TIMSS:
Using research evidence to support excellent mathematics and science teaching

A webinar for school senior leaders and subject leads to understand the importance of participating in TIMSS

- Grace Grima, Pearson
- Jennie Golding, UCL IOE

The session

Pearson will consider

o what the components of TIMSS contribute to our understanding of mathematics and science teaching and learning;
o the importance and benefits to schools of participation; what participating schools need to do and how they will be supported.

UCL will outline

- existing high level international comparisons; and

- consider some specific outcomes for school leaders, and for mathematics and science teachers, via consideration of particular questionnaire and test items (from year 5 mathematics and year 9 science assessments)

Questions

*Please have pen and paper to hand!*

What is TIMSS?

- Trends In Mathematics and Science Study (TIMSS) has run every four years since 1995. TIMSS assessments focus on year 5 and year 9 pupils' knowledge and understanding of curriculum content in mathematics and science. They provide internationally comparable data about trends in performance ('centrepoint' = 500; benchmark performances low, intermediate, high, advanced).

- In England in 2019, e-TIMSS on tablets (with a 'paper bridging study'); Pearson was responsible for data collection and scoring of open-ended responses and UCL for analysis and national report.

- In 2019, year 5 students in England showed significantly improved performance in mathematics and maintained their performance in science compared with 2015; Year 9 students maintained their performance in mathematics but showed significantly weaker performance in science than in TIMSS15

- The IEA TIMSS website and TIMSS 2019 Report for England provide further information

- Information, updates etc. about TIMSS 2023 in England, again delivered by Pearson with UCL, for schools and for interested parents, can be found at www.pearson.com/uk/web/timss

What does the assessment include?

Pupils
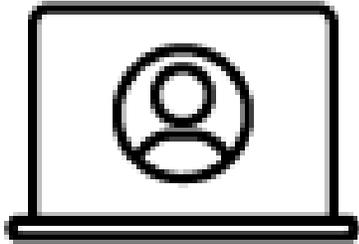
- Pupils will complete an interactive computer-based mathematics and science assessment
- *The pupil questionnaire -* on aspects of their home and school lives

Staff

- *The school questionnaire (Head Teacher) -* a range of contextual questions about the school
- *The teacher questionnaire (Year 5 class teacher and Year 9 maths/science teachers) -* questions about their education and experiences of teaching

Examples of the assessments and questionnaires can be viewed at:
https://www.pearson.com/uk/web/timss/for-schools.html

Why is it important and what are the benefits?

| Importance	Benefits
Allows DfE to benchmark England's performance against other countries	Pupils have the opportunity to practise their mathematics and science skills through an innovative online assessment
Measures trends over time, to identify and analyse factors that impact pupil attainment	Personalised feedback report to schools containing your pupils' perspectives in a range of areas*
Directly influences national policy and developments	£100 administration payment and a Test Administrator to deliver the assessments in your school
Allows us to learn from policies and practices in other countries	Giving your pupils the experience of representing England in an important global study

*A sample of this report is included in the welcome pack and can be viewed on the TIMSS website: https://www.pearson.com/uk/web/timss/for-schools.html
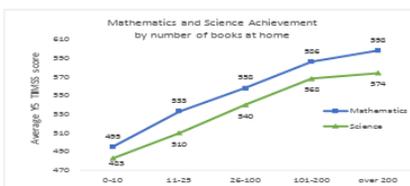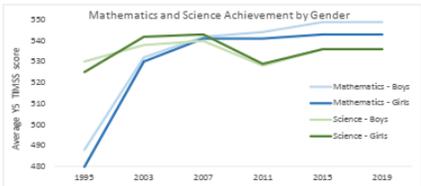
School report

National level data

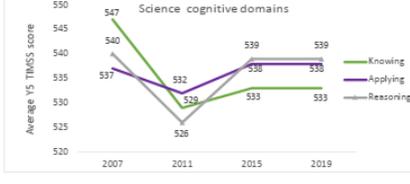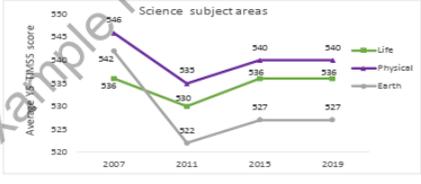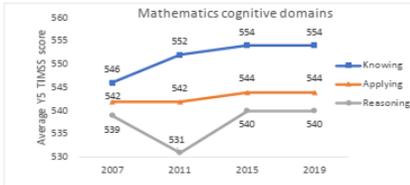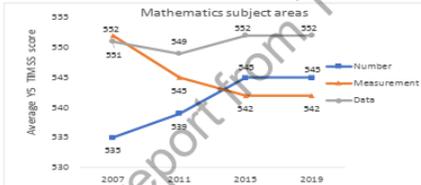School level data compared to national and international data

