

Collision Clues

Use evidence and particle collisions to explain reaction rate.

HS-PS1-5 "Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs..."

NAME _____

DATE _____

1 READ AND MARK _____ Read it twice

YOUR JOB Underline each sentence that explains how temperature or concentration changes collision number or collision energy. Circle words that name conditions that should stay the same in a fair comparison.

Why Reactions Speed Up

- 1 When two reactants are mixed, a reaction happens only when their particles collide in a way that can rearrange bonds. Not every collision succeeds. A collision must have enough energy to overcome an energy barrier. Raising temperature makes particles move faster. They collide more often, and a larger fraction of collisions have enough energy. Both changes can increase reaction rate.
- 2 A class studied a simple reaction between solutions A and B. Each trial used the same volumes and concentrations, but the temperature changed. Students timed how long it took for a visible product to appear. Shorter time means a faster rate because the same reaction change was used to signal completion. The results give evidence for a qualitative temperature-rate relationship.

REACTION BETWEEN SOLUTIONS A AND B

Temperature, °C	Time for visible product, s
10	80
20	46
30	27
40	16

- 3 Concentration changes a different part of the collision model. In a fixed volume, a more concentrated solution contains more reactant particles. Particles are closer, so the reactants collide more often. This can raise the reaction rate, even if temperature stays constant. To claim concentration caused a rate difference, compare trials with different concentrations but the same temperature, volume, and reactants.

2 ANSWER WITH EVIDENCE Use the passage

- 1 Use the data table. What happened to the reaction rate as temperature increased from 10 °C to 40 °C? Use the times as evidence.

- 2 Explain why a higher temperature can make the reaction between two reactants faster. Include collision number and collision energy.

- 3 Why can increasing concentration speed up a reaction when temperature stays constant?

- 4 Name three conditions that should stay the same when testing whether concentration changes reaction rate.

3 YOUR TURN Your own words

Create a two-trial investigation of a reaction with two reactants. In four sentences, state whether you will change temperature or concentration, name what you will keep the same, predict which trial will be faster, and explain the prediction using collisions.

PART 1 • READ AND MARK

Underline each sentence that explains how temperature or concentration changes collision number or collision energy. Circle words that name conditions that should stay the same in a fair comparison. Accept any marking that follows this job and points at the right text.

PART 2 • ANSWERS

#	QUESTION	ANSWER
1	Use the data table. What happened to the reaction rate as temperature increased from 10 °C to 40 °C? Use the times as evidence.	The reaction rate increased. The time for the visible product decreased from 80 s at 10 °C to 16 s at 40 °C.
2	Explain why a higher temperature can make the reaction between two reactants faster. Include collision number and collision energy.	Higher temperature makes particles move faster, so they collide more often. A larger fraction of the collisions also have enough energy to overcome the energy barrier.
3	Why can increasing concentration speed up a reaction when temperature stays constant?	A more concentrated solution has more reactant particles in the same volume. The particles are closer together, so collisions between the reactants occur more often.
4	Name three conditions that should stay the same when testing whether concentration changes reaction rate.	Keep temperature, volume, and the reactants the same.

PART 3 • YOUR TURN (SAMPLE ANSWER)

I would test a reaction between solution C and solution D at 15 °C and 35 °C. I would keep the volumes, concentrations, and reactants the same in both trials. The 35 °C trial should be faster. Its particles will collide more often, and more collisions will have enough energy to react.

Accept equivalent explanations that connect temperature to both collision frequency and collision energy, or concentration to collision frequency. For the open task, accept any valid two-reactant investigation with one changed variable, appropriate controls, a rate prediction, and collision-based reasoning.