



Sampling and representative samples

GRADE 7 MATH

Answer keys for the exit ticket, practice worksheet, and homework, plus notes for the lesson slides. Each answer shows the steps and the most likely wrong answer (“If wrong”), so you can tell what a mistake means, not just that it is one. Questions go from **fluency** to **application** to **reasoning**.

Exit Ticket — answer key

Use: End of the sampling lesson, opening G7 Statistics. 5–8 min, independent. Item 4 is the whole standard: bias is not fixed by size.

Timing: 5–8 min · independent. Choosing 200 on item 4 is near-universal before teaching and is the thing to reteach.

1. Names from a hat of every student **APPLICATION**

Answer: **Yes — representative**

1. Every student's name is in the hat, so everyone has an equal chance of being chosen.
2. That is random selection, and random samples tend to look like the population.
3. No group is systematically more or less likely to appear.

If wrong: Said no because not everyone is asked. A sample never asks everyone — that is what makes it a sample.

2. Students in the library at lunchtime **APPLICATION**

Answer: **No — biased**

1. Students in the library at lunch are not a random slice of the school.
2. People who spend lunch in the library are more likely to be studying, so they probably do MORE homework than average.
3. The sample systematically over-represents one kind of student, which is bias.
4. Any conclusion drawn from it would overstate the school's homework.

If wrong: Said yes because the students were not chosen deliberately. Not choosing on purpose is not the same as choosing randomly — the location did the selecting.

3. Every 10th name on the full roster APPLICATION

Answer: **Yes — representative**

1. The full roster includes every student, and taking every 10th name reaches all parts of the list.
2. No group is favoured, provided the roster is not ordered by something relevant.
3. This is systematic sampling, and it behaves like random sampling here.

If wrong: Said no because it is not literally random. It gives every part of the population a fair chance, which is what matters.

4. 200 from the library vs 20 from the hat REASONING

Answer: **No — the 20 random students are better**

1. The library sample is BIASED: it systematically over-represents students who study at lunch.
2. Increasing it to 200 does not remove that bias. It surveys more of the same skewed group.
3. What size does do is reduce random variation, making the estimate more PRECISE — but precisely wrong.
4. The 20 from the hat are unbiased. The estimate will be rough, because 20 is a small sample, but it is centred on the truth.
5. A rough estimate of the right thing beats a precise estimate of the wrong thing. Bias is a problem of METHOD, and no amount of data fixes a broken method.

If wrong: Chose the 200 because bigger samples are better. Bigger is better only when the method is sound; otherwise it just makes you confidently wrong.

Quick answers for fast checking:

#	Level	Answer
1	application	yes — random
2	application	no — biased
3	application	yes — systematic
4	reasoning	the 20 random

Practice Worksheet — answer key

Use: During the lesson after the deck. Item 8 makes the precision/accuracy distinction explicit, which is what item 7 depends on and what students usually lack the language for.

Timing: 15–25 min · pairs or independent · circulate on 7 and 8. Ask students to name WHO is over-represented in each biased method; naming the group makes the bias concrete.

1. 30 of 600? **FLUENCY**

Answer: **5%**

1. $30 \div 600 = 0.05 = 5\%$.

If wrong: Answered 30%.

2. 60 of 600? **FLUENCY**

Answer: **10%**

1. $60 \div 600 = 0.10 = 10\%$.

If wrong: Answered 60%.

3. Only the football team **APPLICATION**

Answer: **Biased**

1. Football players are more sporty than the school average.
2. A survey about sport asked only of them will overstate participation.
3. One group is systematically over-represented, which is bias.

If wrong: Said yes because the team has many members. Size is irrelevant when the group is unrepresentative.

4. The teacher's own class **APPLICATION**

Answer: **Biased for the school**

1. One class is not a random slice of the whole school.
2. It shares an age group, a timetable and a teacher, so it may differ systematically from other classes.
3. It might be representative of THAT class, but the question asks about the school.

If wrong: Said yes because the teacher did not choose who was in the class. Convenience is not randomness.

5. A poster inviting an online poll REASONING

Answer: **Biased — self-selected**

1. Only students who notice the poster AND choose to respond take part.
2. People with strong opinions are far more likely to volunteer than people who are indifferent.
3. So the sample over-represents those who care most, which is called self-selection bias.
4. This is one of the strongest biases there is, and it survives any number of responses.

If wrong: Said it is fair because anyone could respond. Being ALLOWED to respond is not the same as being CHOSEN to — who actually replies is not random.

6. Names from a hat APPLICATION

Answer: **Representative**

1. Every student is in the hat, so all have an equal chance.
2. That is genuine random selection.

If wrong: Said no because it might by chance pick unusual students. It might, but there is no systematic tilt, and that is the difference between random error and bias.

7. 200 from the poster or 20 from the hat? REASONING

Answer: **The 20 from the hat**

1. The poster responses are self-selected and therefore biased, however many arrive.
2. 200 biased responses estimate the opinion of students who volunteer, not of the school.
3. 20 random names give an unbiased estimate — rough, but centred on the truth.
4. Increasing a biased sample makes the wrong answer more precise, not more correct.
5. Method beats quantity.

If wrong: Chose 200 for the bigger number. The comparison is between a broken method and a sound one.

8. What does a larger sample improve? REASONING

Answer: **Precision — it reduces random variation**

1. With a small random sample you might, by luck, pick unusually studious students.
2. A larger random sample makes such flukes less likely, so repeated samples give answers closer together.
3. That is PRECISION: less spread from sample to sample.
4. It does not touch ACCURACY, which is whether the estimate is centred on the truth. Only the method decides that.
5. So: size fixes randomness, method fixes bias. They are different problems with different cures.

