Unit Title: Exploring the Properties of Matter	**Content Area:** Physical Science	**Grade Level:** 6

Unit Summary: Physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science.

Unit Essential Questions:	**Unit Enduring Understandings:**
• How do the properties of materials determine their use? • How does conservation of mass apply to the interaction of materials in a closed system? • How do we know things have energy?	• The structures of materials determine their properties • When materials interact within a closed system, the total mass of the system remains the same. • Changes take place because of the transfer of energy. • Energy takes many forms. • Energy forms can be grouped into types of energy that are associated with the motion of mass (kinetic energy), and types of energy associated with the position of mass and with energy fields (potential energy).

NJCCCS:

- 5.2.6.A.2 Calculate the density of objects or substances after determining volume and mass.
- 5.2.6.A.3 Determine the identity of an unknown substance using data about intrinsic properties.
- 5.2.6.A.1 Compare the properties of reactants with the properties of the products when two or more substances are combined and react chemically.

NGSS Performance Expectations: Students who demonstrate an understanding can…

- MS-PS1-1.Develop models to describe the atomic composition of simple molecules and extended structures. [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] [Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule or extended structure is not required.]
- MS-PS1-2.Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [Assessment boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.]
- MS-PS1-3.Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] [Assessment Boundary: Assessment is limited to qualitative information.]
- MS-PS1-4.Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawing and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.]
- MS-PS1-5.Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved. [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms, that represent atoms.] [Assessment Boundary: Assessment does not include the use of atomic masses, balancing symbolic equations, or intermolecular forces.]
- MS-PS1-6.Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.* [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] [Assessment Boundary: Assessment is limited to the criteria of amount, time, and temperature of substance in testing the device.]

Primary CCSS ELA/Literacy Connections:	**Primary CCSS Mathematics Connections:**
RST.6-8.1 - Cite specific textual evidence to support analysis of science and technical texts. (MS-PS1-3) RST.6-8.7 - Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table). (MS-PS1-1),	6.NS.C.5 - Understand that positive and negative numbers are used together to describe quantities having opposite directions or values (e.g., temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge); use positive and negative numbers to represent

(MS-PS1-4) WHST.6-8.8 - Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. (MS-PS1-3)	quantities in real-world contexts, explaining the meaning of 0 in each situation. (MS-PS1-4) 6.RP.A.3 - Use ratio and rate reasoning to solve real-world and mathematical problems, e.g., by reasoning about tables of equivalent ratios, tape diagrams, double number line diagrams, or equations. (MS-PS1-1) 8.EE.A.3 - Use numbers expressed in the form of a single digit times an integer power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. (MS-PS1-1) MP.2 - Reason abstractly and quantitatively. (MS-PS1-1) MP.4 - Model with mathematics. (MS-PS1-1)

Ideas About Matter/1

Lesson Title/Number: Ideas About Matter/1	**Learning Objective(s):** • Discuss your definitions of the term "matter." • Observe some properties of matter. • Use your own words and ideas to explain these properties.	**Lesson Duration:** 80-100 minutes

Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)? Students will understand that physical science principles, including fundamental ideas about matter, energy, and motion, are powerful conceptual tools for making sense of phenomena in physical, living, and Earth systems science.***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	KWL Chart-KWL Chart-Students will utilize a KWL Chart to record their initial knowledge. Students will also be directed to sheets of poster paper on which to write basic density-related words. Lesson 1.	• KWL Chart	Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.	Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.	Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Explore: What hands-on/minds-on common experience(s) will you provide for students?	3. In this lesson, students will investigate different properties of matter. Working with one other student, they will complete eight inquiries. In each inquiry, students will observe one or more properties of matter. Each pair of students will start at a different inquiry station. The teacher will tell students at which station to begin.	• Review, Chemical vs. Physical Properties: http://www.teacherbridge.org/public/bhs/teachers/Dana/chemphys.html	Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.	Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4)	Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function.
Explain: How will you help students connect their exploration to the concept/topic under investigation?	4. Each inquiry has instructions students need to follow and questions they should try to answer. The procedure for each inquiry follows (see pages 4–7). It is also printed on a card placed at each station. When students make observations or think that they can explain what their observations are, teachers should discuss these ideas with their student partners. Remember: Exchanging ideas with others is a very important part of science.		Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.	Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms	
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	In their own words, students will write observations, explanations, and ideas on Student Sheet 1.1.		1) Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations. 2) Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-PS1-3)	The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4)	1) Phenomena that can be observed at one scale may not be observable at another scale. 2) The observed function of natural and designed systems may change with scale.

	Students will read WHAT IS MATTER on pages 8-9. THEN STUDENTS WILL ANSWER THE FOLLOWING QUESTIONS 1. What three different states does matter exist in? 2. Matter has mass and volume. Identify the units we use to measure these. 3. Find out how you could calculate the volume of the following items: • a block	• What are Chemical Properties?: http://www.elmhurst.edu/~chm/vchembook/105Achemprop.html	Critically read scientific texts adapted for classroom use to determine the central ideas and/or obtain scientific and/or technical information to describe patterns in and/or evidence about the natural and designed world(s).		
Extend: How will students deepen their conceptual understanding through use in new context?	QUESTIONS 1. Use information from this reader and any other information you can find from books, CD-ROMs, or the Internet to list the evidence for the Big Bang theory as it relates to matter. 2. In science, the term "theory" has a special meaning. Find a definition of this term and give two examples of other theories that are used in physical science.			The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4)	

Determining Density/2

Lesson Title/Number: Determining Density/2	**Learning Objective(s):** 1) Discuss the terms "mass" and "volume." 2)Find the mass of a known volume of water. 3) Calculate the mass of 1.0 cubic centimeter of water. 4) Measure the mass and volume of some regular and irregular objects. 5)Calculate the density of these objects.	**Lesson Duration:** 3 periods

Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	KWL chart-KWL Chart-Students will utilize a KWL Chart to record their initial knowledge. Students will also be directed to sheets of poster paper on which to write basic density-related words. Lesson 2.	• KWL Chart	Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations.	Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.	Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	In their notebooks, students will write what they think the difference is between mass and volume. After a few minutes, the teacher will lead a class discussion on mass and volume. Students should be prepared to contribute their ideas to this discussion.2. After the discussion, students will write their own definitions for mass and volume in their science notebook. Include the units you would use for measuring each of them. 3. Students will read "Useful Calculations" on page 16.		1) Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations. 2) Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-PS1-3)		Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)
	2. Students will work with one partner. Each group will take one of the graduated cylinders out of the plastic box. Examine it carefully. Discuss the answers to the following questions with their partner: A. What is the unit of		Develop a model to predict and/or describe phenomena. (MS-PS1-1), (MS-PS1-4)	In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4)	

	measure for the graduated cylinder? B. What is the maximum volume it can measure? C. What is the minimum volume it can measure? D. What is the number of units measured by the smallest division on its scale? 3. In this experiment, students will investigate the mass of different volumes of a substance. The substance you will use is water. Students will discuss with their partner how you could find the mass of 50 mL of water by using the graduated cylinder and the electronic balance. Students should consider the measurements and the calculations they need to make. Then write ideas in their notebook. Students will be expected to contribute their ideas to a short class discussion. 4. Record the steps of the agreed-upon class procedure on Student Sheet 2.1. 16 STC/MSTM PROPERTIES OF MATTER 5. Students will make sure that before anything is placed on the balance it reads 0.0 gram (g) (see Figure 2.1). If the balance does not read 0.0 g, press the button marked ZERO. Wait for 0.0 g to appear before continuing.				

	Once an object is placed on the balance, wait a few seconds for the reading to stabilize before recording the measurement. Make sure the reading is in grams. Figure 2.1 Make sure the balance reads 0.0 g before placing an object on it. Figure 2.2 Make sure the graduated cylinder is on a level surface. When you take a reading, make sure your eye is level with the bottom of the meniscus. The “meniscus” is the curved upper surface of the water in the cylinder. 6. Look at Figure 2.2 to review how to accurately measure volume with a graduated cylinder. 7. Follow the class procedure to find the mass of 50 mL of water. Record measurements in Table 1 on the student sheet. 8. Complete the last column of Table 1. Students can calculate the mass of 1 cm3 of water by dividing the mass of the water by the volume of the water. 9. Repeat the experiment using 25 mL of water. Remember, students should already know the mass of the graduated cylinder.				

Explain: How will you help students connect their exploration to the concept/topic under investigation?	Students will complete the following. 1. During the lesson, students measured the mass and volume and calculated the density of a liquid and some solids. All the substances had different densities. The teacher will lead a discussion about the results from all three inquiries. To help students participate in the discussion, write your answers to the following questions in your notebook: A. What is the difference between mass and volume? B. What units did you use to measure mass and volume? C. How did you calculate the density of an object? D. What units did you use to measure density? E. Does changing the amount of a substance change its density? F. If two objects are made from the same substance, will they have the same density? 2. Read “Density as a Characteristic Property.”		·	Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.	

Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	On page 21, Students will read, MASS or WEIGHT. QUESTION: How would the weight of the same bag of sugar on Mars and Jupiter differ from that on Earth? Explain your answer. What is the weight of the sugar inside the bag in the picture? If you answer the question by saying 1 kilogram, you would be wrong! You see, kilograms and grams are units of mass, not weight. Weight is measured in units called Newtons. Confused by the difference between mass and weight? Why do we need different units? We have already discussed that mass is a measure of the amount of matter in an object. The bag contains sugar with a mass of 1 kilogram. Weight is quite different from mass. It is a measure of the force of gravity. Gravity is the force of attraction between two objects. Earth and the sugar are attracted to each other. This attraction varies with the size of the two objects and their distance apart. The force of attraction between a mass of 1 kilogram and Earth is about 9.8 Newtons. So the answer to the question "How much does the sugar in this bag weigh?" is 9.8 Newton's. If an astronaut took the bag of sugar to the moon, what would be its mass? Would it contain the same amount of matter? The answer is yes. Provided the			Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-3)	

	astronaut hasn't eaten or dropped any of the sugar, the bag would still contain sugar with a mass of 1 kilogram. What is the weight of the bag of sugar on the moon? The moon is much smaller than Earth, so the force of attraction between the sugar and the moon is less. Gravity on the moon is about one-sixth of that on Earth. So what is the weight of sugar on the moon? Divide 9.8 Newton's by 6 and you'll get an approximate answer. QUESTION How would the weight of the same bag of sugar on Mars and Jupiter differ from that on Earth? Explain your answer.				
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	Students will read ARCHIMEDES CROWNING MOMENT on pages 22-23. Answer the following question. The students will pretend that they are Archimedes. What instructions would the students give for comparing the density of a crown with the density of gold?	• What are Chemical Properties?: http://www.elmhurst.edu/~chm/vchembook/105Achemprop.html			
Extend: How will students deepen their conceptual understanding through use in new context?	How does the property of Density help determine a materials use?	• What are Chemical Properties?: http://www.elmhurst.edu/~chm/vchembook/105Achemprop.html		Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1)	

