Molecules on the Move (Physical Change: Energy Transfer)

Grade Level or Special Area: 6th Grade Science
Written by: Wendy Haggerton and Carey Cleer, Mills Elementary, Hobbs, NM
Length of Unit: Seven Lessons ~ 45-60 minutes each

I. ABSTRACT

A. This unit focuses on the Physical Change: Energy Transfer section from the 6th grade *Core Knowledge Sequence*. It explores the concepts and properties of the states of matter while providing hands-on activities. Students will investigate changing phases of matter, expansion and contraction, and distillation.

II. OVERVIEW

A. Concept Objectives
   1. Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy. (NM Strand II, Standard I: Physical Science)
   2. Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically (NM Strand I, Standard I: Scientific Thinking and Practice)

B. Content from the *Core Knowledge Sequence*
   1. States of Matter (solid, liquid, gas) in terms of molecular motion (p. 154)
      a. In gases, loosely packed atoms and molecules move independently and collide often. Volume and shape change readily. (p. 154)
      b. In liquids, atoms and molecules are more loosely packed than in solids and can move past each other. Liquids change shape readily but resist change in volume. (p. 154)
      c. In solids, atoms and molecules are more tightly packed and can only vibrate. Solids resist change in shape and volume. (p. 154)
   2. Most substances are solid at low temperatures, liquid at medium temperatures, and gaseous at high temperatures. (p. 154)
   3. A change of phase is a physical change (no new substance is produced). (p. 154)
   4. Matter can be made to change phases by adding or removing energy. (p. 154)
   5. Expansion and contraction (p. 154)
      a. Expansion is adding heat energy to a substance, which causes the molecules to move more quickly and the substance to expand. (p. 154)
      b. Contraction is when a substance loses heat energy, the molecules slow down, and the substance contracts. (p. 154)
      c. Water as a special case: water expands when it changes from a liquid to a solid. (p. 154)
   6. Changing phases: condensation; freezing; melting; boiling (p. 154)
      a. Different amounts of energy required to change the phase of different substances. (p. 154)
      b. Each substance has its own melting and boiling point. (p. 154)
      c. The freezing point and boiling point of water (in degrees Celsius and Fahrenheit). (p. 154)
   7. Distillation: separation of mixtures of liquids with different boiling points. (p. 154)

C. Skill Objectives
   1. Demonstrate prior knowledge of the three common states of matter. (NM Strand II, Standard I: Physical Science: A.1)

2. Identify three common states of matter (NM Strand II, Standard I: Physical Science: A.1)
3. Predict the outcome of adding heat to a substance (NM Strand I, Standard I: Scientific Thinking and Practice: A)
4. Record observations during an experiment (NM Strand I, Standard I: Scientific Thinking and Practice: A)
5. Predict the effect of heat energy on expansion and contraction (NM Strand I, Standard I: Scientific Thinking and Practice: A)
6. Explain why a change of phase is a physical change (NM Strand II, Standard I: Physical Science: A.1)
7. Create a graph (NM Strand I, Standard I: Scientific Thinking and Practice: A)
8. Draw and label a diagram of the process of distillation (NM Strand II, Standard I: Physical Science: A.1)

III. BACKGROUND KNOWLEDGE

A. For Teachers
   1. Anne Zeman & Kate Kelly, *Everything You Need to Know About Science*
   2. Great Source, *Physical Science Daybook Teacher's Edition*
   3. Kids' Stuff People, *Science Yellow Pages for Students and Teachers*

B. For Students
   1. First Grade: Matter, Properties of Matter
   2. Fourth Grade: Chemistry
   3. Fifth Grade: Chemistry: Matter and Change

IV. RESOURCES

A. AIMS Education Foundation, *Chemistry Matters*
B. Anne Zeman & Kate Kelly, *Everything You Need to Know About Science*
C. Delta Science, *Science Dictionary Grades 5-6*
D. Delores Bouffard, *Discover! Solids, Liquids, and Gases*
E. E.D. Hirsch, *What your 6th Grader Needs to Know*
F. Edward P. Ortleb & Richard Cadice, *Physical and Chemical Changes*
G. Great Source, *Physical Science Daybook Teacher's Edition*
H. Kids' Stuff People, *Science Yellow Pages for Students and Teachers*
I. The Mailbox Magazine, *Science Made Simple Grades 4-6*
J. http://www.spartechsoftware.com/reeko/Experiments/RocketPoweredPennys.htm
K. http://www.chemforlife.org/experiments/distillation/
L. http://wattles.troy.k12.mi.us/wattlesstaff/jmorris/freezingpoints.htm
M. http://environmentalchemistry.com/yogi/periodic/boilingpoint.html
N. http://id.mind.net/~zona/mstm/physics/mechanics/energy/heatAndTemperature/changesOfPhase/changeOfState.html