If wrong: Said a larger sample makes the answer more correct. It makes it more consistent, which is only the same thing when the method is already unbiased.

9. Write a sound method REASONING

Answer: **e.g. number every student on the roster and use random numbers to pick 50**

1. Take the FULL roster, so nobody is excluded from the start.
2. Assign each student a number, then select using random numbers or a hat.
3. Sound because every student has an equal chance and no group is favoured.
4. Also acceptable: every 10th name on the roster, which reaches all parts of the list evenly.
5. Not acceptable: asking your friends, asking one class, or inviting volunteers — each excludes or over-represents some group before a single answer is collected.

If wrong: Proposed asking 100 students at the school gate. Better than the library, but morning gate arrivals still exclude late-comers and bus users, so it is not random.

Quick answers for fast checking:

#	Level	Answer
1	fluency	5%
2	fluency	10%
3	application	biased
4	application	biased
5	reasoning	self-selected
6	application	representative
7	reasoning	the 20 random

8	reasoning	precision, not accuracy
9	reasoning	random from the full roster

Homework — answer key

Use: Parallels the practice sheet. Item 7 is subtler than it looks — systematic sampling inherits any periodic pattern already in the list, which is the one way it can fail.

Timing: ~15 min at home · independent · review item 8 as the next-day warm-up; it is the sentence students will meet most often outside school.

1. 25 of 500? FLUENCY

Answer: **5%**

$$1. 25 \div 500 = 5\%.$$

If wrong: Answered 25%.

2. 50 of 500? FLUENCY

Answer: **10%**

$$1. 50 \div 500 = 10\%.$$

If wrong: Answered 50%.

3. Only sports teams, about exercise APPLICATION

Answer: **Biased**

1. Team members exercise more than the school average.
2. Asking only them will overstate how much the school exercises.
3. The over-representation is systematic, so it is bias.

If wrong: Said yes because they know most about exercise. Knowing most is exactly what makes them unrepresentative.

4. Hat with all 500 APPLICATION

Answer: **Representative**

1. Every student has an equal chance of selection.
2. No group is favoured, so the sample should resemble the school.

If wrong: Said no because only some are picked. Sampling always means picking some.

5. Online poll on the website **REASONING**

Answer: **Biased — self-selected, and it excludes non-users**

1. Only students who visit the website and choose to respond take part.
2. People with strong views volunteer far more readily than the indifferent.
3. It also excludes anyone without easy internet access, which may correlate with other differences.
4. Two biases stacked: self-selection and coverage.

If wrong: Said it is fair because it is open to all. Open to all is not the same as chosen at random.

6. Every 5th of 500 **APPLICATION**

Answer: **100 students, 20%**

1. $500 \div 5 = 100$ students.
2. $100 \div 500 = 20\%$.

If wrong: Answered 5 students, or 5%.

7. Is every-5th sound? What could break it? **REASONING**

Answer: **Usually sound, but not if the roster has a pattern of period 5**

1. Taking every 5th name from the FULL roster reaches all parts of the list, so normally no group is favoured.
2. It would break if the roster were ordered in a way that repeats every 5. For example, if students were listed in groups of five with the form captain always first, every 5th name might land on the same role each time.
3. Then the sample would systematically over-represent one kind of student.
4. So systematic sampling is sound provided the list has no hidden periodic structure — which is worth checking rather than assuming.
5. With an alphabetical or arbitrary roster, there is no such pattern and the method is fine.

If wrong: Said it is always sound because it is systematic. The method inherits any pattern that already exists in the list.

8. '300 people, so it must be accurate' REASONING

Answer: **Size says nothing about bias; you need to know HOW they were chosen**

1. A sample of 300 chosen badly is still a bad sample. If all 300 were volunteers, all 300 are self-selected.
2. Size reduces random variation, so the estimate is precise — repeatable, consistent, tightly clustered.
3. But precision is not accuracy. A biased method is centred on the wrong value, and 300 responses centre on it more firmly.
4. What you need to know instead: how were the 300 selected? Was every member of the population equally likely to be included? Was anyone excluded by the method?
5. A random sample of 30 would support a better conclusion than 300 volunteers.
6. Ask about the method first. The number is the least informative thing about a sample.

If wrong: Agreed, on the grounds that 300 is a lot. It is a lot of whatever the method gathered, which may be a lot of the wrong people.

Quick answers for fast checking:

#	Level	Answer
1	fluency	5%
2	fluency	10%
3	application	biased
4	application	representative
5	reasoning	self-selected
6	application	100 students, 20%
7	reasoning	sound unless the list has period 5
8	reasoning	ask about the method

Lesson slides — teaching notes & timing

Mini-lesson deck: ~12–15 min, then the practice sheet. Opens G7 Statistics. Slide 5's precision/accuracy split is the language students need for the rest of the domain.

Slide	~Time	Note
1/8	0:00	Frame it: a sample is a shortcut to a whole population, and shortcuts can mislead.
2/8	1:00	Hook — poll A vs B. Do NOT resolve. B wins on the number 200, which is exactly the instinct to dismantle.
3/8	3:00	Define representative and bias. Ask WHO is over-represented in each bad example; naming the group makes it concrete.

4/8	5:00	WE1 — resolve the hook. The key sentence: more data from a biased source is more biased data.
5/8	7:00	WE2 — precision versus accuracy. A dartboard sketch works well: tight cluster off-centre versus loose cluster on-centre.
6/8	9:30	CFU — all-student response. Biased, self-selected. Watch for ‘fair because open to all’.
7/8	11:00	Self-selection by name. It is the bias students will meet most often in real life.
8/8	13:00	Launch the in-class practice sheet.