Bond Energy Maps

Track atoms and energy through chemical reactions

P.7.5D.4 "Build a model to explain that chemical reactions can store (formation of bonds) or release energy (breaking of bonds)."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Read the passage. Underline where bonds break or form, circle words that tell you whether energy enters or leaves, and number the starting materials and products so you can build a model of each reaction.

A Warmer and a Leaf

1 A hand warmer can heat your fingers without a flame. Inside some disposable warmers, iron powder meets oxygen from the air. The iron slowly becomes iron oxide, a material found in rust. A chemical reaction changes which atoms are joined. A useful model shows the starting materials on the left, an arrow for the change, and the products on the right. It also uses an energy arrow to show whether energy enters the reaction or leaves it. The arrow helps explain what you can feel.

2 Separating bonded atoms takes in energy. Joining atoms in new bonds gives off energy. In the hand warmer, breaking bonds in oxygen takes energy, while making bonds in iron oxide gives off energy. More energy comes out during bond formation than goes in during bond breaking, so the reaction warms its surroundings. The atoms are not created or destroyed; they end up in different arrangements. A model that shows only bonds breaking as the source of heat would miss an important part of the process.

3 A plant shows a different energy result. During photosynthesis, plants use light energy to change carbon dioxide and water into sugar and oxygen. The new arrangement of atoms in the products stores more chemical energy than the starting materials did. Overall, energy enters and is stored, even though some bonds form and release energy during the process. A model can show sunlight entering the reaction and chemical energy stored in its products. Models cannot show every tiny step, but they can track matter and the overall direction of energy.

2 ANSWER WITH EVIDENCE

Use the passage

1. Write a word-and-arrow model for the hand warmer reaction. Include an arrow or label showing where energy goes overall.

2. A model says the hand warmer heats up because breaking oxygen bonds releases energy. How would you correct that model?

3. Write a word-and-arrow model for photosynthesis. Show where light energy enters and identify the products that store chemical energy.

4. Compare the products with the starting materials in both reactions. Which set of products stores more chemical energy, and which stores less? Use energy arrows to explain.

3 YOUR TURN

Your own words

Draw a particle-and-energy model for a fictional reaction in which one A_2 molecule and one B_2 molecule become two AB molecules. Breaking the old bonds takes 8 energy units, and forming the new bonds releases 3 energy units. Show the atoms before and after, add an energy arrow labeled with the net amount, and write one sentence explaining whether the reaction stores or releases energy overall.

ANSWER KEY

Bond Energy Maps

GRADE 7 · P.7.5D.4

PART 1 · READ AND MARK

Read the passage. Underline where bonds break or form, circle words that tell you whether energy enters or leaves, and number the starting materials and products so you can build a model of each reaction. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Write a word-and-arrow model for the hand warmer reaction. Include an arrow or label showing where energy goes overall.	**Iron + oxygen → iron oxide; an energy arrow points away from the reaction toward the surroundings.**
2	A model says the hand warmer heats up because breaking oxygen bonds releases energy. How would you correct that model?	**Breaking oxygen bonds takes in energy. Forming bonds in iron oxide gives off more energy than breaking bonds takes in, so heat leaves the reaction overall.**
3	Write a word-and-arrow model for photosynthesis. Show where light energy enters and identify the products that store chemical energy.	**Carbon dioxide + water + light energy → sugar + oxygen. The products, taken together, store more chemical energy than the starting materials.**
4	Compare the products with the starting materials in both reactions. Which set of products stores more chemical energy, and which stores less? Use energy arrows to explain.	**The photosynthesis products store more chemical energy because energy enters from sunlight. The hand warmer's iron oxide stores less chemical energy than its starting materials because energy leaves as heat.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Before: A-A + B-B
After: A-B + A-B
Energy arrow: 5 units into the reaction
The products store 5 more energy units because breaking old bonds takes 8 units while forming new bonds releases 3.

Accept any clear model that conserves two A atoms and two B atoms and shows a net input of 5 energy units. Students should distinguish the energy needed to break bonds from the energy released when bonds form.