BRAIN-COMPATIBLE SCIENCE LESSON PLAN

States of Matter

Teacher: *Warren Phillips, Science K–12*

Lesson Objective(s): *What will you be teaching?*

States of matter: the varying energy levels that cause phase changes

Assessment (Traditional/Authentic): *How will you know students have learned the content?*

Students will learn the song "The States of Matter." They will analyze the information in the song and incorporate the vocabulary into their experiments. They will be able to explain the experiments they've seen and other experiments involving phase changes that they have not seen. They will be able to explain why ice floats. They will be involved in a review game that emphasizes important information.

Ways to Gain/Maintain Attention (Primacy): *How will you gain and maintain students' attention? Consider need, novelty, meaning, or emotion.*

Students will need to learn the phases to help them with their understanding. The novelty of singing a song will add excitement to the lesson. As they experience several demos, they will find meaning through other examples in the world around them. They will eventually become emotionally involved as they sing and gain meaning from the lessons.

Content Chunks: *How will you divide and teach the content to engage students' brains?*

(This lesson will probably take two class periods.)

Lesson Segment 1: Sing "The States of Matter" (Copy the song in Strategy 11 as a handout.)

Activities

Students will sing "The States of Matter" and look at the visual representation of each state on the handout. They will be given hand motions that will change as the phase changes and the energy level

increases or decreases. The teacher will also identify and emphasize the vocabulary associated with the song.

Lesson Segment 2: States of Matter Demonstrations

Activities

1. *Spray a can of compressed air (used for cleaning keyboards, etc.). Notice that the can gets very cold as the liquid in the air changes to a gas. A gas requires more energy, so the air must "take" the energy from its surroundings (the can).*
2. *Get a sodium acetate heat pack and heat it in boiling water until it changes to a liquid. When it cools, inside the liquid you'll notice a small disc. Snap the disc and you'll notice the liquid changing to a solid. As it changes, it moves from a higher energy level (liquid) to a lower one (solid) and releases the energy as heat. This heat pack can be reused indefinitely.*
3. *Get under-car neon lights. These light tubes have connecting wires. Connect the wires to a hand-crank generator. When you crank the generator, the tube will light up. This is because you are adding energy to the gas, changing its phase to plasma.*
4. *Get an ice pack. Punch the solid contents and it will cool off immediately. This is because two chemicals are mixed together in an endothermic reaction. This reaction involves an exchange of electrons, which requires energy and "takes" it from its environment (much like the compressed-air demo above).*
5. *Get some ice melt. Take a few spoonfuls of the ice melt and pour them into a 100-milliliter graduated cylinder. Add water to the cylinder and the compound will heat up. This reaction also involves the exchange of electrons that are at a higher energy level and will release the energy as they combine. This is an exothermic reaction.*

Lesson Segment 3: Vocabulary

Activities

Students form pairs and research on computers about endothermic and exothermic reactions. They can research phase changes and information about the demos they've seen—maybe even other demos! They should also research Bose-Einstein condensate (which was mentioned in the song "The States of Matter"). This can be done as a matrix, with each group learning different materials and then teaching each other.

Lesson Segment 4: Visual Manipulative Demonstrations

Activities

1. *Demonstrate why ice floats: Ice is a solid and, therefore, should be denser (heavier) than liquid water. If it were, then ice would sink to the bottom of the ocean and the variety of life on earth, as we know*

it, would not exist. To show why ice floats, a water molecule kit (see 3-D Molecular Designs at www.3dmoleculardesigns.com) is very effective. The kit contains plastic models of water molecules that will attach only with reverse polarity (opposite magnetism). Six of them match up to create a round molecular structure with a big empty space in the middle. When ice forms, six liquid molecules arrange themselves into this pattern (which is why snowflakes have a hexagonal design) and, because of the empty space, it is lighter than water. This manipulative is very effective at demonstrating an important and difficult concept.

2. *Students will sing the song "The States of Matter" and look at the visual representation of each state on the handout. They will be given hand motions that will change as the phase changes and the energy level increases or decreases. The teacher will also ask students to explain the vocabulary associated with the song and how the song relates to the other activities they have done.*
3. *Have students create questions from the material learned. Arrange the students in teams, and review the materials while playing a game of Jeopardy or Wheel of Fortune. Use Eggspert or Quizzillion Build Your Own Quiz Game to increase the hands-on involvement.*

Brain-Compatible Strategies: *Which will you use to deliver content?*

- ☑ Brainstorming and discussion
- ☐ Drawing and artwork
- ☐ Field trips
- ☑ Games
- ☐ Graphic organizers, semantic maps, and word webs
- ☐ Humor
- ☑ Manipulatives, experiments, labs, and models
- ☑ Metaphors, analogies, and similes
- ☐ Mnemonic devices
- ☑ Movement
- ☑ Music, rhythm, rhyme, and rap
- ☑ Project-based and problem-based instruction
- ☑ Reciprocal teaching and cooperative learning
- ☐ Role plays, drama, pantomimes, and charades
- ☐ Storytelling
- ☐ Technology
- ☐ Visualization and guided imagery
- ☑ Visuals
- ☐ Work study and apprenticeships
- ☑ Writing and journals