V. LESSONS

Lesson One: What Do We Know? (45-60 minutes)

A. *Daily Objectives*
   1. Concept Objective(s)
      a. Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy. (NM Strand II, Standard I: Physical Science)
   2. Lesson Content
      a. States of Matter (solid, liquid, gas) in terms of molecular motion (p. 154)

1. In gases, loosely packed atoms and molecules move independently and collide often. Volume and shape change readily. (p. 154)
2. In liquids, atoms and molecules are more loosely packed than in solids and can move past each other. Liquids change shape readily but resist change in volume. (p. 154)
3. In solids, atoms and molecules are more tightly packed and can only vibrate. Solids resist change in shape and volume. (p. 154)

3. Skill Objective(s)
   a. Demonstrate prior knowledge of the three common states of matter. (NM Strand II, Standard I: Physical Science: A.1)

B. *Materials*
1. Appendix A: KWL Chart
2. Pen/pencil (for each student)
3. Crayons/map pencils (for each student)
4. Notebook paper (10 pages per student)
5. 11x14 large construction paper (1 per student, any color)

C. *Key Vocabulary*
1. KWL Chart – A **KWL chart** is a visual representation of what students already know, what they want to know, and what they learned at the end of a lesson.
2. Solids – In a **solid**, atoms and molecules are tightly packed together, usually in a regular pattern and can only vibrate. Solids can resist change in shape and volume.
3. Liquids – In a **liquid,** atoms and molecules are more loosely packed than in solids and can move past each other. Liquids change shape readily but resist change in volume.
4. Gases – In a **gas**, atoms and molecules are loosely packed and move independently and collide often. Gases change volume and shape readily.
5. Plasma – **Plasma** exists only under special conditions. It occurs when the atoms of gases are heated to an incredibly high temperature (100,000 C, 180,000 F) and becomes electrically charged.

D. *Procedures/Activities*
1. Tell the students "Look around the room. Tell me what you see." Answers should include the solids, liquids, and gases that are present in the room. (Teacher note: since the gas in the room cannot be seen, you may need to guide the students into thinking about this phase).
2. Write their responses on the board.
3. Ask the students if they can put the items they said in groups.
4. Guide the students to the concepts of solids, liquids, and gases, if needed. (Vocabulary on these words will be developed in the next lesson)
5. Tell the students that in the next unit you will be discussing matter and how heat affects phase changes.
6. Pass out Appendix A: KWL Chart
7. Explain to the students what a KWL chart is and how to use it to pre-assess their knowledge.
8. Have students brainstorm together the "What I Know" section. Ask for 5 things for the students to write down together on their chart.
9. Instruct the students to come up with 3 more things to write on this section on their own.
10. Repeat steps 8 and 9 for the "What I Want to Know" section.

11. Ask the students "Can we complete the *What I learned* section?" Answers should be no, because they have not learned the content yet. Explain that they will be filling out this section as new concepts are learned.
12. Pass out a sheet of construction paper to each student.
13. Fold the construction paper in half. This will be the cover to the "Phase Changes" journal.
14. Have the students design and decorate the cover with states of matter.
15. Have each student get 10 sheets of notebook paper.
16. Instruct the students to put Appendix A: KWL Chart on top of the notebook paper.
17. Take Appendix A: KWL Chart and the notebook paper and place inside the folded construction paper. Staple along the folded edge to secure them to the construction paper.
18. Once the journal is created, students will then complete the first entry in their journal.
19. Journal Entry 1: Write about the things you think we will talk about or what you would like us to discover during this unit (teacher can specify length of journal entries).
20. *Extension*: To extend the learning of this unit, you can choose to add a fourth section to the KWL chart. This section can either be titled, "What I Can Still learn" or "How Does This Unit Apply to My Life."

E. *Assessment/Evaluation*
1. Teacher will collect journals and assess both the KWL chart for completion of the first two sections and assess that the journal topic was followed.