Summary of National results for *INSERT NAME OF SCHOOL*

The TIMSS National Study Centre would like to say a big thank you to the school for taking part in Summer 2019. This short report first summarises the overall scores achieved in England and then shows results from the questionnaires completed by *INSERT NUMBER OF PUPILS* pupils in class *INSERT CLASS NAMES*

In TIMSS, pupils answer sets of mathematics and science questions from a larger bank of items, and a questionnaire on attitudes to the subjects and learning in general. The national score is calculated as an average of the approximately 4000 pupils that take part, but test scores for individual pupils and schools cannot be calculated. The questionnaire averages shown for the school should be interpreted with caution due to the small sample.
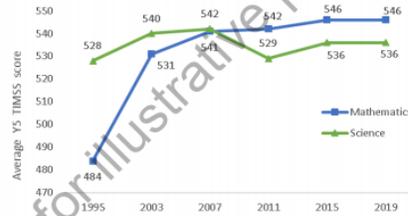
TIMSS scores are based on the 1995 International average of 500. 58 countries participated in 2019; just 5 countries scored significantly above England in Maths and 6 in Science. The TIMSS 2019 National Report for England contains a full analysis and discussion of the findings.

Mathematics		Very		Somewhat		Not very	
		%	Av.Score	%	Av.Score	%	Av.Score
Likes subject	Your school	48%	–	33%	–	19%	–
	England	42%	553	37%	528	21%	517
	International median	37%	518	43%	496	20%	471
Confident in subject	Your school	48%	–	33%	–	19%	–
	England	42%	553	37%	528	21%	517
	International median	37%	518	43%	496	20%	471
Engaged in lessons	Your school	48%	–	33%	–	19%	–
	England	42%	553	37%	528	21%	517
	International median	37%	518	43%	496	20%	471

Science		Very		Somewhat		Not very	
		%	Av.Score	%	Av.Score	%	Av.Score
Likes subject	Your school	48%	–	33%	–	19%	–
	England	42%	553	37%	528	21%	517
	International median	37%	518	43%	496	20%	471
Confident in subject	Your school	48%	–	33%	–	19%	–
	England	42%	553	37%	528	21%	517
	International median	37%	518	43%	496	20%	471
Engaged in lessons	Your school	48%	–	33%	–	19%	–
	England	42%	553	37%	528	21%	517
	International median	37%	518	43%	496	20%	471

Wellbeing		High/Often		Some/Monthly		Low/Weekly	
		%	Av.Score	%	Av.Score	%	Av.Score
Sense of belonging to school	Your school	48%	–	33%	–	19%	–
	England	42%	553	37%	528	21%	517
	International median	37%	518	43%	496	20%	471
Frequency of bullying	Your school	48%	–	33%	–	19%	–
	England	42%	553	37%	528	21%	517
	International median	37%	518	43%	496	20%	471

Mathematics subject areas

Mathematics cognitive domains

Science subject areas

Science cognitive domains

Mathematics and Science Achievement by Gender

Mathematics and Science Achievement by number of books at home

What are the next steps for my school?

1. Each school nominates a School Coordinator as a point of contact.

2. Agree test date (allocated date in the welcome pack, but can be rearranged).

Year 9	8th March - 31st March 2023
Year 5	24th April – 16th June 2023

3. Secure a suitable room(s) for the activities to be conducted on the test date (this could be an IT room, or classroom with a laptops).

4. When contacted by the TIMSS support team, please provide the Year 5/9 class lists and pupil information.

5. Assessments are completed online – you will receive a test link to assess compatibility with your school computers.

We will support your school throughout the process:

Email: timss2023@pearson.com Tel: 020 7010 2010

Class lists – what information is needed?

Submit a list of the Year 5/9 class names, number of students, and names of Maths and Science teachers.

TIMSS Participant Country	England
School Name	Made Up Primary School
School ID	1002
School Coordinator Name	John Madeup
Phone Number	0123456789
Email	John.madeup@MadeupPrimarySchool.co.uk

❶	❷	❸	❹	❺	❻	❼
Class Name	**Year**	**Class Group**	**Number of Students**	**Class Exclusion Status**	**Name of Mathematics Teacher**	**Name of Science Teacher**
Willows	5		25		Peter Piper	Peter Piper
Oaks	5		24		Jocelyn Gates	Jocelyn Gates

Pupil lists

Submit names (or identifiers),

DOB, gender and their maths and

Science teachers).

