0	22.0	-1.02	-0.044	
Poverty level					0.013
High	45.1	48.9	3.81	0.085	
Low	54.9	51.1	-3.81	-0.069	

NOTE: Detail may not sum to totals because of rounding. Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low-poverty schools Eligible schools contained at least one eighth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 8 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

4.1.2 Continuous Variables (TIMSS-8)

Summary means for each continuous variable for participating and eligible schools are shown in tables F-22, F-23 and F-24. One participating school had missing values for race/ethnicity, and this school was dropped from the analysis in table F-23. No data on FRPL eligibility was available for private schools, and so private schools are not included in the FRPL analysis. Three participating schools had missing values for free or reduced-price lunch, and these schools were dropped from the analysis in table F-24.

There were no statistically significant differences between participating and eligible schools with respect to student enrollment, race/ethnicity percentage or free or reduced-price lunch (tables F-22, F-23 and F-24).

Table F-22. Mean enrollment of various characteristics for eligible and participating schools in the U.S. TIMSS eighth-grade original sample: 2015

Student enrollment	Sample schools: Eligible (mean) (N=293)	Sample schools: Participating (mean) (N=229)	Bias	Relative bias	*t* test *p* value
Total school	745.5	757.6	12.02	0.016	0.309
Eighth grade enrollment	242.4	244.5	2.18	0.009	0.659

NOTE: Eligible schools contained at least one eighth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 8 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table F-23. Mean percentage of various characteristics for eligible and participating schools in the U.S. TIMSS eighth-grade original sample, by race/ethnicity: 2015

Race/ethnicity	Sample schools: Eligible (mean) (N=292)	Sample schools: Participating (mean) (N=228)	Bias	Relative bias	*t* test *p* value
White, non-Hispanic	52.9	52.3	-0.55	-0.010	0.559
Black, non-Hispanic	14.9	15.5	0.57	0.039	0.400
Hispanic	23.9	24.1	0.23	0.010	0.754
Asian	4.8	4.5	-0.22	-0.046	0.301
American Indian or Alaska Native	0.7	0.7	-0.01	-0.012	0.886
Hawaiian/Pacific Islander	0.3	0.3	0.02	0.082	0.461
Multiracial	2.6	2.5	-0.05	-0.020	0.628

NOTE: Information on race/ethnicity is missing for one of the 229 participating schools in the sample. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Eligible schools contained at least one eighth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 8 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table F-24. Mean percentage of students eligible for free or reduced-price lunch, in eligible and participating public schools in the U.S. TIMSS eighth-grade original sample: 2015

Students	Sample schools: Eligible (percent) (N=267)	Sample schools: Participating (percent) (N=210)	Bias	Relative bias	*t* test *p* value
Percentage of students eligible for free or reduced-price lunch	51.2	52.7	1.46	0.029	0.095

NOTE: Information on percentage of students eligible for free or reduced-price lunch is missing for three of the 213 participating public schools in the sample. Eligible schools contained at least one eighth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 8 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

4.1.3 Logistic Regression Model (TIMSS-8)

To examine the joint relationship of various characteristics to school nonresponse, the analysis used a logistic regression model with participation status as the binary dependent variable and frame characteristics as predictor variables. Since public and private schools were modeled together using the variables available for all schools, the percentage of students eligible for free or reduced-price lunch was not included in the main logistic regression analysis.

Standard errors and tests of hypotheses for the full model parameter estimates are presented in table F-25 (with six race/ethnicity variables) and table F-26 (with summed race/ethnicity percentage). Private schools are treated as low poverty for the categorical variable poverty level. Only high poverty was a significant predictor of school participation in table F-25. The positive parameter estimate indicates that relative to schools in the low poverty schools, high poverty schools were somewhat overrepresented

among the participating schools. The *F* test statistic to determine whether the race/ethnicity characteristics are simultaneously equal to 0 was 0.51 with a *p* value of 0.7656, which indicates that no significant relationship with participation was detected. Only high poverty was a significant predictor of school participation in table F-26.

Because the percentage of students eligible for free or reduced-price lunch was not included in the main logistic regression analysis, a separate analysis with public schools only was conducted. To include free or reduced-price lunch eligibility in a model, public schools were modeled separately using a model with the summed race/ethnicity percentage and adding the percentage of students eligible for free or reduced-price lunch. Since poverty is derived from the percentage of students eligible for free or reduced-price lunch, an interaction term [7] was also included in the model. Standard errors and tests of hypotheses for the full model parameter estimates are presented in table F-27. Only the South region was a significant predictor of school participation among public schools only. The positive parameter estimate indicates that relative to schools in the West region, schools in the South region were somewhat overrepresented among the participating schools. The model with the six race/ethnicity variables is not shown due to complex interactions that make the results difficult to interpret.

Table F-25. Logistic regression model parameters (with six race/ethnicity variables) using the U.S. TIMSS eighth-grade original school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H_0: parameter = 0	*p* value
Intercept	0.769	0.8091	0.9500	0.3452
Private school	-0.382	0.7493	-0.5102	0.6114
Central city	0.619	0.7308	0.8475	0.3994
Suburb	0.290	0.6348	0.4567	0.6492
Town	-0.061	0.7243	-0.0844	0.9329
Northeast	-0.578	0.5183	-1.1158	0.2681
Midwest	0.344	0.5378	0.6387	0.5250
South	0.667	0.3959	1.6851	0.0961
High poverty	0.946	0.4146	2.2806	0.0254
Total school enrollment	0.001	0.0008	1.5318	0.1298
Eighth grade enrollment	-0.002	0.0017	-1.0990	0.2753
Black, non-Hispanic	-0.010	0.0109	-0.8826	0.3803
Hispanic	-0.013	0.0086	-1.4570	0.1493
Asian	-0.004	0.0179	-0.2066	0.8369
American Indian or Alaska Native	-0.045	0.0640	-0.7042	0.4835
Hawaiian/Pacific Islander	0.204	0.5711	0.3578	0.7215
Multiracial	-0.087	0.0681	-1.2719	0.2073

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 8 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

[7] The interaction term can be interpreted as indicating whether the marginal effect of a one percentage-point increase in FRPL is diminished or amplified for schools above the 50 percent cut point, relative to those below the cut point.

Table F-26. Logistic regression model parameters (with summed race/ethnicity percentage) using the U.S. TIMSS eighth-grade original school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H0: parameter = 0	*p* value
Intercept	0.507	0.6939	0.7312	0.4669
Private school	-0.242	0.7001	-0.3463	0.7301
Central city	0.469	0.7124	0.6590	0.5119
Suburb	0.345	0.6084	0.5673	0.5722
Town	-0.135	0.7134	-0.1898	0.8500
Northeast	-0.417	0.4127	-1.0097	0.3159
Midwest	0.331	0.4785	0.6914	0.4915
South	0.609	0.3257	1.8690	0.0655
High poverty	0.827	0.3471	2.3816	0.0198
Total school enrollment	0.001	0.0007	1.5088	0.1355
Eighth grade enrollment	-0.001	0.0016	-0.7607	0.4492
Summed race/ethnicity percentage	-0.008	0.0071	-1.1379	0.2588

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Summed race/ethnicity percentage includes Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander; and two or more races. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 8 enrollment.

SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table F-27. Logistic regression model parameters (with summed race/ethnicity percentage) using the U.S. TIMSS eighth-grade original public school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H0: parameter = 0	*p* value
Intercept	0.152	0.8474	0.1789	0.8585
Central city	0.579	0.7301	0.7928	0.4304
Suburb	0.681	0.6568	1.0367	0.3032
Town	-0.001	0.7412	-0.0013	0.9990
Northeast	-0.229	0.4357	-0.5261	0.6003
Midwest	0.343	0.4885	0.7029	0.4843
South	0.746	0.3226	2.3110	0.0236
High poverty	2.101	1.4743	1.4253	0.1582
Free or reduced-price lunch eligibility	0.005	0.0139	0.3674	0.7144
High poverty * free or reduced-price lunch eligibility	-0.018	0.0239	-0.7722	0.4424
Total school enrollment	0.001	0.0007	1.3078	0.1949
Eighth grade enrollment	-0.001	0.0017	-0.5643	0.5742
Summed race/ethnicity percentage	-0.009	0.0081	-1.1061	0.2722

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program. Summed race/ethnicity percentage includes Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander; and two or more races. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 8 enrollment.

SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

4.2 Participating Final Sample with Substitutes

This section presents the nonresponse bias analysis based on the final sample of 293 eligible schools for TIMSS-8 including participating substitute schools. The distribution of the participating final sample was compared to the schools in the total eligible final sample. The total eligible final sample includes participating final sample plus those original nonrespondents who were not replaced by substitutes. School base weights were used for both the eligible sample and the participating schools. Through the use of substitute schools, the unweighted school response rate for TIMSS-8 was 84.0 percent after replacement, with 246 out of 293 schools participating. The weighted response rate was also 84.0 percent after replacement.

4.2.1 Categorical Variables (TIMSS-8)

The distribution of participating and eligible schools by the four characteristics is shown in table F-28. The Chi-square statistic for Census region and poverty are significant and suggests that there is evidence of a relationship with participation in the assessment. In particular, schools in the Northeast were underrepresented among participating schools relative to eligible schools (14.6 vs. 17.0 percent, respectively), while schools in the South were overrepresented among participating schools (42.5 vs. 38.4 percent, respectively). High-poverty schools were overrepresented among participating schools (47.5 vs. 45.1 percent, respectively), and low-poverty schools were underrepresented among participating schools (52.5 vs. 54.9 percent, respectively). There are no statistically significant relationships between participation status and any of the other characteristics shown in table F-28.

Table F-28. Percentage distribution of eligible and participating schools in the U.S. TIMSS eighth-grade final sample, by selected categorical variables: 2015

	Sample schools				
School characteristic	Eligible (percent) (N=293)	Participating (percent) (N=246)	Bias	Relative bias	Chi-square *p* value
School control					0.249
Public	92.0	91.3	-0.68	-0.007	
Private	8.0	8.7	0.68	0.085	
Locale					0.080
Central city	30.2	31.0	0.87	0.029	
Suburb	39.9	37.0	-2.89	-0.072	
Town	11.3	11.8	0.53	0.047	
Rural	18.6	20.1	1.49	0.080	
Census region					0.003
Northeast	17.0	14.6	-2.41	-0.142	
Midwest	21.6	22.1	0.48	0.022	
South	38.4	42.5	4.06	0.106	
West	23.0	20.9	-2.13	-0.093	

See notes at end of table.

Table F-28. Percentage distribution of eligible and participating schools in the U.S. TIMSS eighth-grade final sample, by selected categorical variables: 2015—Continued

School characteristic	Sample schools: Eligible (percent) (N=293)	Sample schools: Participating (percent) (N=246)	Bias	Relative bias	Chi-square *p* value
Poverty level					0.026
High	45.1	47.5	2.48	0.055	
Low	54.9	52.5	-2.48	-0.045	

NOTE: Detail may not sum to totals because of rounding. Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Eligible schools contained at least one eighth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 8 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

4.2.2 Continuous Variables (TIMSS-8)

Summary means for each continuous variable for participating and eligible schools are shown in tables F-29, F-30, and F-31. One participating school had missing values for race/ethnicity, and this school was dropped from the analysis in table F-30. No data on FRPL eligibility was available for private schools, and so private schools are not included in the FRPL analysis. Three participating schools had missing values for free or reduced-price lunch, and these schools were dropped from the analysis in table F-31.

There were no statistically significant differences between participating and eligible schools with respect to student enrollment, race/ethnicity percentage or free or reduced-price lunch (tables F-29, F-30, and F-31).

Table F-29. Mean enrollment of various characteristics for eligible and participating schools in the U.S. TIMSS eighth-grade final sample: 2015

Student enrollment	Sample schools: Eligible (mean) (N=293)	Sample schools: Participating (mean) (N=246)	Bias	Relative bias	*t* test *p* value
Total school	744.1	752.4	8.26	0.011	0.398
Eighth grade enrollment	242.3	241.7	-0.60	-0.002	0.881

NOTE: Eligible schools contained at least one eighth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 8 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table F-30. Mean percentage of various characteristics for eligible and participating schools in the U.S. TIMSS eighth-grade final sample, by race/ethnicity: 2015

Race/ethnicity	Sample schools: Eligible (mean) (N=292)	Sample schools: Participating (mean) (N=245)	Bias	Relative bias	*t* test *p* value
White, non-Hispanic	53.0	53.3	0.28	0.005	0.687
Black, non-Hispanic	14.9	15.1	0.13	0.009	0.822
Hispanic	23.8	23.6	-0.15	-0.006	0.794
Asian	4.9	4.6	-0.27	-0.056	0.155
American Indian or Alaska Native	0.7	0.7	0.01	0.011	0.767
Hawaiian/Pacific Islander	0.3	0.3	0.03	0.094	0.175
Multiracial	2.5	2.5	-0.02	-0.007	0.829

NOTE: Information on race/ethnicity is missing for one of the 246 participating schools in the sample. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Eligible schools contained at least one eighth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 8 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table F-31. Mean percentage of students eligible for free or reduced-price lunch, in eligible and participating public schools in the U.S. TIMSS eighth-grade final sample: 2015

Students	Sample schools: Eligible (percent) (N=267)	Sample schools: Participating (percent) (N=222)	Bias	Relative bias	*t* test *p* value
Percentage of students eligible for free or reduced-price lunch	50.8	51.9	1.15	0.023	0.136

NOTE: Information on percentage of students eligible for free or reduced-price lunch is missing for three of the 225 participating public schools in the sample. Eligible schools contained at least one eighth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 8 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

4.2.3 Logistic Regression Model (TIMSS-8)

To examine the joint relationship of various characteristics to school nonresponse, the analysis used a logistic regression model with participation status as the binary dependent variable and frame characteristics as predictor variables. Since public and private schools were modeled together using the variables available for all schools, the percentage of students eligible for free or reduced-price lunch was not included in the main logistic regression analysis.