Lesson Two: Which Phase is it? (45-60 minutes)

A. *Daily Objectives*
1. Concept Objective(s)
    a. Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy. (NM Strand II, Standard I: Physical Science)
2. Lesson Content
    a. States of Matter (solid, liquid, gas) in terms of molecular motion (p. 154)
        1. In gases, loosely packed atoms and molecules move independently and collide often. Volume and shape change readily. (p. 154)
        2. In liquids, atoms and molecules are more loosely packed than in solids and can move past each other. Liquids change shape readily but resist change in volume. (p. 154)
        3. In solids, atoms and molecules are more tightly packed and can only vibrate. Solids resist change in shape and volume. (p. 154)
3. Skill Objective(s)
    a. Identify three common states of matter (NM Strand II, Standard I: Physical Science: A. 1)

B. *Materials*
1. 10-15 dried pinto beans
2. Clear glass plate
3. Cross stitch hoop
4. Overhead projector
5. 11x17 large construction paper (1 per student, any color)
6. Adhesive dots (any size will work)
7. Pen/Pencil (per student)

C. *Key Vocabulary*

1. Solids – In a **solid**, atoms and molecules are tightly packed together, usually in a regular pattern and can only vibrate. Solids can resist change in shape and volume.
2. Liquids – In a **liquid,** atoms and molecules are more loosely packed than in solids and can move past each other. Liquids change shape readily but resist change in volume.
3. Gases – In a **gas**, atoms and molecules are loosely packed and move independently and collide often. Gases change volume and shape readily.
4. Plasma – **Plasma** exists only under special conditions. It occurs when the atoms of gases are heated to an incredibly high temperature (100,000 C, 180,000 F) and becomes electrically charged.
5. Phase change – A **Phase Change** occurs when one state of matter transforms into another state of matter.
6. Molecular motion – **Molecular motion** is the movement of molecules within matter.

D. *Procedures/Activities*

1. *Teacher Demonstration:* (Adapted from The Best of the Mailbox Science)
    a. Explain to students the definition of molecular motion and that you will demonstrate three common phases of matter.
    b. *Solid*: to demonstrate the movement of a solid, place the beans on the glass plate. Place the plate on the overhead projector. Move the plate carefully back and forth causing the beans to vibrate in place without changing their positions.
    c. *Liquid*: to demonstrate the movement of a liquid, place the hoop on the overhead projector. Pour the beans inside the hoop. Move the hoop gently, so the beans bounce around the hoop randomly.
    d. *Gas*: to demonstrate the movement of a gas, place both the beans and the hoop on the glass plate. Shake the plate and hoop together, so that the beans fly out of the hoop and off of the plate.
2. Ask the students to recall the examples of solids, liquids, and gases from the previous lesson. Discuss any other examples the students may give.
3. For vocabulary development, the students will copy the vocabulary in their journals before the lesson journal entry.
4. Divide the students into 3 groups.
5. Assign each group a different phase of matter.
6. Have each group develop a whole body movement to demonstrate their assigned phase.
7. Each group will then show the class their body movement.
8. Pass out 1 sheet of construction paper to each student.
9. Pass out adhesive dots (teacher determined number).
10. Have the students fold the construction paper into three equal parts.
11. Lay the construction paper flat and label the sections, “Solid,” “Liquid,” and “Gas.”
12. Instruct the students to place the adhesive dots in each section giving a visual representation of each phase. (Solid: dots are close together, Liquid: dots are further apart, Gas: dots are few and far between)
13. Add any new information to Appendix A: KWL Chart under the “What We Learned” section. Teacher can do this as a class, or have the students complete it independently (note: if you included the extension sections, you can also add to them at this time.)
14. Journal Entry 2: (Part 1) Have the students identify and describe the three most common states of matter. (Part 2) The students will pretend to be one phase and describe how it feels to be that way for one day.

15. *Extension*: To extend the learning of the states of matter, the teacher can introduce plasma, its properties, and examples.

E. *Assessment/Evaluation*
1. Teacher will observe each group's movement for accuracy.
2. Teacher will collect the Dot Activity and check to see that each phase is represented accurately.
3. Teacher will collect journals and assess that the journal topic was followed.