TIMSS Questionnaire foci

We need to know how questionnaire answers have changed by TIMSS 2023. A high response rate from teachers will make the findings much more useful.

Targeted school and background factors, important for school leaders, and that potentially influence achievement, include:

❑ pupils' attitudes towards mathematics and science

❑ pupils' perceptions of teaching in these subjects

❑ teachers' education, experience and job satisfaction

❑ headteachers' and teachers' views on school discipline and resources; and

❑ pupils' reports on their home environment and resources at home.

- In 2019 teachers of mathematics and science in years 5 and 9 highlighted the need for CPD to (1) improve pupils' critical thinking and problem-solving skills, and (2) integrate technology into practice.

- The perceived need for other mathematics or science subject-specific development was well below international averages.

- Participating schools receive feedback on questionnaire responses in a 'school report'.

Year 5 Mathematics

Content domains quite well aligned with national curriculum

Number: whole numbers (25%); expressions, simple equations and relationships (15%); and fractions and decimals (10%)
Measurement and geometry (30%-15% each)
Data: reading, interpreting, and representing data (15%) and using data to solve problems (5%)

Further items, for restricted use (© IEA), can be found here and can be used in the classroom
No significant differences in performance by gender, ethnicity, first language, except that a slightly higher % of boys reached high and advanced benchmarks

English y5 pupils did very well on data items; but 'measurement and geometry' is relatively weak.

Children are particularly strong on *knowing* mathematics; *reasoning* and *applying* are less well-developed.

Average performance in mathematics, TIMSS 2019

| Country	Maths year 5	Maths year 9
Singapore	625	616
Hong Kong	602	578
Korea	600	607
Taipei	599	612
Japan	593	594
Russia	567	543
England	556	515
Ireland	548	524
US	535	515
Finland	532	509

Will the 2019 y5 success transfer to year 9 by 2023?

There's a persistent association between performance and socio-economic background :