Standard errors and tests of hypotheses for the full model parameter estimates are presented in table F-32 (with six race/ethnicity variables) and table F-33 (with summed race/ethnicity percentage). Private schools are treated as low poverty for the categorical variable poverty level. South region and high poverty were significant predictors of school participation in table F-32. The positive parameter estimates

indicate that relative to schools in the West region, schools in the South region were somewhat overrepresented among the participating schools and that relative to schools in the low poverty schools, high poverty schools were somewhat overrepresented among the participating schools. The *F* test statistic to determine whether the race/ethnicity characteristics are simultaneously equal to 0 was 0.85 with a *p* value of 0.517, which indicates no significant relationship was detected with participation.

South region, high poverty and total enrollment were significant predictors of school participation in table F-33. The positive parameter estimate indicates that the total school enrollment in participating schools was larger than in all eligible schools.

Because the percentage of students eligible for free or reduced-price lunch was not included in the main logistic regression analysis, a separate analysis with public schools only was conducted. To include free or reduced-price lunch eligibility in a model, public schools were modeled separately using a model with the summed race/ethnicity percentage and adding the percentage of students eligible for free or reduced-price lunch. Since poverty is derived from the percentage of students eligible for free or reduced-price lunch, an interaction term was also included in the model. Standard errors and tests of hypotheses for the full model parameter estimates are presented in table F-34. Only the South region was a significant predictor of school participation among public schools only. The model with the six race/ethnicity variables is not shown due to complex interactions that make the results difficult to interpret.

Table F-32. Logistic regression model parameters (with six race/ethnicity variables) using the U.S. TIMSS eighth-grade final school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H_0: parameter = 0	*p* value
Intercept	0.421	0.9851	0.4278	0.6700
Private school	1.217	1.0783	1.1288	0.2626
Central city	0.014	0.8712	0.0157	0.9875
Suburb	0.301	0.7794	0.3861	0.7005
Town	-0.617	0.8437	-0.7310	0.4671
Northeast	0.003	0.6043	0.0052	0.9959
Midwest	0.99	0.5930	1.6688	0.0993
South	1.598	0.5179	3.0858	0.0028
High poverty	1.092	0.4467	2.4438	0.0169
Total school enrollment	0.002	0.0010	1.8807	0.0639
Eighth grade enrollment	-0.002	0.0018	-1.1740	0.2441
Black, non-Hispanic	-0.017	0.0108	-1.5863	0.1169
Hispanic	-0.01	0.0093	-1.0744	0.2861
Asian	-0.003	0.0177	-0.1774	0.8597
American Indian or Alaska Native	0.001	0.1163	0.0091	0.9928
Hawaiian/Pacific Islander	0.751	0.5460	1.3763	0.1728
Multiracial	-0.063	0.0791	-0.7932	0.4302

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 8 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table F-33. Logistic regression model parameters (with summed race/ethnicity percentage) using the U.S. TIMSS eighth-grade final school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H_0: parameter = 0	*p* value
Intercept	0.473	0.8548	0.5538	0.5814
Private school	1.376	0.9714	1.4167	0.1607
Central city	-0.105	0.8521	-0.1230	0.9024
Suburb	0.339	0.757	0.4477	0.6557
Town	-0.619	0.8389	-0.738	0.4628
Northeast	-0.164	0.4877	-0.3371	0.7370
Midwest	0.642	0.5225	1.2292	0.2229
South	1.208	0.4551	2.6552	0.0097
High poverty	0.951	0.3428	2.7734	0.0070
Total school enrollment	0.002	0.0009	2.0249	0.0464
Eighth grade enrollment	-0.002	0.0018	-0.8318	0.4082
Summed race/ethnicity percentage	-0.009	0.0076	-1.1807	0.2415

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Summed race/ethnicity percentage includes Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander; and two or more races. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 8 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table F-34. Logistic regression model parameters (with summed race/ethnicity percentage) using the U.S. TIMSS eighth-grade final public school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H_0: parameter = 0	*p* value
Intercept	-0.272	1.0780	-0.2519	0.8018
Central city	-0.137	0.8568	-0.1595	0.8737
Suburb	0.979	0.8651	1.1314	0.2615
Town	-0.629	0.8493	-0.7400	0.4616
Northeast	-0.027	0.5128	-0.0522	0.9585
Midwest	0.968	0.5516	1.7546	0.0834
South	1.490	0.4916	3.0314	0.0033
High poverty	3.256	1.7237	1.8890	0.0628
Free or reduced-price lunch eligibility	0.012	0.0157	0.7708	0.4432
High poverty * free or reduced-price lunch eligibility	-0.036	0.0284	-1.2545	0.2135
Total school enrollment	0.002	0.0009	1.9483	0.0551
Eighth grade enrollment	-0.001	0.0018	-0.6718	0.5038
Summed race/ethnicity percentage	-0.009	0.0086	-1.0032	0.3190

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program. Summed race/ethnicity percentage includes Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander; and two or more races. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated grade 8 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

4.3 Nonresponse-adjusted Final Sample with Substitutes

This section presents the nonresponse bias analysis based on the final sample of 293 eligible schools for TIMSS-8. The distribution of the participating final sample, including participating substitute schools, was compared to the schools in the total eligible final sample, just like the previous section. However, in the analyses that follow, school base weights were used for the eligible sample of schools, whereas nonresponse-adjusted weights were used for the participating schools.

4.3.1 Categorical Variables (TIMSS-8)

The distribution of participating and eligible schools by the four characteristics is shown in table F-35. There are no statistically significant relationships between participation status and any of the characteristics shown in table F-35.

Table F-35. Percentage distribution of eligible and participating schools in the U.S. TIMSS eighth-grade nonresponse-adjusted sample, by selected categorical variables: 2015

	Sample schools				
School characteristic	Eligible (percent) (N=293)	Participating (percent) (N=246)	Bias	Relative bias	Chi-square *p* value
School control					0.995
Public	92.0	92.0	0.00	0.000	
Private	8.0	8.0	0.00	0.000	
Locale					0.466
Central city	30.2	30.7	0.49	0.016	
Suburb	39.9	38.1	-1.86	-0.046	
Town	11.3	11.5	0.20	0.018	
Rural	18.6	19.8	1.16	0.062	
Census region					1.000
Northeast	17.0	17.0	0.01	0.000	
Midwest	21.6	21.6	-0.04	-0.002	
South	38.4	38.4	0.02	0.000	
West	23.0	23.0	0.01	0.000	
Poverty level					0.984
High	45.1	45.0	-0.02	-0.001	
Low	54.9	55.0	0.02	0.000	

NOTE: Detail may not sum to totals because of rounding. Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Eligible schools contained at least one eighth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school nonresponse adjusted weight and by their estimated grade 8 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

4.3.2 Continuous Variables (TIMSS-8)

Summary means for each continuous variable for participating and eligible schools are shown in tables F-36, F-37 and F-38. One participating school had missing values for race/ethnicity, and this school was dropped from the analysis in table F-37. No data on FRPL eligibility was available for private schools, and so private schools are not included in the FRPL analysis. Three participating schools had missing values for free or reduced-price lunch, and these schools were dropped from the analysis in table F-31.

There were no statistically significant differences between participating and eligible schools with respect to student enrollment, race/ethnicity percentage or free or reduced-price lunch (tables F-36, F-37, and F-38). However, the absolute value of the relative bias for Hawaiian/Pacific Islander is greater than 10 percent, though this is due mostly to the eligible percentage being less than 1.0 percent, as the absolute bias is small.

Table F-36. Mean enrollment of various characteristics for eligible and participating schools in the U.S. TIMSS eighth-grade nonresponse-adjusted sample: 2015

	Sample schools				
Student enrollment	Eligible (mean) (N=293)	Participating (mean) (N=246)	Bias	Relative bias	*t* test *p* value
Total school	744.1	757.0	12.93	0.017	0.211
Eighth grade enrollment	242.3	243.1	0.85	0.004	0.851

NOTE: Eligible schools contained at least one eighth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school nonresponse adjusted weight and by their estimated grade 8 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table F-37. Mean percentage of various characteristics for eligible and participating schools in the U.S. TIMSS eighth-grade nonresponse-adjusted sample, by race/ethnicity: 2015

	Sample schools				
Race/ethnicity	Eligible (mean) (N=292)	Participating (mean) (N=245)	Bias	Relative bias	*t* test *p* value
White, non-Hispanic	53.0	53.8	0.86	0.016	0.246
Black, non-Hispanic	14.9	14.4	-0.48	-0.032	0.407
Hispanic	23.8	23.2	-0.59	-0.025	0.317
Asian	4.9	5.0	0.17	0.035	0.477
American Indian or Alaska Native	0.7	0.7	0.00	0.002	0.966
Hawaiian/Pacific Islander	0.3	0.4	0.06	0.215	0.239
Multiracial	2.5	2.5	-0.03	-0.012	0.740

NOTE: Information on race/ethnicity is missing for one of the 246 participating schools in the sample. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Eligible schools contained at least one eighth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school nonresponse adjusted weight and by their estimated grade 8 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table F-38. Mean percentage of students eligible for free or reduced-price lunch, in eligible and participating public schools in the U.S. TIMSS eighth-grade nonresponse-adjusted sample: 2015

Students	Sample schools: Eligible (percent) (N=267)	Sample schools: Participating (percent) (N=222)	Bias	Relative bias	t test *p* value
Percentage of students eligible for free or reduced-price lunch	50.8	50.8	0.01	0.000	0.994

NOTE: Information on percentage of students eligible for free or reduced-price lunch is missing for three of the 225 participating public schools in the sample. Eligible schools contained at least one eighth-grade class. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school nonresponse adjusted weights and by their estimated grade 8 enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

4.4 Summary—Grade 8

The investigation into nonresponse bias at the school level for the U.S. TIMSS-8 effort shows statistically significant relationship between response status and some of the available school characteristics that were examined in the analysis.

For original sample schools, two variables were found to be statistically significantly related to participation in the bivariate analysis: Census region (table F-21) and poverty (table F-21). However, the absolute value of the relative bias for private schools is greater than 10 percent, which indicates potential bias for school control though the absolute bias is relatively small (table F-21). Although each of these findings indicates some potential for nonresponse bias, when all of these factors were considered simultaneously in a regression analysis, only high poverty was a significant predictor of participation (table F-25). The second model showed that only high poverty was a significant predictor of participation (table F-26, with summed race/ethnicity percentage). The third model showed only the South region, was a significant predictor of school participation among public schools only (table F-27). These results suggest that there is some potential for nonresponse bias in the TIMSS-8 participating sample based on the characteristics studied.

For final sample schools (with substitutes), again Census region (table F-28) and poverty (table F-28) were found to be statistically significantly related to participation in the bivariate analysis. When all of these factors were considered simultaneously in a regression analysis, South region and high poverty were significant predictors of participation (table F-32). The second model showed that South region, high poverty and total school enrollment were significant predictors of participation (table F-33, with summed race/ethnicity percentage). The third model showed South region was a significant predictor of school participation among public schools only (table F-34).

For final sample schools with school nonresponse adjustments applied to the weights, no variables were found to be statistically significantly related to participation in the bivariate analysis. However, the absolute value of the relative bias for Hawaiian/Pacific Islander is greater than 10 percent, though this is due mostly to the eligible percentage being less than 1.0 percent, as the absolute bias is small (table F-37). The multivariate regression analysis cannot be conducted after the school nonresponse adjustments are applied to the weights. The concept of nonresponse-adjusted weights does not apply to the nonresponding

units, and, thus, we cannot conduct an analysis that compares respondents with nonrespondents using nonresponse-adjusted weights.

The results of the analyses are summarized in table F-39.

Table F-39. Characteristics with *p* values less than 0.05 and absolute relative bias greater than 10 percent, U.S. TIMSS eighth-grade schools: 2015

Analysis	Characteristics with *p* values less than 0.05	Additional characteristics with absolute relative bias greater than 10 percent
Original sample	Census region, poverty	private schools
Regression model a	High poverty	N/a
Regression model b	High poverty	N/a
Regression model c	South region	N/a
Sample with substitutes	Census region, poverty	None
Regression model a	South region, high poverty	N/a
Regression model b	South region, high poverty, total school enrollment	N/a
Regression model c	South region	N/a
Nonresponse adjusted	None	Hawaiian/Pacific Islander

NOTE: The South region was significant only in the regression model among public schools and not for the entire original sample.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

These results suggest that there is some potential for nonresponse bias in the U.S. TIMSS-8 original sample based on the characteristics studied. It also suggests that, while there is some evidence that the use of substitute schools has not reduced the potential for bias, it has not added to it substantially. Moreover, after the application of school nonresponse adjustments, there is no evidence of resulting potential bias in the available frame variables and correlated variables in the final sample. There is less reliance on substitution and the nonresponse adjustments in TIMSS-8 than in TIMSS-4 as there are fewer significant variables prior to substitution and nonresponse adjustments in TIMSS-8.

5. TECHNICAL NOTES

Description of Variables

Frame characteristics for public schools were taken from the 2012-13 CCD and, for private schools, from the 2011-12 PSS.