Lesson Three: Make it Rain! (45-60 minutes)

A. *Daily Objectives*
1. Concept Objective(s)
    a. Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy. (NM Strand II, Standard I: Physical Science)
    b. Understand the processes of scientific investigations and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically (NM Strand I, Standard I: Scientific Thinking and Practice)
2. Lesson Content
    a. Most substances are solid at low temperatures, liquid at medium temperatures, and gaseous at high temperatures (p.154)
    b. A change of phase is a physical change (no new substance is produced.) (p.154)
    c. Matter can be made to change phases by adding or removing energy. (p.154)
3. Skill Objective(s)
    a. Predict the outcome of adding heat to a substance. (NM Strand I, Standard I: Scientific Thinking and Practice: A)
    b. Record Observations during an experiment. (NM Strand I, Standard I: Scientific Thinking and Practice: A)

B. *Materials*
1. Appendix B: Phase Change Observation Chart
2. Appendix C: Phase Change Observation Chart (answer key)
3. Ice (8-10 cubes)
4. Pan
5. Hot plate
6. Metal pie plate
7. Journals (from Lesson 1)
8. Pen/Pencil (per student)

C. *Key Vocabulary*
1. Temperature – **Temperature** is the measure of the average kinetic energy of the particles in a sample of matter.
2. Heat – **Heat** is a form of energy associated with the motion of atoms or molecules.
3. Physical Change – A **physical change** is when a substance undergoes some form of change that does not change the substance at the molecular level. Physical changes do not create new substances, as in chemical change, but result in the same substance in a different form or shape.

D. *Procedures/Activities*
1. Discuss with the students how heat and temperature affect the state of matter of a substance.

2. Instruct the students to write the vocabulary (temperature, heat, physical change) and the definitions in their journals.
3. Have students predict what will happen if heat is added to an ice cube. Use Appendix B: Phase Change Observation Chart.
4. Tell the students that when most substances are solid, an increase in heat can create a liquid. A further increase can eventually create a gas.
5. Place an ice cube in a pan and put it on the hot plate.
6. Have the students make observations about the ice and record them on Appendix B: Phase Change Observation Chart.
7. Discuss with the students that the solid (ice) is at a low temperature.
8. As the hot plate heats up the ice, the heat increases because of added energy and the solid melts into a liquid.
9. Have the students record their observations (Appendix B: Phase Change Observation chart) during this first phase change.
10. When you begin to see water vapor rising from the pan, place the metal pie plate over the gas and discuss condensation (heat leaving the gas).
11. Have the students record their observations (Appendix B: Phase Change Observation chart) during this phase change.
12. During this demonstration, explain to the students that although they are witnessing the ice changing phase, throughout the changes, the molecular make-up of the substance remains H20 ~ nothing new is created. It remains "water" in all three states. A physical change has occurred.
13. Discuss phase changes and how they require either the addition of heat energy (melting and evaporation) or subtraction of heat energy (condensation and freezing).
14. Have the students complete Appendix B: Phase Change Observation Chart
15. Add any new information to Appendix A: KWL Chart under the "What We Learned" section. Teacher can do this as a class, or have the students complete it independently (note: if you included the extension sections, you can also add to them at this time).
16. Journal Entry 3: Think of other ways you could physically change a substance without making a new substance. Write these in your journal. (Teacher note: answers could include, but are not limited to: tearing, cutting, painting, change of size, shape, etc.)

E. *Assessment/Evaluation*
1. Teacher will assess students' completion of Appendix B: Phase Change Observation Chart for accuracy (Use Appendix C: Phase Change Observation answer key)
2. Teacher will collect journals and assess that the journal topic was followed.

Lesson Four: Brochure (45-60 minutes to discuss and assign project; 5-8 days to complete)

A. *Daily Objectives*
1. Concept Objective(s)
    a. Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy. (NM Strand II, Standard I: Physical Science)
2. Lesson Content
    a. States of Matter (solid, liquid, gas) in terms of molecular motion (p.154)
        1. In gases, loosely packed atoms and molecules move independently and collide often. Volume and shape change readily. (p.154)

2. In liquids, atoms and molecules are more loosely packed than in solids and can move past each other. Liquid change shape readily but resist change in volume. (p.154)
3. In solids, atoms and molecules are more tightly packed and can only vibrate. Solids resist change in shape and volume. (p.154)

b. A change of phase is a physical change (no new substance is produced.) (p. 154)
c. Matter can be made to change phases by adding or removing energy. (p.154)

3. Skill Objective(s)
   a. Identify the states of matter (NM Strand II, Standard I: Physical Science: A.1)
   b. Explain why a change of phase is a physical change (NM Strand II, Standard I: Physical Science: A.1)

B. *Materials*
1. Appendix D: Brochure Directions (using computer)
2. Appendix E: Brochure Directions (using paper)
3. Samples of brochures
4. Computer/ Internet access (as needed)
5. Desktop publishing program (ex. Microsoft Publisher)
6. Paper
7. Journals (from Lesson 1)
8. Pen/Pencil (per student)

C. *Key Vocabulary*
1. Brochure – A **brochure** is a small booklet or pamphlet, often containing promotional material or product information.