Density Predictions/3

Lesson Title/Number: Density Predictions/3	**Learning Objective(s):** 1) Predict whether an object will float or sink on the basis of how it feels. 2) Use density to predict whether a substance will float or sink in water. 3) Determine the density of different liquids. 4) Build a density	**Lesson Duration:** 2 Periods

		column. 5) Use density to predict how solids will behave when they are placed in a density column.			
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	KWL Chart-Students will utilize a KWL Chart to record their initial knowledge. Students will also be directed to sheets of poster paper on which to write basic density-related words. Lesson 3.	• KWL-Based on the last lesson, how would you predict the density of an object? Or the density of a substance?	Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations	Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.	Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	1. Collect the plastic box of materials for your group. Check its contents against the materials list. During this lesson, you will use an electronic balance. Your teacher will assign an electronic balance to your group. Other groups will be sharing the balance with you. 2. Take the blocks of aluminum, wax, and white and transparent plastic out of the plastic box. As a group, predict whether each object will float or sink in water and explain how you reached your prediction. 3. Your teacher will list the predictions for each group and may ask you to explain your predictions to the rest of the class. 4. Your teacher will ask some of you to test your predictions. Use the results of these tests and the		Develop a model to predict and/or describe phenomena. (MS-PS1-1), (MS-PS1-4)	In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4)	

	data you collected in Lesson 2 to fill in Table 1 on Student Sheet 3.1. 5. Answer the following question on the student sheet: Is there a relationship between density and floating and sinking in water? If so, describe what this relationship is. MATERIALS FOR LESSON 3 For you 1 copy of Student Sheet 3.1: Using Density To Make Predictions 1 copy of Student Sheet 3: Homework for Lesson 3 For you and your lab partner 2 100-mL graduated cylinders 1 250-mL beaker containing colored water 1 copper cylinder 1 nylon spacer 1 test tube brush For your group 1 aluminum block 1 transparent plastic block 1 wax block 1 white plastic block 1 bottle of vegetable oil 1 bottle of corn syrup For the class Access to an electronic balance Access to water 1 container for collecting vegetable oil waste 1 container for collecting corn syrup and water waste Paper towels Detergent				

Explain: How will you help students connect their exploration to the concept/topic under investigation?	REFLECTING ON WHAT YOU'VE DONE 1. Write a short paragraph in your science notebook explaining your observations. Make sure you include the words "density" and "immiscible" in your description. Be prepared to read your paragraph to the rest of the class. 2. Your teacher will show the bottle containing two liquids that you used in Inquiry 1.6. Use your knowledge of immiscible liquids and density to explain (in your note- book) the appearance and behavior of the liquids in the bottle. 3. Oil is less dense than water. Discuss with other members of your group how this information can be applied to cleaning up a spill from an oil tanker.		.		

Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	Why Did the Titanic Float? The New York Herald front page reports the sinking of the Titanic. This newspaper article reported on the disastrous maiden voyage of the Titanic. Why was this voyage a disaster? What role did density play in the tragedy? On April 10, 1912, the luxury liner Titanic left England for New York and sailed straight into the annals of history. Why is the name Titanic so well known? At that time, she was considered the safest ship ever built; some people even considered her unsinkable. The Titanic became famous when she struck an iceberg and sank on her first voyage. About 1500 people drowned or froze to death in the ice-cold Atlantic water. People often ask, “Why did the Titanic sink?” Perhaps a better question would be, “Why did the ship float?” She was, after all, made mainly from iron and steel. Her anchors alone weighed 28 metric tons. (That’s almost 62,000 pounds!) Steel has a density about eight times that of water, so you would expect a ship made of steel to sink. The bow of the Titanic seen under water. The Titanic now lies under 12,500 feet of water. It was made mainly from steel, which is denser than water. How did it manage to float at all? However, if you were to look at a				

	plan of the Titanic, you would discover that most of her volume was occupied by air. Air has a density of about one-thousandth that of water. Therefore, the average density of the ship was less than the density of water. That's why she floated. Iceberg with plane flying in front of it. Icebergs float in water. What does this tell us about their density? Why did she sink? When the Titanic hit the iceberg, water rushed into the ship's hull and displaced the air. The average density of the water and the steel ship was greater than the density of water. The result of this change? The Titanic sank to the bottom of the Atlantic. QUESTIONS Unfortunately, life vests, or personal flotation devices (PFDs), were not enough to save the lives of many of the Titanic's passengers. However, they save hundreds of lives every year. 1. If you were designing a PFD, what factors would you need to take into account? 2. Draw a diagram of a PFD of your own design. Label it, explaining the role of each of its parts, and be sure to include the word "density" somewhere in your explanation.				

Evaluate: How will students demonstrate their mastery of the learning objective(s)?	The New York Herald front page reports the sinking of the Titanic. This newspaper article reported on the disastrous maiden voyage of the Titanic. Why was this voyage a disaster? What role did density play in the tragedy?				
Extend: How will students deepen their conceptual understanding through use in new context?	Iceberg with plane flying in front of it. Icebergs float in water. What does this tell us about their density?				

Do Gases Have Density/4

Lesson Title/Number: Do Gases Have Density/4		**Learning Objective(s): 1) Find out whether air has volume. 2) Design an experiment that can be used to find out the mass of a sample of air. 3) Try to measure the mass of a sample of air. 4) Discuss the accuracy of the procedure.**		**Lesson Duration: 2 Periods**	
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	KWL- Ask students what do they know about density? (Based on the last two lessons) What do they know about gases? What effect do they think density has on gases?	• Students will utilize a KWL Chart to record their initial knowledge. Students will also be directed to sheets of poster paper on which to write basic density-related words. Lesson 4.	Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations	Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.	Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	INTRODUCTION Have you ever thought about air? Air is strange stuff. It's invisible, yet we know it exists. We can feel our own breath or see the effect of the wind. But is air matter? If it is, then it must have both mass and volume. In			Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4)	

	this lesson, you will find out whether air has mass and volume.				
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Getting Started 1. Teachers will show students two pieces of apparatus. In the first one, the funnel goes into the test tube but is held firmly in place by a rubber stopper. The second test tube also holds a funnel but is not sealed around the edge of the tube. 2. In their science notebook, students describe what happens when colored water is poured into each funnel (see Figure 4.1). Try to explain why water behaves differently in each funnel. MATERIALS FOR LESSON 4 For students 1 copy of Student Sheet 4.1: Finding the Density of Air For your group 1 thick-walled plastic bottle 1 rubber washer 1 vacuum pump with vacuum stopper (rubber valve) 1 100-mL graduated cylinder Access to water Access to an electronic balance Finding the Density of Air PROCEDURE 1. Ask students what will they need to measure in order to calculate the density of air? Have them examine the contents of your plastic box and try to		Develop a model to predict and/or describe phenomena. (MS-PS1-1),(MS-PS1-4) Evaluate limitations of a model for a proposed object or tool.		