Race/Ethnicity

Students' race/ethnicity was obtained through student responses to a two-part question. Students were asked first whether they were Hispanic or Latino, and then asked whether they were members of the following racial groups: American Indian/Alaska Native; Asian; Black, non-Hispanic; Native Hawaiian or other Pacific Islander; or White, non-Hispanic. Two or more races was derived when a student chooses more than one of the racial groups. The summed race/ethnicity percentage was derived from summing the six race/ethnicities of Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander and two or more races.

Locale

Locale was derived from the urban-centric locale code that is based on the urbanicity of the school location.

- *Central city* consists of a large territory inside an urbanized area and inside a principal city with population of 250,000 or more, midsize territory inside an urbanized area and inside a principal city with a population less than 250,000 and greater than or equal to 100,000, or small territory inside an urbanized area and inside a principal city with a population less than 100,000.
- *Suburb* consists of a large territory outside a principal city and inside an urbanized area with population of 250,000 or more, midsize territory outside a principal city and inside an urbanized area with a population less than 250,000 and greater than or equal to 100,000, or small territory outside a principal city and inside an urbanized area with a population less than 100,000.
- *Town* consists of a fringe territory inside an urban cluster that is less than or equal to 10 miles from an urbanized area, distant territory inside an urban cluster that is more than 10 miles and less than or equal to 35 miles from an urbanized area, or remote territory inside an urban cluster that is more than 35 miles from an urbanized area.
- *Rural* consists of a fringe census-defined rural territory that is less than or equal to 5 miles from an urbanized area, as well as rural territory that is less than or equal to 2.5 miles from an urban cluster, distant census-defined rural territory that is more than 5 miles but less than or equal to 25 miles from an urbanized area, as well as rural territory that is more than 2.5 miles but less than or equal to 10 miles from an urban

cluster, or remote census-defined rural territory that is more than 25 miles from an urbanized area and is also more than 10 miles from an urban cluster.

Census Region

Region is the census region of the United States. Northeast consists of Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. Midwest consists of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. South consists of Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. West consists of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

Percentage of Students Eligible for Free or Reduced-price Lunch

The proportion of students in a school eligible for the free or reduced-price lunch (FRPL) program, a federally assisted meal program under the National School Lunch Act that provides nutritionally balanced, low-cost or free lunches to eligible children each school day. The question on the CCD questionnaire asked what percentage of students at the school were eligible to receive free or reduced-price lunch through the FRPL program around October 1, 2012. It is available only for public schools as the NCES Private School Universe Survey (PSS) data do not provide the same information for private schools.

Poverty Level in Public Schools

The measure of school poverty is based on the percentage of students eligible for FRPL. Schools were classified as *low poverty* if less than 50 percent of the students were eligible for FRPL and as *high poverty* if 50 percent or more of the students were eligible. In the interest of retaining all of the schools and students in these analyses, private schools were assumed to be low-poverty schools—that is, they were assumed to be schools in which less than 50 percent of students were eligible for FRPL.

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Appendix G

TIMSS Advanced 2015 Nonresponse Bias Analysis

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APPENDIX G: TIMSS ADVANCED 2015 NONRESPONSE BIAS ANALYSIS

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APPENDIX G: TIMSS ADVANCED 2015 NONRESPONSE BIAS ANALYSIS

1. INTRODUCTION

The Trends in International Mathematics and Science Study (TIMSS) Advanced is an international comparative study of the knowledge, skills, and competencies of advanced math and physics students in the domains of mathematics and science. The study was carried out in 9 education systems, including the United States. The target population for advanced mathematics is "students in the final year of secondary schooling who have taken or were taking courses in advanced mathematics." The target population for physics is "students in the final year of secondary schooling who have taken or were taking courses in physics." The courses that define the target populations have to cover most, if not all, of the advanced mathematics and physics topics that were outlined in the *TIMSS Advanced 2015 Assessment Frameworks* (Mullis and Martin 2014).

The U.S. TIMSS Advanced 2015 study, supported by the National Center for Education Statistics (NCES), utilized a two-stage stratified cluster sampling design. The first stage made use of a systematic probability-proportionate-to-size technique to select schools. Though efforts were made to secure the participation of all schools selected in the first stage, it was anticipated that not all schools would choose to participate. Therefore, as each school was selected in the sample, the two neighboring schools in the sorted sampling frame (immediately preceding and following it) were designated as replacement schools. The sampling frame was sorted by explicit strata and secondarily by implicit strata, so the replacement schools were within the same strata as the original school. If an original school refused to participate, the first replacement was then contacted. If that school also refused to participate, the second school was then contacted.

The second stage of sampling consisted of selecting students rather than classrooms within sampled schools. The methodology was designed specifically for the United States target population and to meet international guidelines The TIMSS Advanced 2015 national data collection was fielded in March, April, and May 2015.

There were 348 schools in the original sample for advanced math (hereafter referred to as TIMSS-M). Of these 348 sampled schools, 316 were determined to be eligible [1] (the eligible original school sample) containing at least one advanced math student, and of these, 230 participated (the participating original sample) for an initial weighted response rate of 72.2 percent. An additional 11 replacement schools participated for a total of 241 participating schools after replacement (the participating final sample). The weighted response rate increased to 75.6 percent. The school participation rates for this report are summarized in table G-1.

There were 348 schools in the original sample for advanced physics (hereafter referred to as TIMSS-P). Of these 348 sampled schools, 237 were determined to be eligible[2] (the eligible original school sample) containing at least one advanced physics student, and of these, 156 participated (the participating original sample) for an initial weighted response rate of 64.9 percent. An additional 9 substitute schools participated for a total of 165 participating schools after replacement (the participating final sample). The weighted response rate increased to 69.6 percent.

[1] Of the 348 original schools selected for the sample, there were 32 excluded or ineligible schools for advanced math.
[2] Of the 348 original schools selected for the sample, there were 111 ineligible schools for advanced physics.

Table G-1. Selected characteristics for the nonresponse bias analysis of the U.S. TIMSS advanced math and physics final school samples: 2015

Subject	Schools in original sample	Eligible schools in sample	Number of participating schools		Percent	
			Before replacement	After replacement	School participation rate before replacement	School participation rate after replacement
					Weighted	Weighted
M	348	316	230	241	72.2	75.6
P	348	237	156	165	64.9	67.6

SOURCE: International Association for the Evaluation of Education Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

The weighted student response rate for TIMSS-M was 86.8 percent. The weighted student response rate for TIMSS-P was 85.4 percent.

The National Center for Education Statistics (NCES) standards for assessment surveys stipulate that a nonresponse bias analysis is required at any stage of data collection when the weighted unit response rate is less than 85 percent (before replacement). Since the U.S. TIMSS Advanced 2015 weighted school response rates for both advanced math and physics before replacement are below 85 percent, NCES requires an investigation into the potential magnitude of nonresponse bias at the school level in the U.S. sample. Since the U.S. TIMSS 2015 weighted student response rates are above 85 percent, a nonresponse bias analysis at the student level is not required. The methodology used to investigate nonresponse bias in the TIMSS-M and TIMSS-P U.S. samples is provided in chapter 2 of this appendix, and the results are provided in chapters 3 and 4.

2. METHODOLOGY

To measure the potential nonresponse bias at the school level, the characteristics of participating schools were compared to those of the total eligible sample of schools. This was conducted in a way so that the tests of statistical significance that were applied account for the fact that the participating schools are a subset of the eligible schools, and not a distinct group.

The general approach taken involves an analysis in three parts as described below.

- Analysis of the participating original sample: The distribution for TIMSS-M of the participating original school sample (N=230) was compared with that of the total eligible original school sample (N=316). The distribution for TIMSS-P of the participating original school sample (N=156) was compared with that of the total eligible original school sample (N=237). The participating original sample is the sample before substitution. In each sample, schools were weighted by their school base weights and their estimated advanced math or physics enrollment, excluding any nonresponse adjustment factor. The base weight for each original school is the reciprocal of its selection probability.

- Analysis of the participating final sample with substitutes: The distribution for TIMSS-M of the participating final school sample (N=241), which includes 11 participating substitutes that were used as replacements for nonresponding schools from the eligible original sample, was compared to the total eligible final school sample (N=316). The distribution for TIMSS-P of the participating final school sample (N=165), which includes 9 participating substitutes that were used as replacements for nonresponding schools from the eligible original sample, was compared to the total eligible final school sample (N=237). The total eligible final sample includes the participating final sample plus those original nonrespondents that were not replaced by substitutes. Again, schools were weighted by their school base weights and their estimated advanced math or physics enrollment for both the eligible sample and the participating schools. The base weight for each substitute school is set to the base weight of the original school that it replaced.

- Analysis of the nonresponse adjusted final sample with substitutes: The same sets of schools were compared as in the second analysis, but this time, when analyzing the participating final schools alone, schools were weighted by their school base weights and their estimated advanced math or physics enrollment with school nonresponse adjustments applied. The international weighting procedures form nonresponse adjustment classes by cross-classifying the explicit and implicit stratification variables.

The first analysis indicates the potential for nonresponse bias that was introduced through school nonresponse. The second analysis suggests the remaining potential for nonresponse bias after the mitigating effects of substitution have been accounted for. The third analysis indicates the potential for bias after accounting for the mitigating effects of both substitution and nonresponse weight adjustments. Both the second and third analyses, however, may provide an overly optimistic scenario, resulting from the fact that substitution and nonresponse adjustments may correct somewhat for deficiencies in the characteristics examined here, but there is no guarantee that they are equally as effective for other characteristics and, in particular, for student achievement.

Participating TIMSS schools and the total eligible TIMSS school sample were compared on as many school sampling frame characteristics as possible that might provide information about the presence of nonresponse bias. Comparing frame characteristics between participating schools and the total eligible school sample is not an ideal measure of nonresponse bias if the characteristics are unrelated or weakly related to more substantive items in the survey; however, often it is the only approach available since other data are not available for nonparticipating schools. While the school-level characteristics used in these analyses are limited to those available in the sampling frame, each of the variables had a demonstrated relationship to achievement in previous TIMSS cycles.

Frame characteristics for public schools were from the 2012-13 Common Core of Data (CCD) and, for private schools, from the 2011-12 Private School Universe Survey (PSS).

The following categorical variables were available in the sampling frame for all schools:

- AP status—indicates whether or not the school had students who took a calculus, physics, or both calculus and physics AP test in 2013;
- School control—indicates whether the school is under public control (operated by publicly elected or appointed officials) or private control (operated by privately elected or appointed officials and derives its major source of funds from private sources);
- Locale—urban-centric locale code (i.e., central city, suburb, town, rural);
- Census region—Northeast, Midwest, South and West (see Section 5. Technical Notes for state listing); and
- Poverty level[3]—for public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the national free and reduced-price lunch (FRPL) program, and a low poverty school is defined as one in which fewer than 50 percent are eligible.

The following continuous variables were available in the sampling frame for all schools:

- Estimated number of advanced math or physics students enrolled;
- Total number of students; and
- Percentage of students in seven race/ethnicity categories (White, non-Hispanic; Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander and two or more races).[4]

An additional continuous variable, the percentage of students eligible to participate in the FRPL program, was available only for public schools. The poverty level variable mentioned among the categorical variable is the recoded version of this continuous variable.[5]

[3] The sample frame did not contain a direct measure of poverty. No free or reduced-price lunch (FRPL) program data were available for private schools, thus all private schools are treated as low-poverty schools.
[4] Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin.
[5] The continuous variable percentage of students eligible to participate in the FRPL program is missing for private schools; however, private schools are treated as low poverty for the categorical variable poverty level.

For categorical variables, the distribution of frame characteristics for participating schools was compared with the distribution for all eligible schools. The hypothesis of independence between the characteristic and participation status was tested using a Rao-Scott modified Chi-square statistic at the 5 percent level (Rao and Thomas 2003). For continuous variables, summary means were calculated and the difference between means was tested using a *t* test. The *p* values for the tests are presented in the tables that follow. The statistical significance of differences between participants and the total eligible sample is identical to that which would result from comparing participants and nonparticipants, since all significance tests account for the fact that the participants are a subset of the full sample. The bias and relative bias are also shown in each table. The bias is calculated as the difference between the respective estimates for the participants and the eligible sample. The relative bias is calculated as the bias divided by the estimate from the eligible sample. The relative bias is a measure of the size of the bias compared to the eligible sample estimate.

In addition to these tests, logistic regression models were used to provide a multivariate analysis that examined the conditional independence of these school characteristics as predictors of participation. The logistic regression compared frame characteristics for participating schools with non-participating schools which is effectively the same as comparing to the eligible sample as in the bivariate analysis. It may be that only one or two variables are actually related to participation status. However, if these variables are also related to the other variables examined in the analyses, then other variables, which are not related to participation status, will appear as significant in simple bivariate tables. Dummy variables were created for each component of the categorical variables so that each component was included separately. The last component of each categorical variable is used as the reference category. The *p* value of a dummy variable indicates whether there is a significant difference at the 5 percent level from the effect of the (omitted) reference category. It is not possible to include all the frame characteristics in a single model because the seven race/ethnicity variables are linearly dependent (i.e., they sum up to 100 percent for every school). Therefore, two models were used. In the first model, six race/ethnicities (Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander; and two or more races) were included in the model with "percentage White, non-Hispanic" as the omitted category. In addition, an *F* test was used to determine whether the parameter estimates of these six characteristics were simultaneously equal to zero. In the second model, the summed percentage of the six race/ethnicities (Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander; and two or more races) replaced the six race/ethnicity variables with "percentage White, non-Hispanic" again as the omitted category. The second model permits the analysis of differences in the percentages of White, non-Hispanic students, which is not possible in the first model. All other frame characteristics were included in both models.