D. *Procedures/Activities*
1. Get samples of brochures from your local travel agent to share with the students as examples.
2. Discuss the purpose of a brochure.
3. Share examples that you have collected.
4. Instruct the students to write the vocabulary (brochure) and the definition in their journals.
5. Tell the students they will be researching the states of matter and phase changes and the information will be complied in a brochure.
6. Pass out Appendix D/E: Brochure Directions. The students can use either the computer or paper to complete the assignment depending on the technology available.
7. Discuss Appendix D/E: Brochure Directions and answer any questions.
8. Decide if class time or computer lab time (if possible) will be used to complete this project and assign a due date (Usually 5-8 days is sufficient).
9. After brochure is completed, add any new information to Appendix A: KWL Chart under the "What We Learned" section. Teacher can do this as a class, or have the students complete it independently (note: if you included the extension sections, you can also add to them at this time).
10. Journal Entry 4: What new information did you learn about States of Matter and Phase Changes? Write about it in your journal.

E. *Assessment/Evaluation*
1. Teacher will use Appendix D/E: Brochure Directions (using computer or paper) to evaluate students' projects.
2. Teacher will collect journals and assess that the journal topic was followed.

Lesson Five: Expansion and Contraction (45-60 minutes)

A. *Daily Objectives*

1. Concept Objective(s)
    a. Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy. (NM Strand II, Standard I: Physical Science)
    b. Understand the processes of scientific investigation and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically (NM Strand I, Standard I: Scientific Thinking and Practice)
1. Lesson Content
    a. Expansion is adding heat energy to a substance, which causes the molecules to move more quickly and the substance to expand. (p.154)
    b. Contraction is when a substance loses heat energy, the molecules slow down, and the substance contracts (p. 154)
    c. Water as a special case: water expands when it changes from liquid to a solid. (p.154)
2. Skill Objective(s)
    a. Predict the affect of heat energy on expansion and contraction. (NM Strand I, Standard I: Scientific Thinking and Practice: A)
    b. Record observations during an experiment. (NM Strand I, Standard I: Scientific Thinking and Practice: A)

B. *Materials*

1. Appendix F: Balloon Investigation
2. Ball and Ring Apparatus
3. Balloons (2 per group)
4. Bottles (2 per group, plastic)
5. Hot and cold water
6. Containers (2 per group, and kind big enough for a plastic bottle to sit in)
7. Journals (from Lesson 1)
8. Pen/Pencil (per student)

C. *Key Vocabulary*

1. Expand – **Expand** means to become greater in size, volume, quantity, or scope.
2. Contract – **Contract** means to reduce in size by drawing together or shrinking.

D. *Procedures/Activities*

1. Discuss with students the terms expansion and contraction.
2. Instruct the students to write the vocabulary (expand, contract) and the definitions in their journals.
3. Use the ball and ring apparatus to demonstrate how heating a substance will cause it to expand. (When cool, the ball passes easily through the matching brass ring; when hot, it won't go through; these can be purchased from most science supply companies).
4. Tell the students they will be conducting an experiment to demonstrate the effects of heat energy and how it makes thing expand or contract.
5. Pass out Appendix F: Balloon Investigation. The next set of steps will completed by the students on this Appendix.
6. Guide the students to develop questions on expansion and contraction.
7. Develop a hypothesis about heat energy and its affects on expansion and contraction.