Average score in year 5 mathematics by
eligibility for free school meals and number of books at home (England)
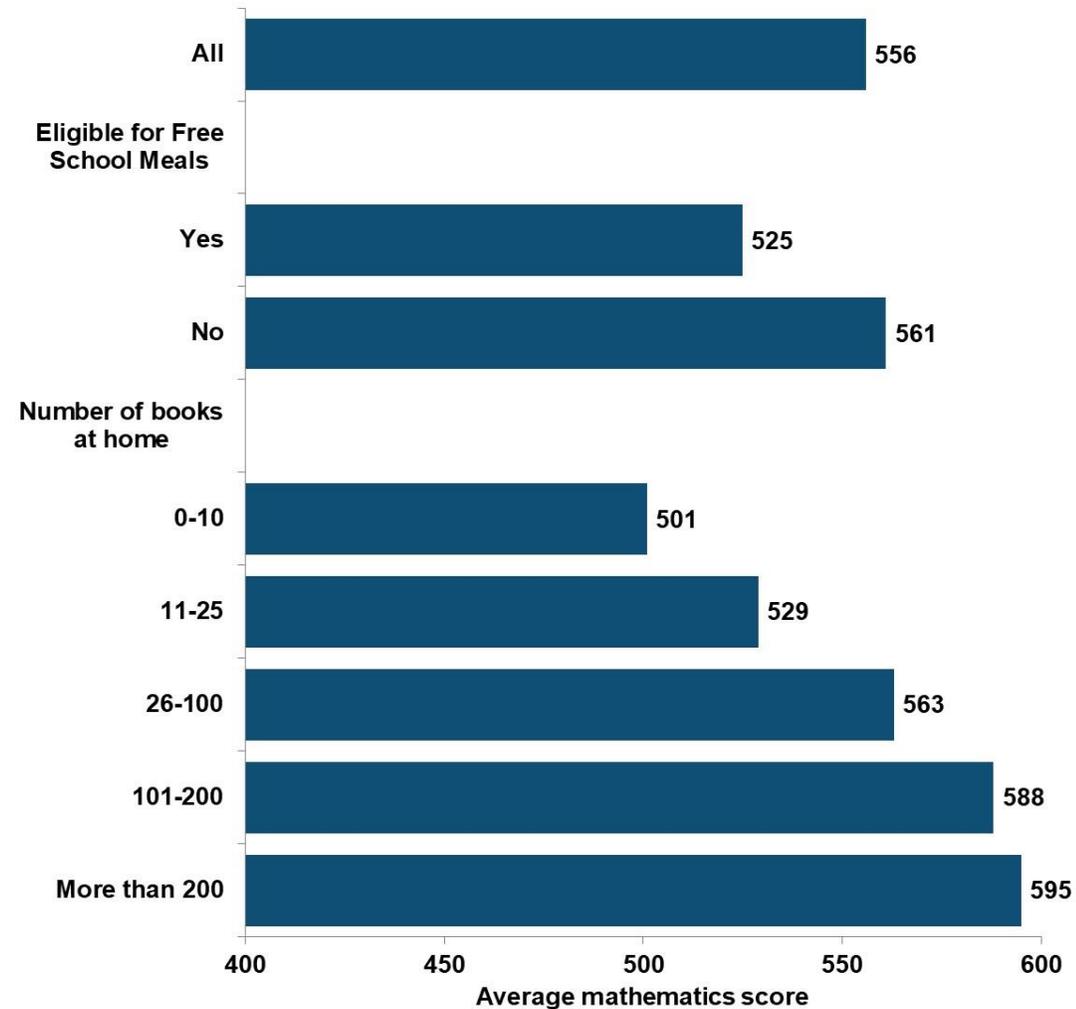
Do year 5 pupils like learning mathematics?
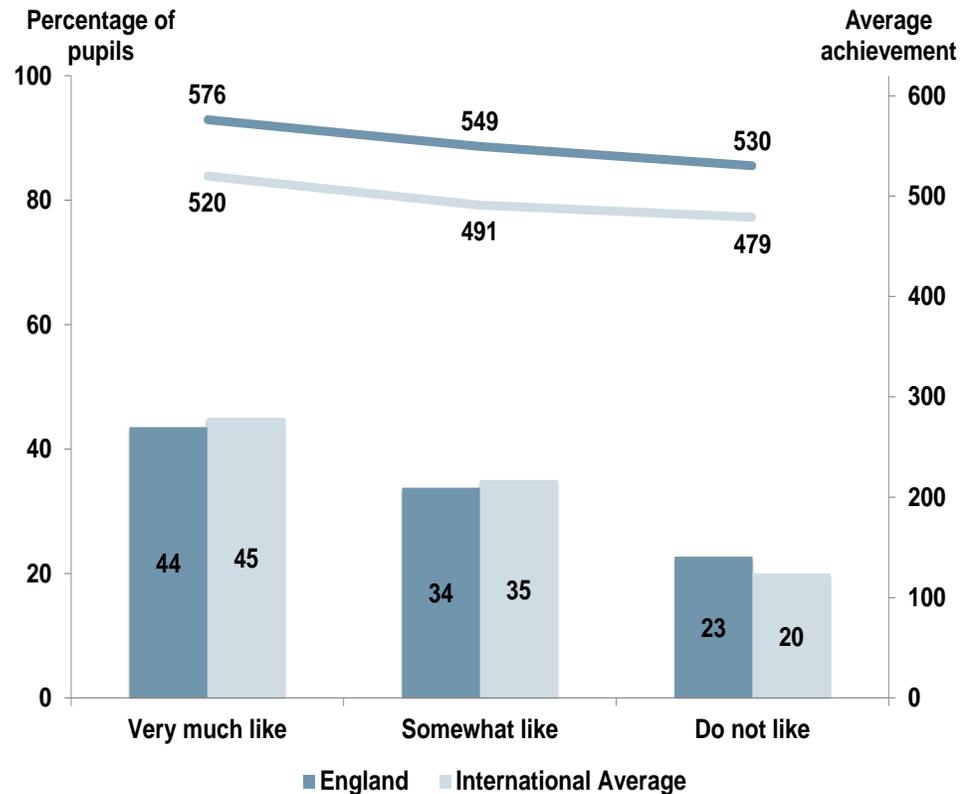
1) I enjoy learning mathematics