	think how to use the apparatus and an electronic balance to find the density of some air (see Figure 4.3). Discuss their ideas with the rest of their group. Try to agree on a procedure that they think will work. Write down their ideas in a short paragraph in their science notebook. Be prepared to present their group's ideas to the rest of the class. 2. After all the groups have shared their ideas, the teacher will use them to devise a standard procedure. Students record the procedure on Student Sheet 4.1. 3. Use the procedure to find the mass and volume of an air sample. Under Steps 2 and 3 on the student sheet, record results and use them to calculate the density of air. 4. Return the apparatus to the plastic box. Pump Valve Washer Rigid plastic bottle				
Explain: How will you help students connect their exploration to the concept/topic under investigation?	REFLECTING ON WHAT YOU'VE DONE- 1. Teachers will write down the different group results for this experiment. Look carefully at the results. Answer the following question on the student sheet: How does the density of air compare with the density of solids and liquids? 2. Are the results all the same? Do you think the procedure you used is very precise? Answer the following question on the student sheet: Why do the class results vary so much?		.		

	3. You have discovered that air does have density. Use this information to answer the following question on the student sheet: Why do some things float in air?				
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	Reading Selection, Lesson 4 Deadly Density People in a chlorinated pool. Chlorine is used to kill the microorganisms in swimming pools. Have you heard about a substance called chlorine? If you have, you probably know that it is sometimes added to water. Chlorine is added to drinking water to kill harmful microorganisms. When you go swimming, you can smell the chlorine at the pool. That's because chemicals that release chlorine are added to the water to keep it safe for swimming. You may be surprised to learn that chlorine is a greenish yellow gas. It is also a very poisonous substance. This property is exploited when chlorine is used as a disinfectant to kill microorganisms. In small amounts, chlorine kills microbes but not larger organisms. However, chlorine has also been	• Module: Properties of Matter Lesson 4 pp. 34 National Science Digital Library, Science Digital Literacy Maps Common Themes – Scales: http://strandmaps.nsdl.org/?id=SMS-MAP-2458	Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-PS1-3)		

	used to kill people. In World War I (1914–1918), chlorine was used as a weapon. Most of the battles in this war were fought between lines of trenches that provided the soldiers with some protection against gunfire. On April 22, 1915, at the battle of Ypres, in France, the Germans used a new secret weapon. That weapon was chlorine. They released chlorine Two world war one soldiers and their mules, all wearing gas masks. To protect themselves against poisonous gases in World War I, these U.S. troops and their mules wore gas masks. gas from their side of the lines. The chlorine was carried by the wind to the enemy trenches. Because chlorine is much denser than air, it stayed near the ground and poured into the trenches. Choked and blinded, the defenders were then overrun by German troops wearing gas masks. After this gas attack, soldiers on both sides were issued gas masks. QUESTION What are other properties and uses of chlorine? Use the library and Internet resources to find out more about chlorine.				

Evaluate: How will students demonstrate their mastery of the learning objective(s)?	QUESTION What are other properties and uses of chlorine? Use the library and Internet resources to find out more about chlorine.				
Extend: How will students deepen their conceptual understanding through use in new context?	Lesson: Density is in the Air Objectives: • • Students will interpret the density of objects compared to air. Students will manipulate variables related to mass and volume. Students will use a flow chart to document their problem-solving strategies. Students will use problem-solving. Students will investigate the variables affecting the volume and mass of a hot-air balloon. Students will use information gained from investigating variables of mass and volume to build a hot-air balloon that floats. Students will complete a flowchart documenting how they determined a satisfactory design using the simulation. Students will work cooperatively in groups to solve a scientific problem. One helium balloon One electrical or battery-operated appliance: lamp, CD player, Materials: For Each Group: • Materials for building balloons to match those used in computer simulation: tissue paper, garbage bags, newsprint/Ziploc bags, newspaper • Patterns for three sizes of 3–	• Lesson plans on density for Middle School Teachers: www.usi.edu/media/1751795/density.pdf	Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or not supported by evidence. (MS-PS1-3)		

	dimensional objects (sphere, rectangular prisms, and pyramid) to match the size and shape of the options available in the computer simulation. • Sterno can • Various building tools: Tape of various kinds, scissors, rulers, glue, etc. • One sticky note per student Safety Procedures: Students will be cutting materials with scissors. Balloons will be launched outside using sterno cans. Close adult supervision is required at all times. 23 Lesson Goal: The purpose of this lesson is to challenge students to apply their knowledge of mass, volume, and density and use the information from a computer simulation to design a hot air balloon that will float. Concepts to be developed: 1. Density is the measurement of the compactness of an object. 2. If an object is less dense than the material around it, it will float. 3. A hot air balloon floats because the components of its design make it less dense than the air around it and it floats because of that density difference. Skills to be developed: Procedure Foundation: 1. Release the helium balloon in front of the students. Ask them why it floats on the ceiling (because it is less dense than				

	air, the gas helium is less dense than the mixture of gases that make up the air in our classroom). Ask students how a balloon floating is different than an airplane flying. (A balloon “floats” because the heat source makes the air inside the balloon less dense so the balloon can float up through it while an airplane flies because its design and the lift of its engines make it aerodynamic) Tell students that they will be building a balloon that will also be less dense than air. Ask students what variables can affect the density of a hot-air balloon (mass and volume). 2. Give each student a sticky note and have them think of a specific part of constructing a hot air balloon that would relate to the mass or volume of that balloon. Example: how heavy the basket is, how many people it would carry, how big the balloon is, what shape it is. List the headings Mass and Volume on the board. Have students put their ideas on the board under the appropriate column. If the fact that air density changes with elevation has not been discussed make sure that it is included as a variable under volume. 3. Discuss the variables as a class and move sticky notes around as necessary to reinforce the concepts of mass and volume. Remind students that in order for something to float above something else, it must be less dense than the object it				

	floats. Tell students that to simplify the building process and increase the chances of success they will only have a few variables to work with. 4. Ask students how engineers build a bridge or a building. Through discussion, have students understand that first a design of the bridge or building is made when the need for the bridge/building is determined, then the design and materials for the bridge/building are tested, and then the bridge/building is actually constructed. Engineers do not just make things from scratch, so neither will they. To make sure that they don't build a balloon that doesn't fly there is a simulation program they can work with first. This will be like an engineer's test phase. Simulation: 1. Show students the selected appliance. Inform students that you have discovered that it does not work and ask students what you should do to find out why. Guide students toward answers that suggest testing some aspect of how it works, not just why it does not work. After soliciting lots of suggestions, decide on one aspect to test first. Show students the flowchart diagram, either on the board or on an overhead, and put the first question in first box. 2. Return to the list of mass and volume variables that has been generated by the class and remove each one that is controlled by the simulation.				