8. Direct the students on the steps for the experiment and the materials needed.
    a. Place the balloons on the bottles so that they cover the openings.
    b. Place and hold one bottle/balloon in the cold water, observe.
    c. Place and hold the other bottle/balloon in hot water, observe.
    d. Switch the bottles around: the cold one goes into the hot water and the hot one goes into the cold water. Observe.
9. Have the students complete Appendix F: Balloon Investigation.
10. Discuss with the students how water as a special case: water expands when it changes from a liquid to a solid.
11. Add any new information to Appendix A: KWL Chart under "What We Learned Section. Teacher can do this as a class, or have the students complete it independently (note: if you included extension sections, you can also add to them at this time.)
12. Journal Entry 5: Imagine you are in a hot air balloon. Relate the Balloon Investigation to what happens when heat energy is added or taken away from the hot air balloon (Discussion might be needed on how a hot air balloon works).
13. *Extension Activity*: The following website can be used for further exploration on expansion and contraction. http://www.spartechsoftware.com/reeko/Experiments/RocketPoweredPennys.htm

E. *Assessment/Evaluation*
1. Teacher will evaluate completed Appendix F: Balloon Investigation.
2. Teacher will collect journals and assess that the journal topic was followed.

Lesson Six: Changing Phases (45-60 minutes)

A. *Daily Objectives*
1. Concept Objective(s)
    a. Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy. (NM Strand II, Standard I: Physical Science)
    b. Understand the processes of scientific investigation and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically (NM Strand I, Standard I: Scientific Thinking and Practice)
2. Lesson Content
    a. Changing Phases: condensation; freezing; melting; boiling
        1. Different amounts of energy are required to change the phase of different substances. (p.154)
        2. Each substance has its own melting and boiling point. (p. 154)
        3. The freezing point and boiling point of water (in degrees Celsius and Fahrenheit) (p.154)
3. Skill Objective(s)
    a. Create a graph (NM Strand I, Standard I: Scientific Thinking and Practice: A)

B. *Materials*
1. Appendix G: Melting and Boiling Points
2. 3 saucepans
3. 3 hot plates
4. 3 candy thermometers
5. 3 oven mitts
6. 3 stirring spoons

7. ½ cup of peanut butter
8. ½ cup chocolate chips
9. ½ cup marshmallows
10. Journals (from Lesson 1)
11. Pen/Pencil (per student)

C. *Key Vocabulary*

1. Condensation – **Condensation** is the process by which a gas or vapor changes to a liquid.
2. Freezing – **Freezing** is to pass from the liquid to the solid state by loss of heat.
3. Melting – **Melting** is to change from a solid to a liquid state especially by the application of heat.
4. Boiling - **Boiling** is to change from a liquid to a vapor by the application of heat.
5. Celsius – **Celsius** is of or relating to a temperature scale that registers the freezing point of water at 0° and the boiling point as 100° under normal atmospheric pressure.
6. Fahrenheit – **Fahrenheit** was discovered by a German-born physicist who invented the mercury thermometer (1714) and devised the Fahrenheit temperature scale.

D. *Procedures/Activities*

1. Teacher can use http://id.mind.net/~zona/mstm/physics/mechanics/energy/heatAndTemperature/changesOfPhase/changeOfState.html or other resources to discuss how heat energy affects different substances.
2. Instruct the students to write the vocabulary (condensation, freezing, melting, boiling, Celsius, Fahrenheit) and the definitions in their journals.
3. *Melting Point Demonstration:* (Adapted from The Best of the Mailbox Science)
   a. Have the students estimate the melting temperatures of the peanut butter, chocolate chips, and marshmallows.
   b. Ask the students to consider what kinds of factors could affect the melting points.
   c. Place the peanut butter, chocolate chips, and marshmallows into separate saucepans.
   d. Place each pan on a hot plate and set the temperature to medium.
   e. Have students stir each food continuously.
   f. Have another student hold the candy thermometer in the foods so that they do not touch the bottom of the saucepans. Make sure the students use oven mitts to hold the thermometers.
   g. Have the students announce temperature as soon as the foods are thoroughly melted.
4. Discuss how condensation and freezing occur when heat energy is taken away. (Opposite of the Melting Point Demonstration)
5. Have the students guess the freezing point and boiling point of water in both Celsius and Fahrenheit. Tell the students the correct temperatures.
6. Use the website: http://environmentalchemistry.com/yogi/periodic/boilingpoint.html to show the different boiling points of different elements.
7. Students will use Appendix G: Melting and Boiling Points to research 5 substances and either their melting point or boiling point. Students can either use the Internet or other available resources.
8. Students will create a graph plotting the 5 different melting or boiling point of their substances. (A spreadsheet program or a drawn graph can be used to plot the data).
9. Add any new information to Appendix A: KWL Chart under "What We Learned Section. Teacher can do this as a class, or have the students complete it independently (note: if you included extension sections, you can also add to them at this time.)

