Dots, Pressure, Limits

Use a particle model to explain invisible gas behavior and judge its limits.

PS.1.e "developing and using models construct, develop, and use models and simulations to illustrate and/or explain observable and unobservable phenomena evaluate limitations of models"

NAME ______________________________ DATE ______________

1 READ AND MARK

Read it twice

YOUR JOB Underline each sentence that tells how the particle model explains evidence, and circle each sentence that states a limit or a reason to revise a model.

Modeling Air Under Pressure

1 Air seems invisible and still, but it is made of tiny particles that move constantly. A scientist cannot watch every particle in a classroom syringe, so she builds a particle model. She represents the gas as many dots moving in random directions inside a container. The dots are not actual particles. They are a tool for explaining observations, such as a plunger pushing back when air is squeezed. In the model, less space makes particle collisions with the syringe walls happen more often.

2 To develop the model, the scientist connects it to evidence. She measures how far a plunger moves when different amounts of force are used. She also repeats the test so one unusual result does not control the model. A computer simulation can extend the idea. In a simulation, she can change the container's volume or the particles' speed and count collisions. If the simulated collision pattern matches pressure measurements, the model gives a useful explanation. If it does not match, she revises the model or checks the investigation.

3 No model is a perfect copy of a gas. The dot model leaves out particle size, mass, and attractive forces. It can show why squeezing usually raises collision frequency, but it cannot predict an exact pressure without measurements and calculations. It is also less useful when a gas cools enough to condense into a liquid, because attractions then matter more. Scientists state such limits so others know which claims the model can support. New evidence, including measurements that disagree with predictions, can lead to a better model.

2 ANSWER WITH EVIDENCE

Use the passage

1. What observation can the scientist make directly, and what unobservable thing does the dot model represent?

2. According to the model, why does a syringe plunger push back more when the air has less space?

3. Name two variables the scientist can change in the computer simulation. How can the simulation help evaluate the model?

4. State one limitation of the dot model and explain why that limitation matters.

3 YOUR TURN

Your own words

A sealed, rigid bottle of air is warmed. In two panels, sketch a particle model before and after warming. Use arrows to show motion. Then write two sentences that explain the pressure change and name one feature or limit your model leaves out.

ANSWER KEY **Dots, Pressure, Limits** GRADES 7-8 · PS.1.e

PART 1 · READ AND MARK

Underline each sentence that tells how the particle model explains evidence, and circle each sentence that states a limit or a reason to revise a model. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	What observation can the scientist make directly, and what unobservable thing does the dot model represent?	**She can directly observe the plunger's movement or measure pressure. The dots represent individual gas particles and their motion or collisions.**
2	According to the model, why does a syringe plunger push back more when the air has less space?	**With less space, gas particles collide with the syringe walls more often.**
3	Name two variables the scientist can change in the computer simulation. How can the simulation help evaluate the model?	**She can change container volume and particle speed. She can compare the simulated collision pattern with pressure measurements to see whether the model gives a useful explanation.**
4	State one limitation of the dot model and explain why that limitation matters.	**The model leaves out particle size, mass, and attractive forces. For example, it is less useful when gas condenses because attractive forces matter more then.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Panel 1 sketch: The same number of dots fill a sealed rigid bottle, and each dot has a short motion arrow. Panel 2 sketch: The same number of dots fill the bottle, and each dot has a longer motion arrow. After warming, faster particles collide with the bottle walls more often and with more force, so the pressure rises. This model does not show particle size or attractive forces.

Accept equivalent observable evidence, such as plunger movement or pressure measurements, and equivalent descriptions of particle collisions. For the open task, look for the same number of particles in both panels, faster motion after warming, a pressure explanation, and one realistic model limitation.