	Review with students that the heat source, the amount of heat added, the weight of the basket and passengers, and any wind or weather factors are assumed to be constant by the simulation. Review with students that the simulation will prompt the user for the local elevation in meters which will be used to determine the target air density. Review with students that they will be able to experiment with four different shapes, sizes, and materials for construction of a balloon and have them talk about how varying each one might affect the ability of their balloon to float. 3. Allow students, working in groups of 3-4, to access the java applet on their computers (or demonstrate on one classroom computer.) Let students work through the program trying the different variables. When they find a combination of variables that work in simulation, allow them to print their results. They now have a description of what to build. Students should record their design process to determine a successful design on the provided sheet. 4. The calculations, formulas, and constants used by the simulation are included as Appendix 1. If teachers will be having their students construct balloons using the same dimensions as the simulation, they may wish to prepare				

	templates for the students to trace. Construction: 1. When students have identified their final design, they should gather their materials and begin building. They should be working in their design groups which are now the test groups. The building should take 1-2 class periods. 2. When all groups are finished take the students outside for Launch Day. Discuss the density of air (this was calculated in the java applet). Ask to students what the density of air inside their balloons must be in order for them to fly. Light the sterno cans for groups one at a time. The balloons should be able to fly. Teachers may wish to choose a different heat source to better suit the needs of the class and the location of the flights. The risk of fires started by a floating, flaming tissue paper balloon should be adequately assessed by each teacher for their individual situation! Perhaps some teachers would like to experiment with balloons constructed only from flame retardant materials! 3. After the flights have students complete the testing portion of their Engineering Process Report worksheet. Evaluation: 1. Students will be evaluated on the completion of the java applet simulation and of the flowchart showing how the variables were tested.				

	2. Students will be evaluated on their problem solving skills and group cooperation during the building process by self-reflection and teacher observation. 3. Students will be evaluated on their analysis of success of their balloon flight and of their understanding of the design, test, and construct process on the Engineering Process Form. 4. Students will be evaluated on their self-evaluation of their learning using the simulation and construction process and how this process is used by engineers. Extension: 1. The simulation/construction process utilized in this lesson has students constructing their balloons from a pre-determined size with pre-determined materials. Students do not need to calculate either the volume of the balloon shape or the mass of the materials and enclosed air in order to make a density determination. 25 2. A possible extension would be to have students truly design their own balloon shape, using the simulation values as parameters for success, and present the calculations to determine whether or not the balloon should fly before testing. Differentiated Instruction techniques: • Clearly state essential questions				

	• Continuous assessment and feedback • Adjust content, process, and product in response to student readiness and learning profiles • Shortened and modified assignments •Time extensions allowed • Use of resource room • Notes and/or extra time allowed on tests • Students and teachers collaborate in learning • Goals for maximum growth and individual success are established and maintained • Student ability grouping strategies are used in cooperative learning activities • Stations are used in allowing for different students to work on different tasks • Tiered activities are used to focus on essential understandings and skills at different levels of complexity, abstractness and open-endedness				

Temperature and Density/5

Lesson Title/Number: Temperature and Density/5	**Learning Objective(s): 1)Use a thermometer and discuss the purpose of its different parts. 2) Build a working thermometer and use it to measure temperature. 3) Discuss how your thermometer works and relate this to changes in the volume and density of matter.**	**Lesson Duration: 3 Periods**

Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Students will utilize a KWL Chart to record their initial knowledge. Students will also be directed to sheets of poster paper on which to write basic temperature-related words. Lesson 5.	• KWL- Ask students what do they know about density? (Based on the last four lessons) What do they know about temperature? What effect do they think density has on temperature?	Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations	The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4)	Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	INTRODUCTION Have you ever looked at a thermometer and wondered how it works? You may be surprised to learn that the thermometer was not invented until about 400 years ago. How did people measure temperature before that? Did they guess the temperature? Did they say something feels hot or cold? Thermometers are actually very easy to make from simple materials. In this lesson, you will build your own thermometer and learn something about how and why it works.	• Properties of Matter Module Page 38.	Develop and/or use a model to predict and/or describe phenomena	The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4)	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.

Explore: What hands-on/minds-on common experience(s) will you provide for students?	Getting Started 1. Collect the plastic box of apparatus for your group and check the items against the materials list. Each plastic box contains a set of apparatus for each pair within your group. 2. With your lab partner, closely examine the thermometer you have been given. Discuss with your partner the purpose of the different parts of the thermometer. The following questions will help you in your discussion: A. Where is most of the liquid in your thermometer? B. What is the temperature range of your thermometer (and what units does it measure in)? C. What do you notice about the distances between the marks on the scale? 3. Hold the bulb of the thermometer (the red end) in your hand. Discuss the following questions with your partner: A. What happens to the red liquid? B. What temperature does it reach? C. What happens to the reading when you let go of the bulb and hold on to the other end of the thermometer? D. Why do you think the liquid in the thermometer moves? 4. Be prepared to discuss your observations and ideas with the rest of the class. Inquiry 5.1 Building a Thermometer PROCEDURE 1. Divide the contents of the plastic box between the two		Develop a model to predict and/or describe phenomena. (MS-PS1-1),(MS-PS1-4) Evaluate limitations of a model for a proposed object or tool.	The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (secondary to MS-PS1-4)	Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used. (MS-PS1-3)