2) I wish I did not have to study mathematics

3) Mathematics is boring

4) I learn many interesting things in mathematics

5) I like mathematics

6) I like any schoolwork that involves numbers

7) I like to solve mathematics problems

8) I look forward to mathematics lessons

9) Mathematics is one of my favourite subjects

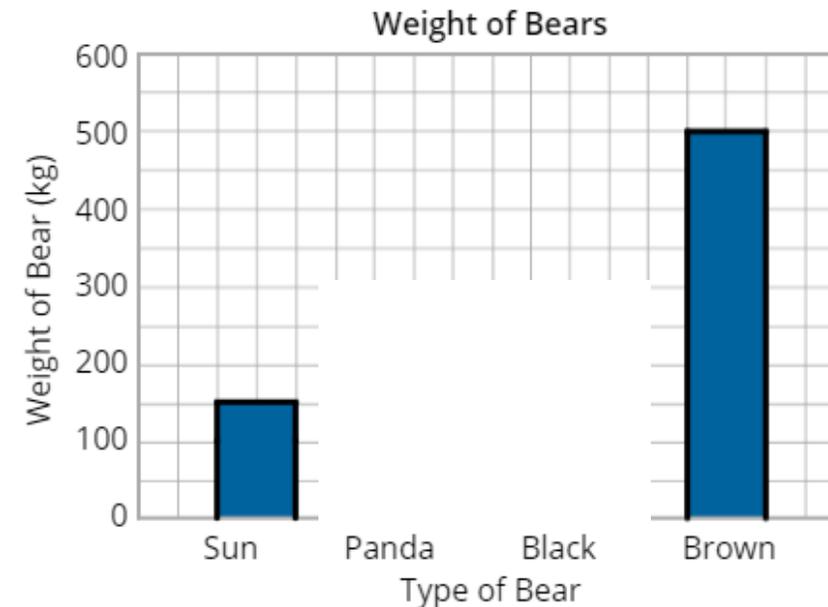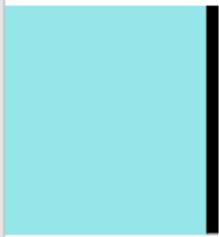The table shows the weights of 4 bears.

Type of Bear	Weight (kg)
Sun	150
Panda	200
Black	250
Brown	500

Use the data to complete the graph.

Year 5
Low/Intermediate benchmark items
have implications for 'shrinking the gap'

Weight of Bears

The table shows the weights of 4 bears.

Type of Bear	Weight (kg)
Sun	150
Panda	200
Black	250
Brown	500

Use the data to complete the graph.

84%^, m=81%

Weight of Bears
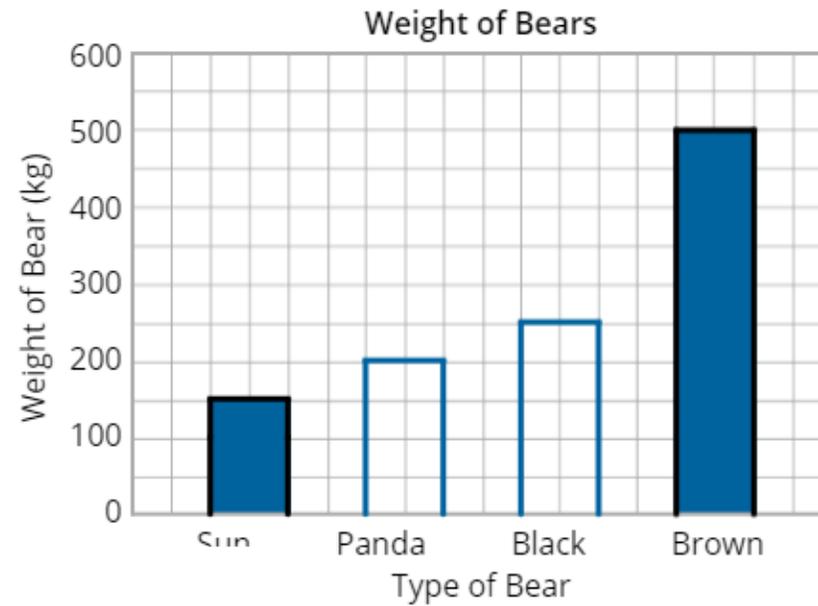
Year 5
Intermediate/high benchmark items
can tell us about pre-requisites for later work

There were 12 liters of water in the tank.

Ravi then poured 3 liters of water into the tank and Indira poured another 3 liters of water into the tank.

How can the amount of water in the tank be calculated?

12 + (2 + 3)

(12 + 3) + (12 + 3)

(12 + 2) × 3

12 + (2 × 3)

There were 12 liters of water in the tank.

Ravi then poured 3 liters of water into the tank and Indira poured another 3 liters of water into the tank.

55%, m=53%

How can the amount of water in the tank be calculated?

