Key Questions For Matter & Energy in Systems

A thorough understanding of how matter and energy move within a living organism includes the ability to answer each of the questions (1-4) listed below. Note that matter movement is addressed at both the beginning (1) and end (4) of your explanation.

1. Matter Movement: Where are Molecules Moving?

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| **Reflection Question** | **Rules to Follow** | **Evidence We Can Observe** |
| How do molecules move to the location of the chemical change? | 1. All materials (solids, liquids, and gases) are made of atoms that are bonded together in molecules. 2. **Scale:** The matter movement question can be answered at the atomic-molecular, cellular, or macroscopic scale. | * Moving solids, liquids, and gases are made of moving molecules. * A change in mass shows that molecules are moving. |
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2. Matter Change: How are atoms in molecules being rearranged into different molecules?

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| **Reflection Question** | **Rules to Follow** | **Evidence We Can Observe** |
| What molecules are carbon atoms in before and after the chemical change?  What other molecules are involved? | 1. **Atoms can be rearranged** to make new molecules, but not created or destroyed. 2. Carbon atoms are bound to other atoms in molecules. 3. **Scale:** The matter change question is always answered at the atomic-molecular scale. | * BTB can indicate CO2 in the air. * Organic materials are made up of molecules containing carbon atoms: |
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3. Energy Change: What is happening to energy?

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| **Reflection Question** | **Rules to Follow** | **Evidence We Can Observe** |
| What forms of energy are involved?  What energy transformations take place during the chemical change? | 1. **Energy can be transformed,** but not created or destroyed. 2. C-C and C-H bonds have more stored chemical energy than C-O and H-O bonds. 3. **Scale:** The energy change question can be answered at the atomic-molecular, cellular, or macroscopic scales. | We can observe indicators of different forms of energy before and after chemical changes:   * light energy * chemical energy stored in organic materials * motion energy * heat energy |
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4. Matter Movement: Where are Molecules Moving?

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| **Reflection Question** | **Rules to Follow** | **Evidence We Can Observe** |
| How do molecules move away from the location of the chemical change? | 1. All materials (solids, liquids, and gases) are made of atoms that are bonded together in molecules. 2. **Scale:** The matter movement question can be answered at the atomic-molecular, cellular, or macroscopic scale. | * Moving solids, liquids, and gases are made of moving molecules * A change in mass shows that molecules are moving. |
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