10. Journal Entry 6: In your own words, explain what happens to a substance when heat energy is either taken away or added.
11. *Extension Activity:* The following website can be used for further exploration on the different freezing points of liquids.
    http://wattles.troy.k12.mi.us/wattlesstaff/jmorris/freezingpoints.htm

E. *Assessment/Evaluation*
1. Teacher will evaluate students' graphs and check for accuracy.
2. Teacher will collect journals and assess that the journal topic was followed.

Lesson Seven: Distillation (45-60 minutes)

A. *Daily Objectives*
1. Concept Objective(s)
   a. Understand the structure and properties of matter, the characteristics of energy, and the interactions between matter and energy. (NM Strand II, Standard I: Physical Science)
   b. Understand the processes of scientific investigation and use inquiry and scientific ways of observing, experimenting, predicting, and validating to think critically (NM Strand I, Standard I: Scientific Thinking and Practice)
2. Lesson Content
   a. Distillation: separation of mixtures of liquids with different boiling points (p.154)
3. Skill Objective(s)
   a. Draw and label a diagram of the process of distillation(NM Strand II, Standard I: Physical Science: A.1)

B. *Materials*
1. Computer/Internet access
2. Journals (from Lesson 1)
3. Pen/Pencil (per student)

C. *Key Vocabulary*
1. Distillation – **Distillation** is the evaporation and subsequent collection of a liquid by condensation as a means of purification.

D. *Procedures/Activities*
1. Instruct the students to write the vocabulary (distillation) and the definition in their journals.
2. Use the website: http://www.chemforlife.org/experiments/distillation/ to show an animation of distillation. On the website, click on the icon "View Flash Experiment".
3. Use the diagram from the website as an example for the students draw and label the process of distillation.
4. Add any new information to Appendix A: KWL Chart under "What We Learned Section. Teacher can do this as a class, or have the students complete it independently (note: if you included extension sections, you can also add to them at this time.)
5. Journal Entry 7: Write a paragraph explaining the process of distillation.

E. *Assessment/Evaluation*
1. Teacher will refer to diagram on website to assess students' diagrams.
2. Teacher will collect journals and assess that the journal topic was followed.

VI. CULMINATING ACTIVITY (Optional)

A. At the end of the unit, students can use a multimedia program (Power Point) or publishing program (Microsoft Publisher) to create a slideshow or newsletter that focuses on one phase of matter, or one of the topics from the unit (physical changes, expansion/contraction, distillation). It can include, but is not limited to vocabulary, diagrams/pictures, explanations of topic, examples, etc. Teachers can assess the project by making sure the criteria they set are met.

VII. HANDOUTS/WORKSHEETS

A. Appendix A: KWL Chart
B. Appendix B: Phase Change Observation Chart
C. Appendix C: Phase Change Observation Chart (answer key)
D. Appendix D: Brochure Directions (using computer)
E. Appendix E: Brochure Directions (using paper)
F. Appendix F: Balloon Investigation
G. Appendix G: Melting and Boiling Points

VIII. BIBLIOGRAPHY

A. AIMS Education Foundation, *Chemistry Matters*. California: AIMS, 2003, ISBN 978-1-932093-03-2
B. Bouffard, D. *Discover! Solids, Liquids, & Gases.* Missouri: Milliken Publishing, 1999, ISBN 0-7877-0437-7
C. Delta Education. *Delta Science Dictionary.* New Hampshire: Delta, 2003, ISBN 1-59242-299-3
D. Frank, M. *Science Yellow Pages.* Tennessee: Incentive Publications, 2002, ISBN 0-86530-558-7
E. Harmon, C. *Physical Science Daybook Teacher's Edition.* California: Houghton Mifflin, 2003, ISBN 0-669-49252-3
F. Hirsch, E.D. *What your 6th Grader Needs to Know.* New York: Dell Publishing, 1993, ISBN 0-385-31467-1
G. Mondello, C. *The Best of the Mailbox: Science Made Simple.* North Carolina, The Education Center, 1999, ISBN 1-56234-275-4
H. Ortleb, E. *Physical and Chemical Changes.* Missouri: Milliken Publishing, 1993, ISBN 1-55863-062-7
I. Zeman, A. *Everything You Need to Know About Science.* New York: Scholastic, 1993, ISBN 0-590-49357-4

Appendix A
KWL Chart
States of Matter

What I KNOW	What I WANT to Know	What I LEARNED	

Appendix B
Phase Change Observation Chart

Name :_____
Date:_____

What will happen to an ice cube if heat is added?
Prediction:

_____

_____

Complete the chart with your observations of the phase change demonstration.