A 12 + (2 + 3)

B (12 + 3) + (12 + 3)

C (12 + 2) × 3

D 12 + (2 × 3)

Year 5 Advanced benchmark…
can indicate areas needing further development for later success, or require more than one solution

34%^, m=24%

A teacher wants to put 30 students in groups so that

- each group has the same number of students, **and**
- each group has an odd number of students.

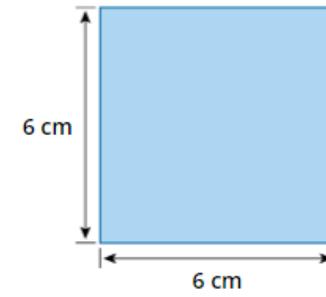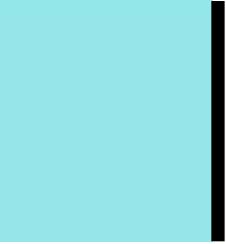Show two different ways the teacher could make the groups.

Way 1

Number of groups: ☐

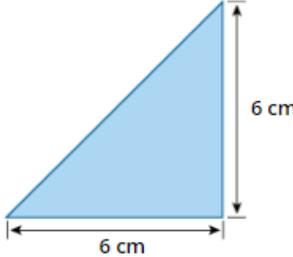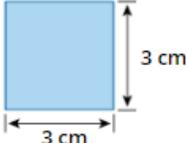Number of students in each group: ☐

Way 2

Number of groups: ☐

Number of students in each group: ☐

6 cm

6 cm

The square above can be made by putting together smaller shapes.

Complete the table with the number of each shape that are needed to cover the whole square.

Shape	Number Needed to Cover the Square Above
2 cm / 6 cm	
6 cm / 6 cm	
3 cm / 3 cm	

24%, m=21%

Year 9 Science

Content domains reasonably aligned with national curriculum

In 2019, year 9 performance across all **content domains** (biology, chemistry, physics and Earth science) was in line with England's overall science average score, significantly lower in 2019 than in 2015

Pupils performed in line with their overall science average score in the knowing and applying **cognitive domains** but significantly below this in the reasoning domain (in contrast to 2015, when reasoning was the strongest cognitive domain).

No significant differences in performance by gender or ethnicity except for Black pupils; pupils with English as a first language scored significantly higher than pupils whose first language was not English. Persistent association of performance with SES.
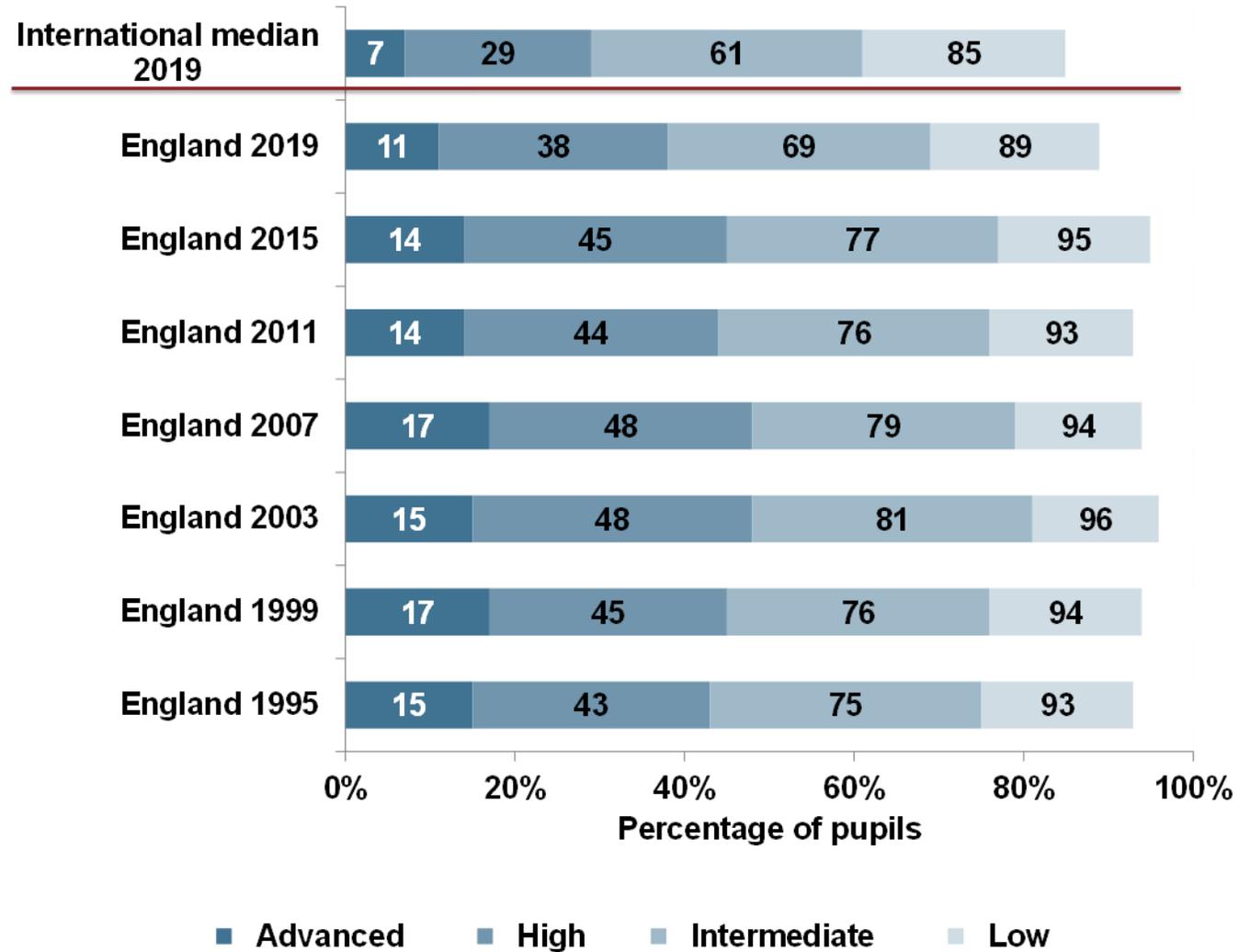
Average performance in science, TIMSS 2019