	pairs in your group. How could you use the materials to build a thermometer? You have 5 minutes to discuss possible designs with your partner and draw your design on Student Sheet 5.1. Do not build the thermometer yet. 2. Your teacher will conduct a short brain- storming session and a discussion on thermometer design. 3. Follow the design discussed to build your thermometer. 4. Add a scale to the thermometer. This process is called calibration. To calibrate your thermometer, follow these instructions: A. Place the test tube end of the thermometer in the cold water bath. Let it stand for about 5 minutes. B. Without removing the test tube from the cold water bath, use the black permanent marker to make a mark on the plastic tubing at the water level. C. Use the thermometer in the water bath to record the temperature of the water bath on Student Sheet 5.1. D. Place the test tube in the hot water bath. Let it stand for about 5 minutes. E. Mark the tubing and record the temperature as before. F. Calculate the temperature difference between the two readings you made. Write your answer on the student sheet. G. What is the distance in millimeters (mm) between the two marks on the plastic tubing?				

	Write your measurement under Step 3 on Student Sheet 5.1. H. Calculate the distance on your thermometer that is equal to 1 °C. I. Use this information to figure out where 0 °C and 100 °C will be on your thermometer. J. Mark off the temperature scale between 0 °C and 100 °C in 5 °C intervals. Label these intervals every 10 °C. 5. Once you have built and calibrated your thermometer, test it by measuring room temperature. Allow time for your thermometer to reach room temperature. What reading did your thermometer give for room temperature? Write your answer on the student sheet. 6. Measure room temperature with the laboratory thermometer. What reading did the laboratory thermometer give? Write your answer on the student sheet. 7. Answer the following questions on your student sheet: How accurate is your thermometer compared with the laboratory thermometer? How quickly does your thermometer respond to temperature changes? Is it quicker, slower, or the same as the laboratory thermometer? When the temperature increases, what happens to the volume of water in your thermometer? When the temperature increases, do you think the mass of water in your thermometer changes? If you decreased the size of the thermometer bulb, how would				

	the accuracy and the response time of your thermometer be affected? How could you improve the design of your thermometer to make it more accurate?				

	Explain to students that Galileo built some of the earliest thermoscopes, which are thermometers without scales. Thermoscopes were used to compare temperatures but had no standardized scale. Assign students the following article. MEASURING TEMPERATURE BY DEGREES "How cold is it outside?" "Is your soup hot enough?" How many times have you been asked questions about temperature? Usually, we answer them according to how things feel to us. We compare temperatures to our own body temperature. People have always compared temperatures in this way. However, sometimes you need to know exactly how hot or cold something is. For example, if you cook a pizza in an oven that is too hot, it may burn—so you need to know the temperature of the oven. About 400 years ago, some scientists began to tackle the problem of measuring temperature. Galileo was one of the first. He made a thermoscope. This was a device that could be used to compare temperatures. Look at the picture of the thermoscope. Can you figure out how it worked? It took another scientist, Olas Roemer, a Dane who was interested in astronomy and meteorology, to come up with a way of com- paring temperatures measured with different devices.	• Page 44 STC/MSTM PROPERTIES OF MATTER	Evaluate limitations of a model for a proposed object or tool.	Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small.	

	In 1701, Roemer calibrated his temperature-measuring devices according to the temperatures of ice water and the human body. He had made the first thermometer. Another scientist, this time from Holland, borrowed Roemer's ideas. His name was G. Daniel Fahrenheit. Fahrenheit altered Roemer's scale. He used the melting point of a salt-and-water slush as his zero point and the human body temperature as his high point. He divided the space between the two points into 96 degrees. The scale was later adjusted so that its calibration points were at 32 °F for ice melting and 212 °F for water boiling. On the adjusted scale, human body temperature became 98.6 °F. The new scale was named after Fahrenheit and is still used today. About 30 years later, in 1742, another scientist, Anders Celsius from Sweden, came up with a new scale. Celsius designated the melting point of ice as 100 °C and the boiling point of water (at sea level) as 0 °C. After Celsius' death, the scale was reversed so that the melting point of ice became 0 °C and the boiling point of water (at sea level) became 100 °C. This scale, called the Celsius (or centigrade) scale, was popular because it used two temperatures that most people easily understand. It's now used all around the world. This scale has one big problem. All				

	temperatures below zero become negative numbers. Can you really have a negative temperature? Wouldn't it be better to start a scale at the lowest possible temperature and work your way up? About 100 years later, in 1848, British physicist William Thomson could see the advantage of just such a scale. By that time, work done by Thomson and other scientists on how energy behaves in the universe led him to develop a scale that placed the absolute lowest possible temperature at zero. This temperature is the same as −273 °C and is called absolute zero. An object at absolute zero contains no heat energy. Thomson borrowed the divisions on Celsius' scale and made the melting point of ice 273 degrees. What happened to the Thomson scale? It is still used by scientists around the world, who consider it to be the most useful temperature scale. Thomson was such a clever scientist and inventor that the British government made him a lord and gave him the title Lord Kelvin. So his scale became the Kelvin scale, and temperature is measured in kelvins (abbreviated as K).				
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	The Trans-Alaska Pipeline: Meeting Nature's Challenges Trans-Alaska Pipeline: Facts and Figures ● The pipeline is 1287 kilometers long. Each piece is 127 centimeters in diameter.	• STC/MSTM PROPERTIES OF MATTER PAGE 53 LESSON 5 TEMPERATURE AND DENSITY • National Science Digital Library, Science Digital		In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change	