The logistic regression was performed using WesVar® (Westat 2007) and replicate weights to properly account for the complex sample design. The JK2 method was used to create the replicate weights (Westat 2007).

3. RESULTS—TIMSS ADVANCED MATH

3.1 Original Respondent Sample

This section presents the nonresponse bias analysis based on the original sample of 316 eligible schools for TIMSS-M. The distribution of the participating original sample was compared to the schools in the total eligible original sample. School base weights were used for both the eligible sample and the participating schools. The unweighted school response rate for TIMSS-M was 72.8 percent before replacement, with 230 out of 316 schools participating. The weighted response rate was 72.2 percent before replacement.

3.1.1 Categorical Variables (TIMSS-M)

The distribution of participating and eligible schools by the four characteristics is shown in table G-2. There are no statistically significant relationships between participation status and any of the characteristics shown in table G-2. However, the absolute value of the relative bias for rural is greater than 10 percent, which indicates potential bias for locale (table G-2).

Table G-2. Percentage distribution of eligible and participating schools in the U.S. TIMSS advanced math original sample, by selected categorical variables: 2015

School characteristic	Sample schools: Eligible (percent) (N=316)	Sample schools: Participating (percent) (N=230)	Bias	Relative bias	Chi-square *p* value
AP status					0.917
Non-AP school	15.4	15.6	0.20	0.002	
AP school	84.6	84.4	-0.20	-0.002	
School control					0.780
Public	87.0	87.5	0.48	0.006	
Private	13.0	12.5	-0.48	-0.037	
Locale					0.066
Central city	27.8	26.1	-1.70	-0.061	
Suburb	44.4	41.4	-2.95	-0.066	
Town	8.4	9.0	0.62	0.074	
Rural	19.4	23.5	4.03	0.207	
Census region					0.653
Northeast	18.3	16.7	-1.60	-0.087	
Midwest	24.1	25.6	1.46	0.061	
South	33.4	34.9	1.51	0.045	
West	24.2	22.8	-1.37	-0.057	

See notes at end of table.

Table G-2. Percentage distribution of eligible and participating schools in the U.S. TIMSS advanced math original sample, by selected categorical variables: 2015—Continued

School characteristic	Sample schools: Eligible (percent) (N=316)	Sample schools: Participating (percent) (N=230)	Bias	Relative bias	Chi-square *p* value
Poverty level					0.345
High	21.7	23.4	1.62	0.074	
Low	78.3	76.6	-1.62	-0.021	

NOTE: Detail may not sum to totals because of rounding. AP status indicates whether or not the school has students who took a relevant AP test in 2013. Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low-poverty schools. Eligible schools contained at least one advanced math student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced math enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

3.1.2 Continuous Variables (TIMSS-M)

Summary means for each continuous variable for participating and eligible schools are shown in tables G 3, G-4 and G-5. No data on FRPL eligibility were available for private schools, so private schools are not included in the FRPL analysis. Three eligible schools had missing values for free or reduced-price lunch, and these schools were dropped from the analysis in table G-5.

There were no statistically significant differences between participating and eligible schools with respect to student enrollment, race/ethnicity percentage or free or reduced-price lunch (tables G-3, G-4 and G-5). However, the absolute value of the relative bias for multiracial is greater than 10 percent (table G-4). Though for multiracial this is due mostly to the eligible percentage being less than 3.0 percent, as the absolute bias is small.

Table G-3. Mean enrollment of various characteristics for eligible and participating schools in the U.S. TIMSS advanced math original sample: 2015

Student enrollment	Sample schools: Eligible (mean) (N=316)	Sample schools: Participating (mean) (N=230)	Bias	Relative bias	*t* test *p* value
Total school	1,418.2	1,364.8	-53.38	-0.038	0.201
Advanced math	67.3	66.2	-1.06	-0.016	0.724

NOTE: Eligible schools contained at least one advanced math student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced math enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table G-4. Mean percentage of various characteristics for eligible and participating schools in the U.S. TIMSS advanced math original sample, by race/ethnicity: 2015

Race/ethnicity	Sample schools: Eligible (mean) (N=316)	Sample schools: Participating (mean) (N=230)	Bias	Relative bias	*t* test *p* value
White, non-Hispanic	58.9	59.3	0.49	0.008	0.929
Black, non-Hispanic	10.5	9.5	-1.01	-0.096	0.685
Hispanic	19.6	20.2	0.59	0.030	0.261
Asian	7.7	7.9	0.14	0.018	0.548
American Indian or Alaska Native	0.5	0.6	0.03	0.059	0.789
Hawaiian/Pacific Islander	0.2	0.2	0.00	0.021	0.507
Multiracial	2.5	2.3	-0.25	-0.100	0.834

NOTE: Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Eligible schools contained at least one advanced math student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced math enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table G-5. Mean percentage of students eligible for free or reduced-price lunch, in eligible and participating public schools in the U.S. TIMSS advanced math original sample: 2015

Students	Sample schools: Eligible (percent) (N=292)	Sample schools: Participating (percent) (N=218)	Bias	Relative bias	*t* test *p* value
Percentage of students eligible for free or reduced-price lunch	34.5	35.7	1.19	0.035	0.286

NOTE: Information on percentage of students eligible for free or reduced-price lunch is missing for three of the 295 eligible public schools in the sample. Eligible schools contained at least one advanced math student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced math enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

3.1.3 Logistic Regression Model (TIMSS-M)

To examine the joint relationship of various characteristics to school nonresponse, the analysis used a logistic regression model with participation status as the binary dependent variable and frame characteristics as predictor variables. Since public and private schools were modeled together using the variables available for all schools, the percentage of students eligible for free or reduced-price lunch was not included in the main logistic regression analysis.

Standard errors and tests of hypotheses for the full model parameter estimates are presented in table G-6 (with six race/ethnicity variables) and table G-7 (with summed race/ethnicity percentage). Private schools are treated as low poverty for the categorical variable poverty level. None of the parameter estimates are

significant in table G-6. The *F* test statistic to determine whether the race/ethnicity characteristics are simultaneously equal to 0 was 0.39 with a *p* value of 0.852, which indicates that no significant relationship with participation was detected. None of the parameter estimates are significant in table G-7.

Because the percentage of students eligible for free or reduced-price lunch was not included in the main logistic regression analysis, a separate analysis with public schools only was conducted. To include free or reduced-price lunch eligibility in a model, public schools were modeled separately using a model with the summed race/ethnicity percentage and adding the percentage of students eligible for free or reduced-price lunch. Since poverty is derived from the percentage of students eligible for free or reduced-price lunch, an interaction term[6] was also included in the model. Standard errors and tests of hypotheses for the full model parameter estimates are presented in table G-8. There were no significant predictors of school participation among public schools only in table G-8.

Table G-6. Logistic regression model parameters (with six race/ethnicity variables) using the U.S. TIMSS advanced math original school sample: 2015

Parameter	Parameter estimate	Standard error	t test for H0: parameter = 0	*p* value
Intercept	1.445	0.8443	1.7120	0.0910
Non-AP school	-0.612	0.5749	-1.0648	0.2904
Private school	-0.399	0.5563	-0.7164	0.4760
Central city	0.008	0.6391	0.0127	0.9899
Suburb	0.970	0.6457	1.5028	0.1371
Town	-0.117	0.6471	-0.1803	0.8574
Northeast	-0.361	0.7148	-0.5051	0.6149
Midwest	0.570	0.7100	0.8022	0.4250
South	0.553	0.5752	0.9620	0.3391
High poverty	0.436	0.4544	0.9605	0.3399
Total school enrollment	0.000	0.0003	-1.3571	0.1788
Advanced math enrollment	0.002	0.0036	0.6314	0.5297
Black, non-Hispanic	-0.017	0.0132	-1.2514	0.2147
Hispanic	0.004	0.0118	0.3753	0.7085
Asian	0.011	0.0202	0.5324	0.5961
American Indian or Alaska Native	0.097	0.6267	0.1541	0.8779
Hawaiian/Pacific Islander	0.150	0.5790	0.2596	0.7959
Multiracial	-0.123	0.0717	-1.7122	0.0910

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced math enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

[6] The interaction term can be interpreted as indicating whether the marginal effect of a one percentage-point increase in FRPL is diminished or amplified for schools above the 50 percent cut point, relative to those below the cut point.

Table G-7. Logistic regression model parameters (with summed race/ethnicity percentage) using the U.S. TIMSS advanced math original school sample: 2015

Parameter	Parameter estimate	Standard error	t test for H0: parameter = 0	*p* value
Intercept	1.430	0.6785	2.1070	0.0385
Non-AP school	-0.516	0.5745	-0.8988	0.3717
Private school	-0.496	0.4883	-1.0158	0.3130
Central city	-0.385	0.5810	-0.6634	0.5091
Suburb	0.798	0.6581	1.2121	0.2293
Town	-0.376	0.5942	-0.6323	0.5291
Northeast	-0.271	0.5937	-0.4559	0.6498
Midwest	0.280	0.5733	0.4889	0.6263
South	0.291	0.4824	0.6040	0.5477
High poverty	0.656	0.4998	1.3134	0.1931
Total school enrollment	0.000	0.0003	-1.3154	0.1924
Advanced math enrollment	0.003	0.0031	0.9336	0.3535
Summed race/ethnicity percentage	-0.002	0.0079	-0.2164	0.8293

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Summed race/ethnicity percentage includes Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander; and two or more races. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced math enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table G-8. Logistic regression model parameters (with summed race/ethnicity percentage) using the U.S. TIMSS advanced math original public school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H0: parameter = 0	*p* value
Intercept	1.720	0.8379	2.0525	0.0436
Non-AP school	-0.287	0.6941	-0.4134	0.6805
Central city	-0.075	0.6511	-0.1146	0.9091
Suburb	0.378	0.7019	0.5388	0.5916
Town	-0.069	0.6416	-0.1070	0.9151
Northeast	-0.583	0.6494	-0.8984	0.3718
Midwest	0.079	0.6074	0.1296	0.8973
South	0.617	0.5256	1.1748	0.2438
High poverty	0.693	2.5839	0.2683	0.7892
Free or reduced-price lunch eligibility	0.021	0.0146	1.4055	0.1640
High poverty * free or reduced-price lunch eligibility	-0.010	0.0408	-0.2454	0.8068
Total school enrollment	0.000	0.0003	-1.0728	0.2868
Advanced math enrollment	0.003	0.0032	0.9206	0.3602
Summed race/ethnicity percentage	-0.012	0.0074	-1.5961	0.1147

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program. Summed race/ethnicity percentage includes Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander; and two or more races. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced math enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

3.2 Participating Final Sample with Substitutes

This section presents the nonresponse bias analysis based on the final sample of 316 eligible schools for TIMSS-M including participating substitute schools. The distribution of the participating final sample was compared to the schools in the total eligible final sample. The total eligible final sample includes participating final sample plus those original nonrespondents who were not replaced by substitutes. School base weights were used for both the eligible sample and the participating schools. Through the use of substitute schools, the unweighted school response rate for TIMSS-M was 76.3 percent after replacement, with 241 out of 316 schools participating. The weighted response rate was 75.6 percent after replacement.

3.2.1 Categorical Variables (TIMSS-M)

The distribution of participating and eligible schools by the four characteristics is shown in table G-9. There are no statistically significant relationships between participation status and any of the characteristics shown in table G-9. However, the absolute value of the relative bias for town, rural, and Northeast region is greater than 10 percent, which indicates potential bias for locale and Census region (table G-9).

Table G-9. Percentage distribution of eligible and participating schools in the U.S. TIMSS advanced math final sample, by selected categorical variables: 2015

School characteristic	Sample schools: Eligible (percent) (N=316)	Sample schools: Participating (percent) (N=241)	Bias	Relative bias	Chi-square *p* value
AP status					0.843
Non-AP school	15.1	14.8	-0.37	-0.024	
AP school	84.9	85.2	0.37	0.004	
School control					0.905
Public	87.5	87.7	0.20	0.002	
Private	12.5	12.3	-0.20	-0.016	
Locale					0.050
Central city	28.0	27.0	-0.93	-0.033	
Suburb	43.5	39.9	-3.64	-0.084	
Town	8.9	10.1	1.11	0.124	
Rural	19.6	23.0	3.47	0.177	
Census region					0.397
Northeast	18.0	15.9	-2.19	-0.121	
Midwest	24.2	25.9	1.71	0.071	
South	34.2	36.3	2.10	0.061	
West	23.5	21.9	-1.63	-0.069	

See notes at end of table.

Table G-9. Percentage distribution of eligible and participating schools in the U.S. TIMSS advanced math final sample, by selected categorical variables: 2015—Continued

School characteristic	Sample schools: Eligible (percent) (N=316)	Sample schools: Participating (percent) (N=241)	Bias	Relative bias	Chi-square *p* value
Poverty level					0.399
High	21.1	22.5	1.39	0.066	
Low	78.9	77.5	-1.39	-0.018	

NOTE: Detail may not sum to totals because of rounding. AP status indicates whether or not the school has students who took a relevant AP test in 2013. Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Eligible schools contained at least one advanced math student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced math enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

3.2.2 Continuous Variables (TIMSS-M)

Summary means for each continuous variable for participating and eligible schools are shown in tables G-10, G-11, and G-12. No data on FRPL eligibility was available for private schools, and so private schools are not included in the FRPL analysis. Three eligible schools had missing values for free or reduced-price lunch, and these schools were dropped from the analysis in table G-12.