Country	Science Y5	Science Y9
Singapore	595	608
Hong Kong	531	504
Korea	588	561
Taipei	558	574
Japan	562	570
Russia	567	543
England	537	517
Ireland	528	523
US	539	522
Finland	555	543

Will the relatively poor performance of year 9 students seen in TIMSS19 persist in the 2023 cycle?

# Year 9 science performance by benchmark, over time

	Advanced	High	Intermediate	Low
International median 2019	7	29	61	85
England 2019	11	38	69	89
England 2015	14	45	77	95
England 2011	14	44	76	93
England 2007	17	48	79	94
England 2003	15	48	81	96
England 1999	17	45	76	94
England 1995	15	43	75	93

Percentage of pupils

■ Advanced ■ High ■ Intermediate ■ Low

Intermediate benchmark:
Biology reasoning
has implications for 'shrinking the gap'

67%^, m=55%

Dixon read a fact sheet about crocodiles.

Crocodile Facts

1. Crocodiles have a lifespan of up to 75 years.

2. Crocodiles today look like ancient crocodiles found in fossils.

3. Crocodiles have an angle of vision of 290° as shown in the diagram.

145°   145°
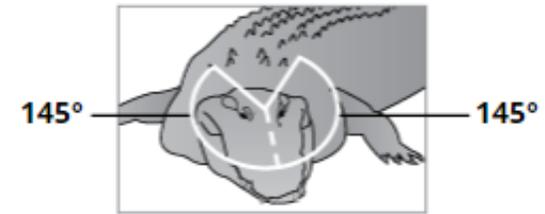
How can a crocodile's angle of vision help it to survive in its environment?

Give one reason.

High benchmark *can tell us about pre-requisites for later work*:
Chemistry reasoning

31%*, m=39%

Maria placed two identical pieces of solid paint at the bottom of two identical tubes, X and Y, filled with water. On Day 1 she put one tube in a refrigerator and left the other in the warm room. Maria took a picture of each tube at the same time for five days. The diagram shows Maria's pictures from each day.

