# Dye in Motion

Use a particle model to predict what changes in four trials.

**FSL.3D.4** "Use new information to make a prediction based on a theoretical model."

NAME _____ DATE _____

## 1 READ AND MARK

Read it twice

**YOUR JOB** Underline the rules of the particle model that can help you predict dye movement. Circle the new condition in each trial.

### Which Way Will the Dye Move?

1. Imagine two clear chambers joined by a narrow opening. Each holds the same volume of water, but the left chamber begins with more dissolved blue dye per milliliter than the right. In a particle model, dye molecules move randomly in every direction. While the opening is clear, more molecules cross from the higher-concentration side to the lower-concentration side than cross back. This difference is called net movement. When both sides reach the same concentration, molecules still cross, but equal numbers cross in each direction over time. The model assumes the water itself is not being pumped between chambers.

2. A class sets up four separate trials, each starting with the original unequal dye concentrations. In Trial A, a student adds more dye to the left chamber before opening the passage. In Trial B, a thin stopper seals the opening while the concentrations are still unequal. In Trial C, both chambers are warmed, but neither chamber gains or loses water or dye. In Trial D, a student adds enough dye to the right chamber that its concentration becomes higher than the left chamber's. All other conditions remain the same in each trial.

3. An investigator should not treat a model as a list of memorized outcomes. Instead, the investigator checks which conditions have changed and uses the model's rules to predict a new result. Here, the opening is the only route for dye molecules to pass between chambers. Temperature affects their random motion: in warmer water, they move faster, and diffusion usually happens faster. The model does not include a pump or a chemical reaction that removes dye. A useful prediction names the new condition, states what should happen, and explains the link between them. Each trial is separate, not a step in one long experiment.

## 2 ANSWER WITH EVIDENCE

Use the passage

1. In Trial A, which way will the dye's net movement go after the passage opens? Use the new condition and the model to explain.

2. In Trial B, will dye move between the chambers while the stopper is in place? Explain using the model.

3. In Trial C, how should warming affect the time it takes the chambers to reach equal concentrations? Explain.

4. In Trial D, which way will the dye's net movement go? Identify the new information that changes the prediction.

## 3 YOUR TURN

Your own words

Now suppose the left chamber holds twice as much water as the right chamber, and dye begins only on the left. After the open chambers reach equal dye concentrations, predict which chamber contains more dye in total. Explain your prediction in two or three sentences.

**ANSWER KEY**

# Dye in Motion



## PART 1 · READ AND MARK

Underline the rules of the particle model that can help you predict dye movement. Circle the new condition in each trial. Accept any marking that follows this job and points at the right text.

## PART 2 · ANSWERS

| # | QUESTION | ANSWER |
|---|---|---|
| 1 | In Trial A, which way will the dye's net movement go after the passage opens? Use the new condition and the model to explain. | **Net movement will be from left to right because adding dye leaves the left side at a higher concentration.** |
| 2 | In Trial B, will dye move between the chambers while the stopper is in place? Explain using the model. | **No. The opening is the only route between chambers, and the stopper blocks it.** |
| 3 | In Trial C, how should warming affect the time it takes the chambers to reach equal concentrations? Explain. | **They should reach equal concentrations sooner because dye molecules move faster in warmer water, so diffusion usually happens faster.** |
| 4 | In Trial D, which way will the dye's net movement go? Identify the new information that changes the prediction. | **Net movement will be from right to left because the right chamber now has the higher dye concentration.** |

## PART 3 · YOUR TURN (SAMPLE ANSWER)

The left chamber will contain twice as much dye in total. At equal concentrations, each milliliter has the same amount of dye, but the left chamber holds twice as many milliliters.

For Part 3, accept answers that distinguish total amount of dye from dye concentration. At equal concentrations, the chamber with twice the water contains twice the dye.