There were no statistically significant differences between participating and eligible schools with respect to student enrollment, race/ethnicity percentage or free or reduced-price lunch (tables G-10, G-11, and G-12).

Table G-10. Mean enrollment of various characteristics for eligible and participating schools in the U.S. TIMSS advanced math final sample: 2015

Student enrollment	Sample schools: Eligible (mean) (N=316)	Sample schools: Participating (mean) (N=241)	Bias	Relative bias	*t* test *p* value
Total school	1,420.6	1,381.3	-39.27	-0.028	0.315
Advanced math	69.0	68.2	-0.80	-0.012	0.775

NOTE: Eligible schools contained at least one advanced math student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced math enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table G-11. Mean percentage of various characteristics for eligible and participating schools in the U.S. TIMSS advanced math final sample, by race/ethnicity: 2015

Race/ethnicity	Sample schools: Eligible (mean) (N=316)	Sample schools: Participating (mean) (N=241)	Bias	Relative bias	*t* test *p* value
White, non-Hispanic	59.5	60.3	0.88	0.015	0.776
Black, non-Hispanic	10.3	9.3	-1.02	-0.099	0.457
Hispanic	19.2	19.5	0.34	0.017	0.246
Asian	7.8	7.7	-0.02	-0.003	0.722
American Indian or Alaska Native	0.5	0.5	0.02	0.035	0.967
Hawaiian/Pacific Islander	0.2	0.2	0.00	0.003	0.672
Multiracial	2.6	2.4	-0.19	-0.074	0.974

NOTE: Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Eligible schools contained at least one advanced math student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced math enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table G-12. Mean percentage of students eligible for free or reduced-price lunch, in eligible and participating public schools in the U.S. TIMSS advanced math final sample: 2015

Students	Sample schools: Eligible (percent) (N=292)	Sample schools: Participating (percent) (N=228)	Bias	Relative bias	*t* test *p* value
Percentage of students eligible for free or reduced-price lunch	29.5	31.3	1.84	0.063	0.284

NOTE: Information on percentage of students eligible for free or reduced-price lunch is missing for three of the 295 eligible public schools in the sample. Eligible schools contained at least one advanced math student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced math enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

3.2.3 Logistic Regression Model (TIMSS-M)

To examine the joint relationship of various characteristics to school nonresponse, the analysis used a logistic regression model with participation status as the binary dependent variable and frame characteristics as predictor variables. Since public and private schools were modeled together using the variables available for all schools, the percentage of students eligible for free or reduced-price lunch was not included in the main logistic regression analysis.

Standard errors and tests of hypotheses for the full model parameter estimates are presented in table G-13 (with six race/ethnicity variables) and table G-14 (with summed race/ethnicity percentage). Private schools are treated as low poverty for the categorical variable poverty level. None of the parameter estimates are significant in table G-13. The *F* test statistic to determine whether the race/ ethnicity characteristics are simultaneously equal to 0 was 0.52 with a *p* value of 0.763, which indicates no

significant relationship was detected with participation. None of the parameter estimates are significant in table G-14.

Because the percentage of students eligible for free or reduced-price lunch was not included in the main logistic regression analysis, a separate analysis with public schools only was conducted. To include free or reduced-price lunch eligibility in a model, public schools were modeled separately using a model with the summed race/ethnicity percentage and adding the percentage of students eligible for free or reduced-price lunch. Since poverty is derived from the percentage of students eligible for free or reduced-price lunch, an interaction term was also included in the model. Standard errors and tests of hypotheses for the full model parameter estimates are presented in table G-15. None of the parameter estimates are significant in table G-15. The model with the six race/ethnicity variables is not shown due to complex interactions that make the results difficult to interpret.

Table G-13. Logistic regression model parameters (with six race/ethnicity variables) using the U.S. TIMSS advanced math final school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H_0: parameter = 0	*p* value
Intercept	1.731	0.8685	1.9925	0.0500
Non-AP school	-0.794	0.5734	-1.3842	0.1704
Private school	-0.284	0.6701	-0.4242	0.6727
Central city	-0.267	0.6503	-0.4099	0.6831
Suburb	0.642	0.6384	1.0058	0.3178
Town	-0.550	0.6528	-0.8420	0.4024
Northeast	-0.302	0.7282	-0.4147	0.6796
Midwest	0.766	0.7891	0.9709	0.3347
South	0.798	0.6303	1.2657	0.2095
High poverty	0.611	0.4767	1.2809	0.2042
Total school enrollment	0.000	0.0003	-1.0041	0.3186
Advanced math enrollment	0.001	0.0035	0.4188	0.6765
Black, non-Hispanic	-0.020	0.0130	-1.5662	0.1215
Hispanic	0.002	0.0122	0.1804	0.8574
Asian	0.008	0.0198	0.3863	0.7003
American Indian or Alaska Native	0.071	0.4602	0.1534	0.8785
Hawaiian/Pacific Islander	0.191	0.6118	0.3121	0.7558
Multiracial	-0.103	0.0725	-1.4173	0.1605

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced math enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table G-14. Logistic regression model parameters (with summed race/ethnicity percentage) using the U.S. TIMSS advanced math final school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H_0: parameter = 0	*p* value
Intercept	1.798	0.7156	2.5121	0.0142
Non-AP school	-0.705	0.5721	-1.2322	0.2217
Private school	-0.384	0.6072	-0.6321	0.5293
Central city	-0.610	0.6226	-0.9794	0.3305

See notes at end of table.

Table G-14. Logistic regression model parameters (with summed race/ethnicity percentage) using the U.S. TIMSS advanced math final school sample: 2015—Continued

Parameter	Parameter estimate	Standard error	*t* test for H_0: parameter = 0	*p* value
Suburb	0.505	0.6771	0.7462	0.4579
Town	-0.763	0.6158	-1.2393	0.2191
Northeast	-0.298	0.604	-0.4931	0.6234
Midwest	0.402	0.619	0.6498	0.5178
South	0.468	0.5384	0.8691	0.3876
High poverty	0.797	0.5313	1.5002	0.1378
Total school enrollment	0.000	0.0003	-0.8981	0.3720
Advanced math enrollment	0.002	0.0031	0.6915	0.4914
Summed race/ethnicity percentage	-0.005	0.008	-0.5842	0.5608

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced math enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table G-15. Logistic regression model parameters (with summed race/ethnicity percentage) using the U.S. TIMSS advanced math final public school sample: 2015

Parameter	Parameter estimate	Standard error	t test for H0: parameter = 0	*p* value
Intercept	1.473	0.7952	1.8525	0.0679
Non-AP school	-0.478	0.6937	-0.6892	0.4928
Central city	-0.465	0.6319	-0.7365	0.4637
Suburb	-0.063	0.7128	-0.0878	0.9303
Town	-0.494	0.6363	-0.7764	0.4400
Northeast	-0.603	0.6337	-0.9517	0.3443
Midwest	0.249	0.6289	0.3952	0.6938
South	0.677	0.5602	1.2086	0.2306
High poverty	1.341	2.9505	0.4545	0.6508
Free or reduced-price lunch eligibility	0.023	0.0157	1.4944	0.1393
High poverty * free or reduced-price lunch eligibility	-0.020	0.0454	-0.4457	0.6571
Total school enrollment	0.000	0.0003	-0.7083	0.4809
Advanced math enrollment	0.002	0.0033	0.6126	0.5420
Summed race/ethnicity percentage	-0.014	0.0073	-1.8487	0.0684

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced math enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

3.3 Nonresponse-adjusted Final Sample with Substitutes

This section presents the nonresponse bias analysis based on the final sample of 316 eligible schools for TIMSS-M. The distribution of the participating final sample, including participating substitute schools,

was compared to the schools in the total eligible final sample, just like the previous section. However, in the analyses that follow, school base weights were used for the eligible sample of schools, whereas nonresponse-adjusted weights were used for the participating schools.

3.3.1 Categorical Variables (TIMSS-M)

The distribution of participating and eligible schools by the four characteristics is shown in table G-16. There are no statistically significant relationships between participation status and any of the characteristics shown in table G-16. However, the absolute value of the relative bias for town and rural is greater than 10 percent, which indicates potential bias for locale (table G-16).

Table G-16. Percentage distribution of eligible and participating schools in the U.S. TIMSS advanced math nonresponse-adjusted sample, by selected categorical variables: 2015

	Sample schools				
School characteristic	Eligible (percent) (N=316)	Participating (percent) (N=241)	Bias	Relative bias	Chi-square *p* value
AP status					0.795
Non-AP school	15.1	14.7	-0.49	-0.032	
AP school	84.9	85.3	0.49	0.006	
School control					0.559
Public	87.5	86.3	-1.17	-0.013	
Private	12.5	13.7	1.17	0.094	
Locale					0.069
Central city	28.0	26.8	-1.14	-0.041	
Suburb	43.5	40.1	-3.50	-0.080	
Town	8.9	9.9	0.92	0.103	
Rural	19.6	23.3	3.72	0.190	
Census region					0.865
Northeast	18.0	18.9	0.83	0.046	
Midwest	24.2	25.0	0.83	0.034	
South	34.2	32.4	-1.77	-0.052	
West	23.5	23.7	0.12	0.005	
Poverty level					0.446
High	21.1	22.4	1.29	0.061	
Low	78.9	77.6	-1.29	-0.016	

NOTE: Detail may not sum to totals because of rounding. AP status indicates whether or not the school has students who took a relevant AP test in 2013. Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Eligible schools contained at least one advanced math student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school nonresponse adjusted weight and by their estimated advanced math enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

3.3.2 Continuous Variables (TIMSS-M)

Summary means for each continuous variable for participating and eligible schools are shown in tables G-17, G-18 and G-19. No data on FRPL eligibility was available for private schools, and so private schools are not included in the FRPL analysis. Three eligible schools had missing values for free or reduced-price lunch, and these schools were dropped from the analysis in table G-19.

There were no statistically significant differences between participating and eligible schools with respect to student enrollment, race/ethnicity percentage or free or reduced-price lunch (tables G-17, G-18, and G-19). However, the absolute values of the relative bias for Black, non-Hispanic is greater than 10 percent (table G-18).

Table G-17. Mean enrollment of various characteristics for eligible and participating schools in the U.S. TIMSS advanced math nonresponse-adjusted sample: 2015

	Sample schools				
Student enrollment	Eligible (mean) (N=316)	Participating (mean) (N=241)	Bias	Relative bias	*t* test *p* value
Total school	1,420.6	1,362.4	-58.12	-0.041	0.152
Advanced math	69.0	66.8	-2.18	-0.032	0.401

NOTE: Eligible schools contained at least one advanced math student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school nonresponse adjusted weight and by their estimated advanced math enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table G-18. Mean percentage of various characteristics for eligible and participating schools in the U.S. TIMSS advanced math nonresponse-adjusted sample, by race/ethnicity: 2015

	Sample schools				
Race/ethnicity	Eligible (mean) (N=316)	Participating (mean) (N=241)	Bias	Relative bias	*t* test *p* value
White, non-Hispanic	59.5	60.7	1.22	0.021	0.521
Black, non-Hispanic	10.3	8.9	-1.46	-0.142	0.309
Hispanic	19.2	19.4	0.24	0.012	0.094
Asian	7.8	8.0	0.21	0.027	0.804
American Indian or Alaska Native	0.5	0.5	0.01	0.016	0.707
Hawaiian/Pacific Islander	0.2	0.2	0.01	0.028	0.847
Multiracial	2.6	2.3	-0.22	-0.086	0.792

NOTE: Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Eligible schools contained at least one advanced math student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school nonresponse adjusted weight and by their estimated advanced math enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table G-19. Mean percentage of students eligible for free or reduced-price lunch, in eligible and participating public schools in the U.S. TIMSS advanced math nonresponse-adjusted sample: 2015

Students	Sample schools: Eligible (percent) (N=292)	Sample schools: Participating (percent) (N=228)	Bias	Relative bias	*t* test *p* value
Percentage of students eligible for free or reduced-price lunch	29.5	30.9	1.43	0.049	0.420

NOTE: Information on percentage of students eligible for free or reduced-price lunch is missing for three of the 295 eligible public schools in the sample. Eligible schools contained at least one advanced math student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school nonresponse adjusted weights and by their estimated advanced math enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

3.4 Summary—Advanced Math

The investigation into nonresponse bias at the school level for the U.S. TIMSS-M effort shows no statistically significant relationships between response status and all of the available school characteristics that were examined in the analysis.

For original sample schools, no variables were found to be statistically significantly related to participation in the bivariate analysis. However, the absolute value of the relative bias for rural and multiracial is greater than 10 percent (tables G-2 and G-4, respectively), which indicates potential bias even though no statistically significant relationship was detected. Although each of these findings indicates some potential for nonresponse bias, when all of these factors were considered simultaneously in a regression analysis, none of the parameter estimates are significant predictors of participation (tables G-6 and G-7, with summed race/ethnicity percentage, G-8). None of the parameter estimates are significant predictors of participation among public schools only (table G-8).

For final sample schools (with substitutes), no variables were found to be statistically significantly related to participation in the bivariate analysis. However, the absolute value of the relative bias for town, rural, and Northeast region is greater than 10 percent (table G-9), which indicates potential bias even though no statistically significant relationship was detected. When all of these factors were considered simultaneously in a regression analysis, none of the parameter estimates are significant predictors of participation (tables G-13 and G-14, with summed race/ethnicity percentage). None of the parameter estimates are significant predictors of participation among public schools only (table G-15).