State of Matter	Form of H2O	Observations	Heat movement during phase change (Gaining or Losing)	Term for phase change after heat was added or taken away
Solid				
Liquid				
Gas				

Describe what would happen to the droplets of water on the pie plate if more heat energy was taken away.
_____
_____

What would be the term for this phase change? _____

Appendix C
Phase Change Observation Chart
Answer Key

Name :_____
Date:_____

What will happen to an ice cube if heat is added?
Prediction: Accept reasonable answers

_____

_____

Complete the chart with your observations of the phase change demonstration.

State of Matter	Form of H2O	Observations	Heat movement during phase change (Gaining or Losing)	Term for phase change after heat was added or taken away
Solid	Ice	Accept reasonable observations	Gaining	Melting
Liquid	Water		Gaining	Vaporizing (boiling and evaporation)
Gas	Water Vapor		Losing (gas changing back to a liquid)	Condensation

Describe what would happen to the droplets of water on the pie plate if more heat energy was taken away.
It could become a solid again.

_____

_____

What would be the term for this phase change? Freezing _____

Appendix D
Brochure Directions (Computer)

States of Matter Brochure

Your task is to research the three common states of matter and phase changes. When you have enough information, you are going to use a computer publishing program (ex. Microsoft publisher) to design and create a brochure to communicate your findings. Each column of your brochure needs a heading (Solid, Liquid, Gas, Phase Changes)

You will be evaluated on the following criteria:

1. Accuracy of information
2. Clear and concise grammar
3. Diagrams/Pictures (at least 4)
4. Title
5. Headings for each topic
6. Extra Credit: Add information about a fourth state of matter, plasma, to brochure

Your brochure is due: _____

Appendix E
Brochure Directions (Paper)

States of Matter Brochure

Your task is to research the three common states of matter and phase changes. When you have enough information, you are going to design and create a brochure to communicate your findings. To make the brochure, you will fold a sheet of construction paper into three equal sections and either write or type your information in the columns. Each column needs a heading (Solid, Liquid, Gas, Phase Changes)

You will be evaluated on the following criteria:

1. Accuracy of information
2. Clear and concise grammar
3. Diagrams/Pictures (at least 4)
4. Title
5. Headings for each column
6. Extra Credit: Add information about a fourth state of matter, plasma, to brochure

Your brochure is due: _____

Appendix F
Balloon Investigation

Name:_____
Date:_____

Observe and Ask Questions

Make a list of questions you have about expansion and contraction.

_____
_____
_____

Form a Hypothesis

A hypothesis is a suggested answer to the question you are investigating.

_____
_____

Plan an Experiment

To plan an experiment, you must first identify the important variables.

The variable I will change is

_____

The variable I will observe or measure is

_____

The variables I will keep the same, or *control*, are the

_____

Make a List of Materials

What will you need to carry out your experiment?

_____
_____
_____
_____
_____
_____

Appendix F
Balloon Investigation (continued)

Develop a Procedure

Write the steps you will follow to set up an experiment and collect data

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Conduct the Experiment

Follow your plan and observe. Record your observations. Be sure to note anything unusual or unexpected.

Observations on balloon and bottle placed in cold water

_____
_____
_____

Observations on balloon and bottle placed in hot water

_____
_____
_____

Draw Conclusions

Was your hypothesis supported by your observations in the experiment?

_____

How would you revise the experiment, if needed?

_____

Describe the affect heat energy has on expansion and contraction

_____
_____
_____

Graphing Melting and Boiling Points

Your task is to research 5 substances to find either the melting point or boiling point of each. Record your findings on a graph. The graph can be computer generated (ex. Microsoft Excel) or drawn on graph paper. Chose the best type of graph to represent your data.

Be sure to include the following:

1. Title
2. Proper labels on the X and Y axis
3. Legend
4. Accurate data representation

You also need to include 5 statements describing your data. These statements can be written on the back of your graph.