Tube X   water

solid paint

Tube Y   water

solid paint

1 2 3 4 5
Day

1 2 3 4 5
Day
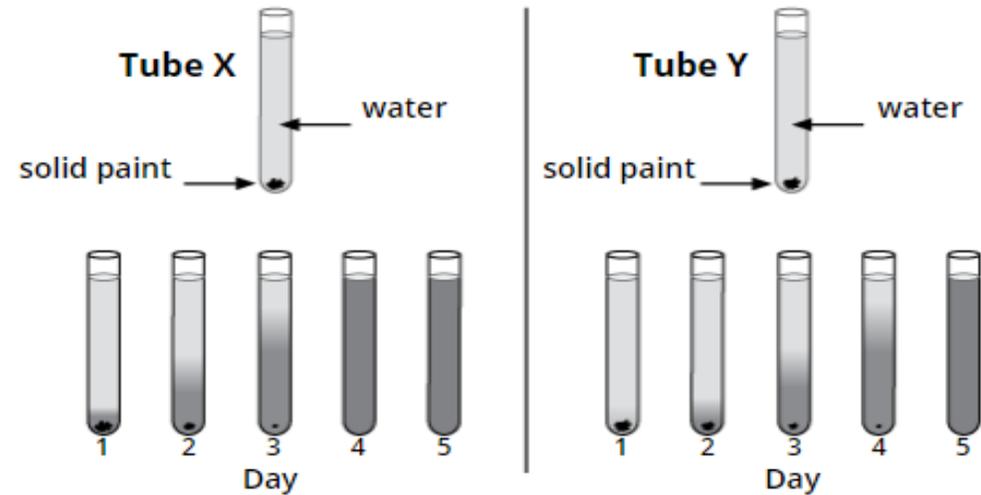
Which tube was in the refrigerator?

(Click one box.)

☐ Tube X

☐ Tube Y

Explain your answer.

High benchmark: Physics applying

35%, m=38%

Nada hangs her cell phone under a glass bowl as shown. The ringer on the phone is turned on. She removes the air from under the bowl so that her phone is in a vacuum.

Nada asks her friend to call her phone. Will they hear it ring?
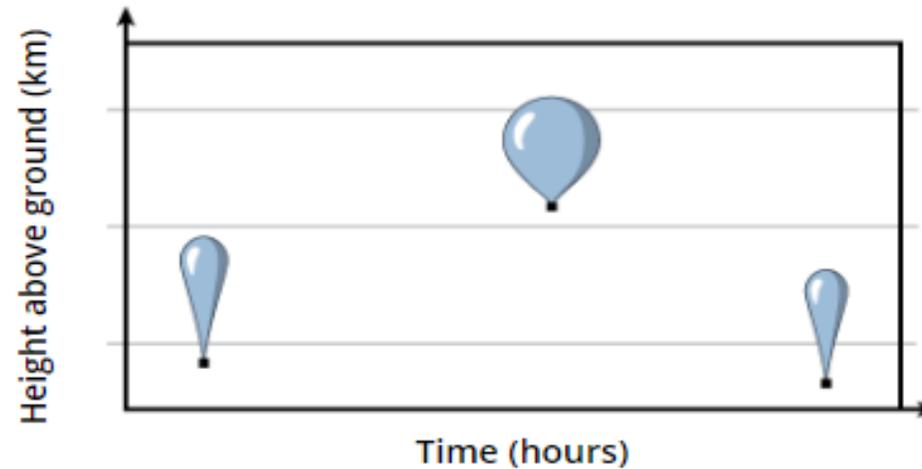
(Click one box.)

☐ Yes

☐ No

Explain your answer.

The diagram shows the height above the ground of a helium-filled weather balloon during a period of several hours.

What causes the balloon to become bigger as its height above the ground increases?

Gravity decreases.

Atmospheric pressure decreases.

The balloon is heated by the Sun.

The balloon absorbs air.

Advanced benchmark *can indicate areas needing further development for later success* : Earth science knowing

42%, m=42%

This is a portion of the periodic table of elements.

¹H								
Li	Be	B		N	O			Ne
	Mg	Al	Si	P	S	Cl	Ar

Hydrogen (H) is the first element of the periodic table. The nucleus of a hydrogen atom contains one proton. The atomic number of hydrogen is 1.

Four elements from the periodic table are shown below. The elements are not ordered by their atomic numbers.

Drag the four elements below to sort them by atomic number from smallest to largest.

Smallest   **Largest**

| Helium (He) | Carbon (C) | Fluorine (F) | Sodium (Na) |

Advanced benchmark: chemistry applying

31%, m=29%

Please feel free to contact us, including asking for the ppt:

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Thank you for listening

DISCUSSION QUESTIONS

* Do any of these findings surprise you?

* What use could you make of the items in your classroom?

* What are the TIMSS19 outcomes telling us about our priorities?

* How else should the data be mined?

* How can the (relatively wide) spread of performance be addressed?

* How can we tackle the persistent difference by socio-economic status?

Looking forward: TIMSS 2023

The International TIMSS 2023 report will be launched in December 2024, and we publish the national report for England on the same day. Other publications will follow in 2025.

https://www.pearson.com/uk/web/timss.html