For final sample schools with school nonresponse adjustments applied to the weights, no variables were found to be statistically significantly related to participation in the bivariate analysis. However, the absolute value of the relative bias for town, rural, and Black, non-Hispanic is greater than 10 percent, (tables G-16 and G-18), which indicates potential bias even though no statistically significant relationship was detected. The multivariate regression analysis cannot be conducted after the school nonresponse adjustments are applied to the weights. The concept of nonresponse-adjusted weights does not apply to the nonresponding units, and, thus, we cannot conduct an analysis that compares respondents with nonrespondents using nonresponse-adjusted weights.

The results of the analyses are summarized in table G-20.

Table G-20. Characteristics with *p* values less than 0.05 and absolute relative bias greater than 10 percent, U.S. TIMSS advanced math schools: 2015

Analysis	Characteristics with *p* values less than 0.05	Additional characteristics with absolute relative bias greater than 10 percent
Original sample	None	Rural, multiracial
Regression model a	None	†
Regression model b	None	†
Regression model c	None	†
Sample with substitutes	None	Town, rural, Northeast region
Regression model a	None	†
Regression model b	None	†
Regression model c	None	†
Nonresponse adjusted	None	Town, rural, Black non-Hispanic

† Not applicable.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Note that the standard errors for both advanced math and physics are generally much larger than for grades 4 and 8. This means some large biases could have been significant had the standard errors been in line with grades 4 and 8. This was likely due to having a measure of size for school sampling (grade 12 enrollment) that was not a good measure of the true number of advanced students. Additionally, the estimated advanced math and physics enrollments (used as the measure of school size for conducting these nonresponse bias analyses) were not always a good measure of the true number of advanced students.

These results suggest that there is little potential for nonresponse bias in the U.S. TIMSS-M original sample based on the characteristics studied. It also suggests that, while there is some evidence that the use of substitute schools has not reduced the potential for bias, it has not added to it substantially. Moreover, after the application of school nonresponse adjustments, there is little evidence of resulting potential bias in the available frame variables and correlated variables in the final sample. Given there is limited statistical power due to larger standard errors as mentioned above, the possibility of meaningful bias cannot be ruled out by the lack of statistically significant results.

4. RESULTS—TIMSS ADVANCED PHYSICS

4.1 Original Respondent Sample

This section presents the nonresponse bias analysis based on the original sample of 237 eligible schools for TIMSS-P. The distribution of the participating original sample was compared to the schools in the total eligible original sample. School base weights were used for both the eligible sample and the participating schools. The unweighted school response rate for TIMSS-P was 65.8 percent before replacement, with 156 out of 237 schools participating. The weighted response rate was 64.9 percent before replacement.

4.1.1 Categorical Variables (TIMSS-P)

The distribution of participating and eligible schools by the four characteristics is shown in table G-21. There are no statistically significant relationships between participation status and any of the characteristics shown in table G-21. However, the absolute value of the relative bias for non-AP, private, central city, suburb, town, rural, Northeast, Midwest, South, and high poverty is greater than 10 percent, which indicates potential bias for AP schools, school control, locale, Census region, and poverty level, respectively (table G-21). Note that the relative bias for private and non-AP schools is much higher than for public and AP schools, respectively, due to the binary nature of the variable as the absolute bias is the same for both categories.

Table G-21. Percentage distribution of eligible and participating schools in the U.S. TIMSS advanced physics original sample, by selected categorical variables: 2015

	Sample schools				
School characteristic	Eligible (percent) (N=237)	Participating (percent) (N=156)	Bias	Relative bias	Chi-square *p* value
AP status					0.316
Non-AP school	4.9	3.5	-1.44	-0.292	
AP school	95.1	96.5	1.44	0.015	
School control					0.673
Public	91.2	92.3	1.07	0.012	
Private	8.8	7.7	-1.07	-0.122	
Locale					0.082
Central city	32.7	37.6	4.89	0.150	
Suburb	52.1	46.2	-5.93	-0.114	
Town	4.1	2.6	-1.54	-0.373	
Rural	11.1	13.6	2.58	0.233	
Census region					0.122
Northeast	18.8	15.5	-3.27	-0.174	
Midwest	22.9	19.8	-3.09	-0.135	
South	31.4	39.0	7.61	0.243	
West	27.0	25.7	-1.24	-0.046	

See notes at end of table.

Table G-21. Percentage distribution of eligible and participating schools in the U.S. TIMSS advanced physics original sample, by selected categorical variables: 2015—Continued

School characteristic	Sample schools: Eligible (percent) (N=237)	Sample schools: Participating (percent) (N=156)	Bias	Relative bias	Chi-square *p* value
Poverty level					0.253
High	17.6	20.1	2.43	0.138	
Low	82.4	79.9	-2.43	-0.030	

NOTE: Detail may not sum to totals because of rounding. AP status indicates whether or not the school has students who took a relevant AP test in 2013. Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low-poverty schools Eligible schools contained at least one advanced physics student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced physics enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

4.1.2 Continuous Variables (TIMSS-P)

Summary means for each continuous variable for participating and eligible schools are shown in tables G-22, G-23 and G-24. No data on FRPL eligibility was available for private schools, and so private schools are not included in the FRPL analysis. Two eligible schools had missing values for free or reduced-price lunch, and these schools were dropped from the analysis in table G-24.

There were no statistically significant differences between participating and eligible schools with respect to student enrollment, race/ethnicity percentage or free or reduced-price lunch (tables G-22, G-23 and G-24). However, the absolute value of the relative bias for advanced physics enrollment, Black, non-Hispanic, and multiracial is greater than 10 percent (tables G-22 and G-23, respectively). Though for multiracial this is due mostly to the eligible percentage being less than 3.0 percent, as the absolute bias is small.

Table G-22. Mean enrollment of various characteristics for eligible and participating schools in the U.S. TIMSS advanced physics original sample: 2015

Student enrollment	Sample schools: Eligible (mean) (N=237)	Sample schools: Participating (mean) (N=156)	Bias	Relative bias	*t* test *p* value
Total school	1,704.4	1,659.5	-44.81	-0.026	0.557
Advanced physics	54.0	46.9	-7.09	-0.131	0.462

NOTE: Eligible schools contained at least one advanced physics student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced physics enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table G-23. Mean percentage of various characteristics for eligible and participating schools in the U.S. TIMSS advanced physics original sample, by race/ethnicity: 2015

Race/ethnicity	Sample schools: Eligible (mean) (N=237)	Sample schools: Participating (mean) (N=156)	Bias	Relative bias	*t* test *p* value
White, non-Hispanic	54.3	51.5	-2.78	-0.051	0.139
Black, non-Hispanic	14.9	17.4	2.42	0.162	0.125
Hispanic	19.3	20.6	1.32	0.068	0.295
Asian	8.0	7.5	-0.57	-0.071	0.403
American Indian or Alaska Native	0.6	0.5	-0.04	-0.069	0.653
Hawaiian/Pacific Islander	0.2	0.2	-0.02	-0.092	0.334
Multiracial	2.7	2.4	-0.34	-0.125	0.080

NOTE: Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Eligible schools contained at least one advanced physics student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced physics enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table G-24. Mean percentage of students eligible for free or reduced-price lunch, in eligible and participating public schools in the U.S. TIMSS advanced physics original sample: 2015

Students	Sample schools: Eligible (percent) (N=219)	Sample schools: Participating (percent) (N=146)	Bias	Relative bias	*t* test *p* value
Percentage of students eligible for free or reduced-price lunch	30.1	32.0	1.85	0.061	0.317

NOTE: Information on percentage of students eligible for free or reduced-price lunch is missing for two of the 221 eligible public schools in the sample and one of the 147 public schools that participated. Eligible schools contained at least one advanced physics student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced physics enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

4.1.3 Logistic Regression Model (TIMSS-P)

To examine the joint relationship of various characteristics to school nonresponse, the analysis used a logistic regression model with participation status as the binary dependent variable and frame characteristics as predictor variables. Since public and private schools were modeled together using the variables available for all schools, the percentage of students eligible for free or reduced-price lunch was not included in the main logistic regression analysis.

Standard errors and tests of hypotheses for the full model parameter estimates are presented in table G-25 (with six race/ethnicity variables) and table G-26 (with summed race/ethnicity percentage). Private schools are treated as low poverty for the categorical variable poverty level. Non-AP schools, central city, suburb and multiracial were significant predictors of school participation in table G-25. The negative parameter estimate indicates that relative to AP schools, Non-AP schools were somewhat

underrepresented among the participating schools and that the percentage of multiracial students in participating schools were smaller than in all eligible schools. The positive parameter estimate indicates that relative to schools in rural areas, schools in central cities and suburbs were somewhat overrepresented among the participating schools. The *F* test statistic to determine whether the race/ethnicity characteristics are simultaneously equal to 0 was 0.46 with a *p* value of 0.808, which indicates that no significant relationship with participation was detected.

Central city, suburb, and South region were significant predictors of school participation in table G-26. The positive parameter estimates indicate that relative to schools in the West region, schools in the South region were somewhat overrepresented among the participating schools. The parameter estimates for central city and suburb remained positive as in table G-25.

Because the percentage of students eligible for free or reduced-price lunch was not included in the main logistic regression analysis, a separate analysis with public schools only was conducted. To include free or reduced-price lunch eligibility in a model, public schools were modeled separately using a model with the summed race/ethnicity percentage and adding the percentage of students eligible for free or reduced-price lunch. Since poverty is derived from the percentage of students eligible for free or reduced-price lunch, an interaction term[7] was also included in the model. Standard errors and tests of hypotheses for the full model parameter estimates are presented in table G-27. Central city and South region were significant predictors of school participation among public schools only. The parameter estimates for central city and South region remained positive as in as in tables G-25 and G-26. The model with the six race/ethnicity variables is not shown due to complex interactions that make the results difficult to interpret.

Table G-25. Logistic regression model parameters (with six race/ethnicity variables) using the U.S. TIMSS advanced physics original school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H_0: parameter = 0	*p* value
Intercept	0.713	1.1091	0.6432	0.5220
Non-AP school	-2.059	1.0091	-2.0400	**0.0449**
Private school	-0.624	0.9843	-0.6335	0.5283
Central city	2.059	0.8166	2.5214	**0.0138**
Suburb	2.193	0.9230	2.3757	**0.0201**
Town	1.330	0.7817	1.7018	0.0929
Northeast	-1.351	0.8910	-1.5166	0.1336
Midwest	-0.773	0.8513	-0.9077	0.3669
South	0.637	0.7102	0.8970	0.3726
High poverty	0.258	0.6617	0.3897	0.6979
Total school enrollment	0.000	0.0003	-0.7093	0.4803
Advanced physics enrollment	-0.004	0.0041	-0.8689	0.3877
Black, non-Hispanic	0.007	0.0139	0.5308	0.5971
Hispanic	-0.005	0.0124	-0.4148	0.6795
Asian	0.002	0.0233	0.0959	0.9239
American Indian or Alaska Native	-0.058	0.0872	-0.6702	0.5048
Hawaiian/Pacific Islander	-0.720	0.6152	-1.1697	0.2458
Multiracial	-0.209	0.1046	-1.9980	**0.0493**

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced physics enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

[7] The interaction term can be interpreted as indicating whether the marginal effect of a one percentage-point increase in FRPL is diminished or amplified for schools above the 50 percent cut point, relative to those below the cut point.

Table G-26. Logistic regression model parameters (with summed race/ethnicity percentage) using the U.S. TIMSS advanced physics original school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H0: parameter = 0	*p* value
Intercept	-0.610	1.0298	-0.5920	0.5556
Non-AP school	-1.730	0.9723	-1.7790	0.0793
Private school	-0.834	0.9485	-0.8793	0.3820
Central city	2.005	0.8996	2.2291	0.0288
Suburb	2.277	1.0745	2.1189	0.0374
Town	1.201	0.8699	1.3811	0.1714
Northeast	-0.260	0.6605	-0.3938	0.6949
Midwest	-0.019	0.6946	-0.0275	0.9781
South	1.218	0.6011	2.0261	0.0463
High poverty	0.414	0.6671	0.6202	0.5370
Total school enrollment	0.000	0.0003	-0.9251	0.3579
Advanced physics enrollment	-0.002	0.0054	-0.3244	0.7465
Summed race/ethnicity percentage	0.003	0.011	0.2453	0.8069

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced physics enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table G-27. Logistic regression model parameters (with summed race/ethnicity percentage) using the U.S. TIMSS advanced physics original public school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H0: parameter = 0	*p* value
Intercept	-0.230	1.3061	-0.1760	0.8608
Non-AP school	-1.633	1.0160	-1.6068	0.1123
Central city	2.306	1.0088	2.2854	**0.0251**
Suburb	1.745	1.0142	1.7202	0.0895
Town	1.219	0.9778	1.2464	0.2165
Northeast	-0.449	0.7120	-0.6307	0.5301
Midwest	-0.155	0.7405	-0.2087	0.8352
South	1.513	0.6497	2.3283	**0.0226**
High poverty	-1.633	1.8192	-0.8978	0.3722
Free or reduced-price lunch eligibility	-0.010	0.0241	-0.4296	0.6687
High poverty * free or reduced-price lunch eligibility	0.038	0.0330	1.1644	0.2480
Total school enrollment	0.000	0.0004	-0.7303	0.4675
Advanced physics enrollment	-0.003	0.0052	-0.5426	0.5890
Summed race/ethnicity percentage	-0.003	0.0149	-0.1854	0.8534

NOTE: Information on percentage of students eligible for free or reduced-price lunch is missing for two of the 221 eligible public schools in the sample, so these two schools were dropped from the regression. Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced physics enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

4.2 Participating Final Sample with Substitutes

This section presents the nonresponse bias analysis based on the final sample of 237 eligible schools for TIMSS-P including participating substitute schools. The distribution of the participating final sample was compared to the schools in the total eligible final sample. The total eligible final sample includes participating final sample plus those original nonrespondents who were not replaced by substitutes. School base weights were used for both the eligible sample and the participating schools. Through the use of substitute schools, the unweighted school response rate for TIMSS-P was 69.6 percent after replacement, with 165 out of 237 schools participating. The weighted response rate was also 67.6 percent after replacement.