	● The pipeline crosses 34 major rivers and streams and 3 mountain ranges. ● Construction was started in 1973 and completed in 1977. The cost was $8 billion. Explain to students that scientists had to consider the temperature and the density of the crude oil in order to construct a safe, environmentally friend pipeline. It was 1968, and the United States was concerned about its oil supply. With war brewing in the Middle East and an oil embargo threatening, where would the United States get the petroleum it needed? How could the country become less dependent on oil imports in the years ahead? Just when concerns were getting serious, geologists discovered the largest oil field in this country—in Prudhoe Bay on the northern slope of Alaska. Part of the problem was solved. But during the winter, the waters of Prudhoe Bay are frozen solid. For much of the year, they cannot be reached by sea going oil tankers. How could those billions of gallons of oil be transported to the lower United States? The answer: Build a pipeline! The people who took on this problem would find themselves involved in one of the most difficult engineering challenges of this century. To solve it, they had to focus on three features of the Alaskan territory: permafrost, earth- quakes, and temperature	Literacy Maps Common Themes – Scales: http://strandmaps.nsdl.org/?id=SMS-MAP-2458		relative locations.	

	extremes. Watching Out for Permafrost At first, the engineers assumed that the pipeline would be buried underground. That's how most pipelines are built, after all. But no one had ever built a pipeline in a place like Alaska, where it gets so cold that in many parts of the state, the subsoil is permanently frozen. This deep soil, which never thaws, is called permafrost. Planners realized that the pipeline couldn't be buried in the permafrost, because the heat of the oil could cause the icy soil to melt. If the icy soil melted, the pipe would sag and it might leak. In winter, the soil around the pipe would freeze again. This freeze-thaw cycle could cause the pipe to move enough to cause serious damage. To avoid these complications, the engineers made an important decision: About one-half of the pipeline (about 700 kilometers) would have to be built above ground. They supported the pipe with refrigeration posts that are topped with aluminum radiators. The posts con- duct heat away from the soil. The pipeline is also wrapped in 10 centimeters of fiberglass insulation. Both of these measures help to keep the permafrost solid. Blowing Hot and Cold A second challenge was Alaska's temperature, which ranges between −60 °C and 35 °C. Because the metals from which the pipeline is made				

	expand and contract with changes in temperature, the pipeline had to be built to accommodate changes in length. The engineers estimated that a 304-meter segment of pipeline could shrink by as much as 0.3 meter in the coldest weather and expand by an equal amount during the warmest season. That doesn't sound like much of a change, unless you remember that the pipeline is nearly 1500 kilometers long! If the pipe- line were straight, even a small change in each segment of the pipeline would be disastrous. The pipe- line would either snap if it contracted too much or buckle if it expanded. To prevent the pipeline from breaking, the designers used a zigzag configuration. These bends help relieve the effect of contraction and expansion. Accounting for Earthquakes. As if these extreme temperatures weren't enough, engineers had to deal with another big problem: earth- quakes. Earthquakes are fairly common in Alaska. In fact, the largest earthquake ever to occur in the United States (measuring 9.2 on the Richter scale) took place in southern Alaska. The engineers had to build a pipeline that could survive such an event intact. They designed a two-part system of "shoes" and "anchors" that hold the pipe- line in place at weak areas (faults) where earthquakes have occurred, yet allow it to move enough so that it				

	does not fall off its supports if the ground moves. At the Denali fault zone, where earthquake activity has been heavy, the pipeline is designed to move up to 6 meters side to side and 1.5 meters up and down. QUESTIONS 1. How did engineers overcome the challenge of a 95 °C temperature range when designing the Trans-Alaska Pipeline? 2. What is the difference between conduction and radiation? Use a dictionary or other references to help you answer this question.				
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	Student will answer the following questions on the student sheet: How accurate is your thermometer compared with the laboratory thermometer? How quickly does your thermometer respond to temperature changes? Is it quicker, slower, or the same as the laboratory thermometer? When the temperature increases, what happens to the volume of water in your thermometer? When the temperature increases, do you think the mass of water in your thermometer changes? If you decreased the size of the thermometer bulb, how would the accuracy and the response time of your thermometer be affected? How could you improve the design of your thermometer to make it more accurate?	• Properties of Matter Module Page 40.	Evaluate limitations of a model for a proposed object or tool.	The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter.	Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Extend: How will students deepen their conceptual understanding through use in new context?	QUESTIONS 1. How did engineers overcome the challenge of a 95 °C temperature range when designing the Trans-Alaska Pipeline? 2. What is the difference between conduction and radiation? Use a dictionary or other references to help you answer this question.	• National Science Digital Library, Science Digital Literacy Maps Common Themes – Scales: http://strandmaps.nsdl.org/?id=SMS-MAP-2458			
Pure Substance or Mixture/11					
Lesson Title/Number: Pure Substance or Mixture/11		**Learning Objective(s):** 1) Discuss the meaning of the term "pure substance." 2) Discuss how you can distinguish between pure substances and mixtures. 3) Use your own techniques to discover whether several samples of matter are pure substances or mixtures.			**Lesson Duration:** 2 Periods
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	Students will utilize a KWL Chart to record their initial knowledge. Students will also be directed to sheets of poster paper on which to write basic pure substance, mixture-related words. Lesson 11	• KWL-Ask students what do they know or want to know about a mixture.	Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations	Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.	Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Milk looks like a single substance. Is it pure or is it a mixture? INTRODUCTION In previous lessons, you discovered how the characteristics of substances, such as density, and the behavior of substances when they are heated can be used to help identify substances.		Develop and/or use a model to predict and/or describe phenomena	Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.	Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.