4.2.1 Categorical Variables (TIMSS-P)

The distribution of participating and eligible schools by the four characteristics is shown in table G-28. There are no statistically significant relationships between participation status and any of the characteristics shown in table G-28. However, the absolute value of the relative bias for non-AP, private, central city, suburb, town, rural, Northeast, Midwest, South, and high poverty is greater than 10 percent, which indicates potential bias for AP schools, school control, locale, Census region, and poverty level, respectively (table G-28). Note that the relative bias for private and non-AP schools is much higher than for public and AP schools, respectively, due to the binary nature of the variable as the absolute bias is the same for both categories.

Table G-28. Percentage distribution of eligible and participating schools in the U.S. TIMSS advanced physics final sample, by selected categorical variables: 2015

	Sample schools				
School characteristic	Eligible (percent) (N=237)	Participating (percent) (N=165)	Bias	Relative bias	Chi-square *p* value
AP status					0.271
Non-AP school	4.8	3.3	-1.52	-0.314	
AP school	95.2	96.7	1.52	0.016	
School control					0.592
Public	91.4	92.7	1.28	0.014	
Private	8.6	7.3	-1.28	-0.149	
Locale					0.088
Central city	33.2	38.0	4.82	0.145	
Suburb	51.4	45.2	-6.21	-0.121	
Town	4.1	2.8	-1.26	-0.308	
Rural	11.4	14.0	2.65	0.233	
Census region					0.089
Northeast	18.5	14.8	-3.68	-0.199	
Midwest	23.1	20.4	-2.68	-0.116	
South	32.0	39.7	7.75	0.242	
West	26.5	25.1	-1.39	-0.052	

See notes at end of table.

Table G-28. Percentage distribution of eligible and participating schools in the U.S. TIMSS advanced physics final sample, by selected categorical variables: 2015—Continued

School characteristic	Sample schools: Eligible (percent) (N=237)	Sample schools: Participating (percent) (N=165)	Bias	Relative bias	Chi-square *p* value
Poverty level					0.145
High	17.0	19.8	2.85	0.168	
Low	83.0	80.2	-2.85	-0.034	

NOTE: Detail may not sum to totals because of rounding. AP status indicates whether or not the school has students who took a relevant AP test in 2013. Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Eligible schools contained at least one advanced physics student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced physics enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

4.2.2 Continuous Variables (TIMSS-P)

Summary means for each continuous variable for participating and eligible schools are shown in tables G-29, G-30, and G-31. One participating school had missing values for race/ethnicity, and this school was dropped from the analysis in table G-30. No data on FRPL eligibility was available for private schools, and so private schools are not included in the FRPL analysis. Two eligible schools had missing values for free or reduced-price lunch, and these schools were dropped from the analysis in table G-31.

There were no statistically significant differences between participating and eligible schools with respect to student enrollment, race/ethnicity percentage or free or reduced-price lunch (tables G-29, G-30, and G-31). However, the absolute value of the relative bias for advanced physics enrollment, Black, non-Hispanic, Hawaiian/Pacific Islander, and multiracial is greater than 10 percent (tables G-29 and G-30, respectively). Though for Hawaiian/Pacific Islander and multiracial this is due mostly to the eligible percentage being less than 3.0 percent, as the absolute bias is small.

Table G-29. Mean enrollment of various characteristics for eligible and participating schools in the U.S. TIMSS advanced physics final sample: 2015

Student enrollment	Sample schools: Eligible (mean) (N=237)	Sample schools: Participating (mean) (N=165)	Bias	Relative bias	*t* test *p* value
Total school	1,703.5	1,674.0	-29.42	-0.017	0.687
Advanced physics	54.2	46.7	-7.50	-0.138	0.424

NOTE: Eligible schools contained at least one advanced physics student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced physics enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table G-30. Mean percentage of various characteristics for eligible and participating schools in the U.S. TIMSS advanced physics final sample, by race/ethnicity: 2015

Race/ethnicity	Sample schools: Eligible (mean) (N=237)	Sample schools: Participating (mean) (N=165)	Bias	Relative bias	*t* test *p* value
White, non-Hispanic	55.1	52.6	-2.52	-0.046	0.156
Black, non-Hispanic	14.6	16.9	2.26	0.154	0.119
Hispanic	18.7	19.9	1.26	0.067	0.278
Asian	8.1	7.5	-0.61	-0.076	0.347
American Indian or Alaska Native	0.6	0.5	-0.05	-0.086	0.567
Hawaiian/Pacific Islander	0.2	0.2	-0.02	-0.111	0.234
Multiracial	2.8	2.5	-0.31	-0.111	0.097

NOTE: Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Eligible schools contained at least one advanced physics student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced physics enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table G-31. Mean percentage of students eligible for free or reduced-price lunch, in eligible and participating public schools in the U.S. TIMSS advanced physics final sample: 2015

Students	Sample schools: Eligible (percent) (N=219)	Sample schools: Participating (percent) (N=155)	Bias	Relative bias	*t* test *p* value
Percentage of students eligible for free or reduced-price lunch	29.5	31.3	1.84	0.063	0.284

NOTE: Information on percentage of students eligible for free or reduced-price lunch is missing for two of the 221 eligible public schools in the sample and one of the 156 public schools that participated. Eligible schools contained at least one advanced physics student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced physics enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

4.2.3 Logistic Regression Model (TIMSS-P)

To examine the joint relationship of various characteristics to school nonresponse, the analysis used a logistic regression model with participation status as the binary dependent variable and frame characteristics as predictor variables. Since public and private schools were modeled together using the variables available for all schools, the percentage of students eligible for free or reduced-price lunch was not included in the main logistic regression analysis.

Standard errors and tests of hypotheses for the full model parameter estimates are presented in table G-32 (with six race/ethnicity variables) and table G-33 (with summed race/ethnicity percentage). Private schools are treated as low poverty for the categorical variable poverty level. Only non-AP schools was a significant predictor of school participation in table G-32. The negative parameter estimate indicates that relative to AP schools, Non-AP schools were somewhat underrepresented among the participating schools The *F* test statistic to determine whether the race/ethnicity characteristics are simultaneously equal to 0

was 0.73 with a *p* value of 0.606, which indicates no significant relationship was detected with participation.

Only the South region was a significant predictor of school participation in table G-33. The positive parameter estimates indicate that relative to schools in the West region, schools in the South region were somewhat overrepresented among the participating schools.

Because the percentage of students eligible for free or reduced-price lunch was not included in the main logistic regression analysis, a separate analysis with public schools only was conducted. To include free or reduced-price lunch eligibility in a model, public schools were modeled separately using a model with the summed race/ethnicity percentage and adding the percentage of students eligible for free or reduced-price lunch. Since poverty is derived from the percentage of students eligible for free or reduced-price lunch, an interaction term was also included in the model. Standard errors and tests of hypotheses for the full model parameter estimates are presented in table G-34. Only the South region was a significant predictor of school participation among public schools only. The parameter estimates for central city and suburb remained positive as in table G-33.The model with the six race/ethnicity variables is not shown due to complex interactions that make the results difficult to interpret.

Table G-32. Logistic regression model parameters (with six race/ethnicity variables) using the U.S. TIMSS advanced physics final school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H_0: parameter = 0	*p* value
Intercept	1.061	1.2786	0.8301	0.4091
Non-AP school	-2.201	1.0597	-2.0767	**0.0413**
Private school	-0.783	0.9787	-0.8000	0.4262
Central city	1.807	0.9607	1.8806	0.0639
Suburb	2.047	1.0718	1.9096	0.0600
Town	1.056	0.9552	1.1057	0.2724
Northeast	-1.550	0.9230	-1.6791	0.0973
Midwest	-0.867	0.9059	-0.9566	0.3419
South	0.606	0.7443	0.8142	0.4181
High poverty	0.592	0.7344	0.8061	0.4228
Total school enrollment	0.000	0.0004	-0.1786	0.8587
Advanced physics enrollment	-0.005	0.0046	-1.1783	0.2424
Black, non-Hispanic	0.006	0.0148	0.4302	0.6683
Hispanic	-0.011	0.0131	-0.8149	0.4177
Asian	0.001	0.0231	0.0304	0.9758
American Indian or Alaska Native	-0.079	0.0837	-0.9457	0.3473
Hawaiian/Pacific Islander	-0.916	0.6238	-1.4676	0.1464
Multiracial	-0.190	0.1004	-1.8905	0.0626

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced physics enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table G-33. Logistic regression model parameters (with summed race/ethnicity percentage) using the U.S. TIMSS advanced physics final school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H_0: parameter = 0	*p* value
Intercept	-0.437	1.2086	-0.3614	0.7188
Non-AP school	-1.853	1.0156	-1.8250	0.0720
Private school	-0.895	0.9528	-0.9393	0.3506
Central city	1.843	1.0561	1.7449	0.0851
Suburb	2.220	1.2322	1.8020	0.0756
Town	0.977	1.0433	0.9368	0.3519
Northeast	-0.304	0.657	-0.4633	0.6445
Midwest	0.087	0.7338	0.1190	0.9056
South	1.323	0.6582	2.0108	0.0479
High poverty	0.618	0.7279	0.8496	0.3982
Total school enrollment	0.000	0.0004	-0.5050	0.6150
Advanced physics enrollment	-0.003	0.0058	-0.5163	0.6072
Summed race/ethnicity percentage	0.001	0.0117	0.0492	0.9609

NOTE: Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Summed race/ethnicity percentage includes Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander; and two or more races. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced physics enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table G-34. Logistic regression model parameters (with summed race/ethnicity percentage) using the U.S. TIMSS advanced physics final public school sample: 2015

Parameter	Parameter estimate	Standard error	*t* test for H_0: parameter = 0	*p* value
Intercept	-0.001	1.4879	-0.0007	0.9994
Non-AP school	-1.773	1.1151	-1.5899	0.1161
Central city	2.139	1.1695	1.8292	0.0713
Suburb	1.624	1.1969	1.3565	0.1790
Town	0.972	1.1708	0.8302	0.4091
Northeast	-0.502	0.6972	-0.7198	0.4739
Midwest	-0.067	0.7737	-0.0866	0.9312
South	1.661	0.7017	2.3676	0.0205
High poverty	-1.620	1.9755	-0.8199	0.4148
Free or reduced-price lunch eligibility	-0.013	0.0247	-0.5234	0.6022
High poverty * free or reduced-price lunch eligibility	0.043	0.0355	1.2046	0.2322
Total school enrollment	0.000	0.0004	-0.3221	0.7483
Advanced physics enrollment	-0.004	0.0057	-0.7540	0.4532
Summed race/ethnicity percentage	-0.001	1.4879	-0.0007	0.9994

NOTE: Information on percentage of students eligible for free or reduced-price lunch is missing for two of the 221 eligible public schools in the sample, so these two schools were dropped from the regression. Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program. Summed race/ethnicity percentage includes Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander; and two or more races. Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Schools were weighted by their school base weights that did not include a nonresponse adjustment factor, and by their estimated advanced physics enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

4.3 Nonresponse-adjusted Final Sample with Substitutes

This section presents the nonresponse bias analysis based on the final sample of 237 eligible schools for TIMSS-P. The distribution of the participating final sample, including participating substitute schools, was compared to the schools in the total eligible final sample, just like the previous section. However, in the analyses that follow, school base weights were used for the eligible sample of schools, whereas nonresponse-adjusted weights were used for the participating schools.

4.3.1 Categorical Variables (TIMSS-P)

The distribution of participating and eligible schools by the four characteristics is shown in table G-35. There are no statistically significant relationships between participation status and any of the characteristics shown in table G-35. However, the absolute value of the relative bias for non-AP, central city, suburb, town, rural, and high poverty schools is greater than 10 percent, which indicates potential bias for AP schools, locale, and poverty level, respectively (table G-35). Note that the relative bias for non-AP schools is much higher than for AP schools due to the binary nature of the variable as the absolute bias is the same for both categories.

Table G-35. Percentage distribution of eligible and participating schools in the U.S. TIMSS advanced physics nonresponse-adjusted sample, by selected categorical variables: 2015

	Sample schools				
School characteristic	Eligible (percent) (N=237)	Participating (percent) (N=165)	Bias	Relative bias	Chi-square *p* value
AP status					0.534
Non-AP school	4.8	3.9	-0.98	-0.203	
AP school	95.2	96.1	0.98	0.010	
School control					0.797
Public	91.4	92.1	0.68	0.007	
Private	8.6	7.9	-0.68	-0.079	
Locale					0.102
Central city	33.2	37.4	4.25	0.128	
Suburb	51.4	45.0	-6.33	-0.123	
Town	4.1	2.8	-1.27	-0.312	
Rural	11.4	14.7	3.35	0.295	
Census region					0.854
Northeast	18.5	20.1	1.62	0.088	
Midwest	23.1	20.9	-2.16	-0.094	
South	32.0	32.3	0.28	0.009	
West	26.5	26.7	0.27	0.010	
Poverty level					0.199
High	17.0	19.6	2.66	0.157	
Low	83.0	80.4	-2.66	-0.032	

NOTE: Detail may not sum to totals because of rounding. AP status indicates whether or not the school has students who took a relevant AP test in 2013. Census region is the state-based region of the country (see technical notes for state listing). For public schools, a high poverty school is defined as one in which 50 percent or more of the students are eligible for participation in the FRPL program; all private schools are treated as low poverty schools. Eligible schools contained at least one advanced physics student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school nonresponse adjusted weight and by their estimated advanced physics enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

4.3.2 Continuous Variables (TIMSS-P)

Summary means for each continuous variable for participating and eligible schools are shown in tables G-36, G-37 and G-38. No data on FRPL eligibility was available for private schools, and so private schools are not included in the FRPL analysis. Two eligible schools had missing values for free or reduced-price lunch, and these schools were dropped from the analysis in table G-31.

There were no statistically significant differences between participating and eligible schools with respect to student enrollment (table G-36). Participating schools had a lower mean percentage of multiracial students than the eligible sample (2.4 vs. 2.8 percent, respectively; table G-37). There were no statistically significant differences between participating and eligible schools with respect to free or reduced-price lunch (table G-38). However, the absolute value of the relative bias for advanced physics enrollment, American Indian or Alaskan Native, and Hawaiian/Pacific Islander is greater than 10 percent (tables G-36 and G-37, respectively). Though for the two race/ethnicity categories this is due mostly to the eligible percentage being less than 3.0 percent, as the absolute bias is small.

Table G-36. Mean enrollment of various characteristics for eligible and participating schools in the U.S. TIMSS advanced physics nonresponse-adjusted sample: 2015

	Sample schools				
Student enrollment	Eligible (mean) (N=237)	Participating (mean) (N=165)	Bias	Relative bias	*t* test *p* value
Total school	1,703.5	1,627.4	-76.04	-0.045	0.327
Advanced physics	54.2	45.3	-8.85	-0.163	0.350

NOTE: Eligible schools contained at least one advanced physics student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school nonresponse adjusted weight and by their estimated advanced physics enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table G-37. Mean percentage of various characteristics for eligible and participating schools in the U.S. TIMSS advanced physics nonresponse-adjusted sample, by race/ethnicity: 2015

	Sample schools				
Race/ethnicity	Eligible (mean) (N=237)	Participating (mean) (N=165)	Bias	Relative bias	*t* test *p* value
White, non-Hispanic	55.1	54.3	-0.76	-0.014	0.670
Black, non-Hispanic	14.6	15.6	1.02	0.070	0.480
Hispanic	18.7	19.4	0.78	0.042	0.509
Asian	8.1	7.5	-0.55	-0.068	0.426
American Indian or Alaska Native	0.6	0.5	-0.06	-0.105	0.482
Hawaiian/Pacific Islander	0.2	0.2	-0.03	-0.142	0.144
Multiracial	2.8	2.4	-0.40	-0.142	**0.035**

NOTE: Black includes African American, and Hispanic includes Latino. Racial categories exclude Hispanic origin. Eligible schools contained at least one advanced physics student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school nonresponse adjusted weight and by their estimated advanced physics enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Table G-38. Mean percentage of students eligible for free or reduced-price lunch, in eligible and participating public schools in the U.S. TIMSS advanced physics nonresponse-adjusted sample: 2015

Students	Sample schools: Eligible (percent) (N=219)	Sample schools: Participating (percent) (N=155)	Bias	Relative bias	*t* test *p* value
Percentage of students eligible for free or reduced-price lunch	29.5	30.9	1.43	0.049	0.420

NOTE: Information on percentage of students eligible for free or reduced-price lunch is missing for two of the 221 participating public schools in the sample and one of the 156 public schools that participated. Eligible schools contained at least one advanced physics student. Participating schools agreed to have their students assessed. The relative bias is calculated as the bias divided by the estimate from the eligible sample. Schools were weighted by their school nonresponse adjusted weights and by their estimated advanced physics enrollment.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

4.4 Summary—Advanced Physics

The investigation into nonresponse bias at the school level for the U.S. TIMSS-P effort shows statistically significant relationship between response status and some of the available school characteristics that were examined in the analysis.

For original sample schools, no variables were found to be statistically significantly related to participation in the bivariate analysis. However, the absolute value of the relative bias for non-AP, private, central city, suburb, town, rural, Northeast, Midwest, South, high poverty, advanced physics enrollment, Black, non-Hispanic, and multiracial is greater than 10 percent (tables G-21, G-22, and G-23, respectively), which indicates potential bias even though no statistically significant relationship was detected. Although each of these findings indicates some potential for nonresponse bias, when all of these factors were considered simultaneously in a regression analysis, Non-AP schools, central city, suburb, and multiracial were significant predictors of participation (table G-25). The second model showed that Central city, suburb, and South region were significant predictors of participation (table G-26, with summed race/ethnicity percentage). The third model showed Central city and South region were significant predictors of school participation among public schools only (table G-27).

For final sample schools (with substitutes), no variables were found to be statistically significantly related to participation in the bivariate analysis. However, the absolute value of the relative bias for non-AP, private, central city, suburb, town, rural, Northeast, Midwest, South, high poverty, advanced physics enrollment, Black, non-Hispanic, Hawaiian/Pacific Islander, and multiracial is greater than 10 percent (tables G-28, G-29, and G-30, respectively), which indicates potential bias even though no statistically significant relationship was detected. Though for Hawaiian/Pacific Islander and multiracial this is due mostly to the eligible percentage being less than 3.0 percent, as the absolute bias is small. When all of these factors were considered simultaneously in a regression analysis, only non-AP was a significant predictor of participation (table G-32). The second model showed that only South region was a significant predictor of participation (table G-33, with summed race/ethnicity percentage). The third model showed again only South region was a significant predictor of school participation among public schools only (table G-34).

For final sample schools with school nonresponse adjustments applied to the weights, multiracial students (table G-37) were found to be statistically significantly related to participation in the bivariate analysis.

However, the absolute value of the relative bias for non-AP, central city, suburb, town, rural, high poverty, advanced physics enrollment, American Indian or Alaskan Native, and Hawaiian/Pacific Islander is greater than 10 percent, which indicates potential bias even though no statistically significant relationship was detected (tables G-35, G-36, and G-37, respectively). Though for the three race/ethnicity categories this is due mostly to the eligible percentage being less than 3.0 percent, as the absolute bias is small. The multivariate regression analysis cannot be conducted after the school nonresponse adjustments are applied to the weights. The concept of nonresponse-adjusted weights does not apply to the nonresponding units, and, thus, we cannot conduct an analysis that compares respondents with nonrespondents using nonresponse-adjusted weights.

The results of the analyses are summarized in table G-39.

Table G-39. Characteristics with *p* values less than 0.05 and absolute relative bias greater than 10 percent, U.S. TIMSS advanced physics schools: 2015

Analysis	Characteristics with *p* values less than 0.05	Additional characteristics with absolute relative bias greater than 10 percent
Original sample	None	Non-AP, private, central city, suburb, town, rural, Northeast, Midwest, South, high poverty, advanced physics enrollment, Black, non-Hispanic, multiracial
Regression model a	Non-AP, central city, suburb, multiracial	†
Regression model b	Central city, suburb, South region	†
Regression model c	Central city, South region	†
Sample with substitutes	None	Non-AP, private, central city, suburb, town, rural, Northeast, Midwest, South, high poverty, advanced physics enrollment, Black, non-Hispanic, Hawaiian/Pacific Islander, multiracial
Regression model a	Non-AP	†
Regression model b	South region	†
Regression model c	South region	†
Nonresponse adjusted	Multiracial	Non-AP, central city, suburb, town, rural, high poverty, advanced physics enrollment, American Indian or Alaskan Native, Hawaiian/Pacific Islander

† Not applicable.
SOURCE: International Association for the Evaluation of Educational Achievement (IEA), Trends in International Mathematics and Science Study (TIMSS) 2015.

Note that the standard errors for both advanced math and physics are generally much larger than for grades 4 and 8. This means some large biases could have been significant had the standard errors been in line with grades 4 and 8. This was likely due to having a measure of size for school sampling (grade 12

enrollment) that was not a good measure of the true number of advanced students. Additionally, the estimated advanced math and physics enrollments (used as the measure of school size for conducting these nonresponse bias analyses) were not always a good measure of the true number of advanced students.

These results suggest that there is some potential for nonresponse bias in the U.S. TIMSS-P original sample based on the characteristics studied. It also suggests that, while there is some evidence that the use of substitute schools reduced the potential for bias, it has not reduced it substantially. Moreover, after the application of school nonresponse adjustments, there is some evidence of resulting potential bias in the available frame variables and correlated variables in the final sample with the largest bias in locale. It is important to note that the relative bias for private and non-AP schools is much higher than for public and AP schools, respectively, due to the binary nature of the variable as the absolute bias is the same for both categories. Also, the relative bias is potentially misleading for the American Indian or Alaskan Native, and Hawaiian/Pacific Islander, and multiracial categories, as the absolute bias is small in each case. Given there is limited statistical power due to larger standard errors as mentioned above, the possibility of meaningful bias cannot be ruled out by the lack of statistically significant results.

5. TECHNICAL NOTES

Description of Variables

Frame characteristics for public schools were taken from the 2012-13 CCD and, for private schools, from the 2011-12 PSS.

Race/Ethnicity

Students' race/ethnicity was obtained through student responses to a two-part question. Students were asked first whether they were Hispanic or Latino, and then asked whether they were members of the following racial groups: American Indian/Alaska Native; Asian; Black, non-Hispanic; Native Hawaiian or other Pacific Islander; or White, non-Hispanic. Two or more races was derived when a student chooses more than one of the racial groups. The summed race/ethnicity percentage was derived from summing the six race/ethnicities of Black, non-Hispanic; Hispanic; Asian; American Indian or Alaska Native; Hawaiian/Pacific Islander and two or more races.

Locale

Locale was derived from the urban-centric locale code that is based on the urbanicity of the school location.

- *Central city* consists of a large territory inside an urbanized area and inside a principal city with population of 250,000 or more, midsize territory inside an urbanized area and inside a principal city with a population less than 250,000 and greater than or equal to 100,000, or small territory inside an urbanized area and inside a principal city with a population less than 100,000.

- *Suburb* consists of a large territory outside a principal city and inside an urbanized area with population of 250,000 or more, midsize territory outside a principal city and inside an urbanized area with a population less than 250,000 and greater than or equal to 100,000, or small territory outside a principal city and inside an urbanized area with a population less than 100,000.

- *Town* consists of a fringe territory inside an urban cluster that is less than or equal to 10 miles from an urbanized area, distant territory inside an urban cluster that is more than 10 miles and less than or equal to 35 miles from an urbanized area, or remote territory inside an urban cluster that is more than 35 miles from an urbanized area.

- *Rural* consists of a fringe census-defined rural territory that is less than or equal to 5 miles from an urbanized area, as well as rural territory that is less than or equal to 2.5 miles from an urban cluster, distant census-defined rural territory that is more than 5 miles but less than or equal to 25 miles from an urbanized area, as well as rural territory that is more than 2.5 miles but less than or equal to 10 miles from an urban cluster, or remote census-defined rural territory that is more than 25 miles from an urbanized area and is also more than 10 miles from an urban cluster.

Census Region

Region is the census region of the United States. Northeast consists of Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont. Midwest consists of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. South consists of Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia. West consists of Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

Percentage of Students Eligible for Free or Reduced-price Lunch

The proportion of students in a school eligible for the free or reduced-price lunch (FRPL) program, a federally assisted meal program under the National School Lunch Act that provides nutritionally balanced, low-cost or free lunches to eligible children each school day. The question on the CCD questionnaire asked what percentage of students at the school were eligible to receive free or reduced-price lunch through the FRPL program around October 1, 2012. It is available only for public schools as the NCES Private School Universe Survey (PSS) data do not provide the same information for private schools.

Poverty Level in Public Schools

The measure of school poverty is based on the percentage of students eligible for FRPL. Schools were classified as *low poverty* if less than 50 percent of the students were eligible for FRPL and as *high poverty* if 50 percent or more of the students were eligible. In the interest of retaining all of the schools and students in these analyses, private schools were assumed to be low-poverty schools—that is, they were assumed to be schools in which less than 50 percent of students were eligible for FRPL.

AP Status

Additionally, NCES worked with the College Board to obtain data on schools that offered AP courses in 2013. This list was matched to the school frame to supplement the frame data with school information on students that took AP exams. The data on the AP file included frequencies of students taking AP exams in calculus, physics, and both calculus and physics. Since actual counts of advanced calculus and physics students are not available, estimated eligible student counts were computed with the available information. In non-AP schools, the percentages of graduates who earned credit in calculus and/or physics from the 2009 High School Transcript Study (HSTS) were used with the estimated grade 12 enrollment. In AP schools, the counts of students taking AP exams in calculus, physics, and both calculus and physics were inflated based on the HSTS percentages. This was done within each school by inflating the AP counts in calculus, physics, and both calculus and physics by the comparable ratio of total percentage of advanced to AP students. For example, the number of advanced calculus students in a school was estimated by applying a ratio of 16.8/11.3 to the AP calculus count in the school.

6. REFERENCES

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