	However, there is one problem. These properties are most useful in identifying pure substances. Many of the materials that we come across in our daily lives are not pure. Mixtures of substances are much more common than pure substances are. For example, look at your own body. You are made up of matter that consists of many complex substances that work together to produce the chemical reactions that occur in living organisms Identifying the individual substances from which living things are made is very difficult. To separate the substances in a living cell, a bio- chemist would need to grind up samples of the tissue and then expose the soup like mixture to an array of separation techniques to obtain pure samples of each substance. Finding out whether something is pure is hard work! In this lesson, you will try to define the term “pure substance.” You will devise your own techniques to determine whether eight different samples are pure substances or mixtures. You will then discuss the difficulties you encountered in classifying the samples. MATERIALS FOR LESSON 11 For you 1 copy of Student Sheet 11.1: Identifying Pure Substances and Mixtures 1 pair of safety goggles For your group 8 samples (labeled A through H) 4 loupes (double-eye magnifiers)				

	2 lab scoops 2 pipettes 4 petri dish lids or bases 4 sheets of black paper 4 sheets of white paper 1 magnet 4 test tubes 1 test tube rack 1 test tube brush Access to water				
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Getting Started 1. Before students start investigating whether substances are pure or mixtures, it would be useful to think about how they already use these terms. Students will answer the following questions on their student sheet: What is their definition of a pure substance? Students will give two examples of pure substances. For each, they should explain why they think it is pure. Question: If you were given an unknown sample of matter, how could you tell whether it was a pure substance or a mixture? 2. Students will use their answers to contribute to a class discussion. Inquiry 11.1 Determining Whether Substances Are Pure or Mixtures PROCEDURE 1. Have one member of each group collect the plastic box of materials. Check its contents against the list of materials. 2. Take samples A through H out of the plastic box. 3. The purpose of this inquiry is to answer the question, “Which of these substances are mixtures				

	and which are pure substances?" You have about 20 minutes to answer this question and to record your answers, so you will need to split the work among the members of your group. 4. Students may use all of the apparatus in the plastic box, plus water, to help you with your investigation. Devise your own techniques to determine whether each sample is a pure substance or a mixture. 5. For each sample, record your findings in Table 1 on the student sheet. 6. Use any additional data collected by other group members to complete Table 1. Discuss the results with the other members of your group. 7. Answer the following questions on your student sheet: How can the properties of pure substances be used to discover whether a sample is a mixture? Were the samples all well mixed? How did the extent of mixing affect your investigation? 8. Put the wastes from Mixtures G and H in the appropriate container. Wash all of the test tubes and return the materials to the plastic box. Make sure you also wash your hands when you are finished. 9. The teacher will lead a class discussion about your procedures and results. Listen carefully as other students describe their approaches to answering the question of whether a sample is a pure				

	substance or a mixture, explain their results, and make suggestions for alternative approaches to the problem REFLECTING ON WHAT YOU'VE DONE 1. After the discussion, your teacher will return to the concept of "pure substance." Look at the definition you provided at the start of the lesson. 2. Review your original definition of "pure substance." If it is different from the new one agreed on in class, write the new one on the student sheet.				
Explain: How will you help students connect their exploration to the concept/topic under investigation?	Explain to students that a pure substance can be used along with other substances/pure substances to create a more beneficial material/substance to benefit society. Reading Selection, Lesson 11 Perfect Teamwork Wouldn't it be great to have a baseball team made entirely of the world's greatest pitchers? Well, no. This would not be a happy team. It wouldn't matter how many strikes these superstars could throw. A team without players who are good at catching, hitting, and stealing bases would have a hard time winning. A team with a good balance of skills is more likely to make it to the World Series. Combining skills is important for making strong materials, too. Often, a pure substance on its own does not have all of the necessary properties for a	• Page 102 Properties of Matter Module	.		Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function

	particular material. But you can make many useful materials by combining two or more substances that have different properties. The result is a mixture called a composite. A good composite exploits the best properties of each ingredient. People have been making composites since the beginning of civilization. For ancient peoples, dried mud and even animal dung were handy for making huts. The huts were simple to make: Find dirt, add water. The mud kept out the wind and didn't rot, but it crumbled and cracked. Ancient peoples also used straw, grass, or sticks, which were woven into durable mats, to make hut walls. But woven walls leaked. The solution was to combine the two. In many parts of the world, people realized they could weave a house frame (usually supported by timber) out of straw, grass, or sticks and cover it with mud. The result, called "wattle-and-daub" construction, wasn't always pretty. But it kept out the cold and did not fall apart every time the kids got a little rowdy. People have been coming up with new composite materials ever since. Usually, a composite has two materials with opposite properties. The two materials put together as a composite can do what each ingredient alone				

	cannot. Like ancient wattle-and-daub huts, modern composites are often made of fibers embedded in a solid that sticks the fibers together. The fibers are strong but floppy. The solid isn't floppy, but it easily shatters or cracks. A combination of these two opposites can be unbeatable. The solid provides stiffness. The fibers keep the solid from cracking apart. (This is because a crack would have to break too many of the strong fibers running through the solid.) man holding fishing pole being pulled down towards the water Why are fiberglass and carbon fiber composites good materials for making fishing rods? Fiberglass is one example of a modern composite. To make fiberglass, glass is melted and stretched into long threads. The glass threads are woven into cloth. The cloth is embedded in plastic goo, and the whole thing is shaped in a mold. When the goo hardens, the object has the shape of the mold, is light in weight, and is cheap to make. Fiberglass was originally developed to cover radar dishes on World War II bombers. It is now used for everything from boats to fishing rods to picnic tables. More recently, engineers have developed new composite materials. One of these composites contains carbon fibers that are stiffer and much				

	more heat-resistant than glass is. A given weight of carbon composite is stronger than steel. This lightweight strength makes carbon composites ideal for use in many types of objects that would normally be made of metal. The wings of jet fighter planes and helicopter blades are two examples. Composites are widely used in sports equipment and are replacing many natural materials. For example, tennis rackets, originally made from wood, now have frames made from glass, carbon, or boron fibers embedded in a plastic-like nylon. Fighter jet on ground with jets in formation in the air in background Navy Blue Angels fly F/A-18 Hornets with composite wings. The core of the racket is made from plastic foam. The result is a lightweight, stiff racket that is easy to control and that returns the ball with maximum force. Even though carbon composites are one of the latest advances in composite materials, they share something with ancient mud huts. Both combine the best parts of different materials to make something that is better than either one alone				

Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	1. What is one object made from a composite material that you can find in your home? 2. What is the function of the object? 3. Why was that composite material chosen for that function?	• Page 105 Properties of Matter Module	Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations		
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	1. After the discussion, the teacher will return to the concept of "pure substance." Look at the definition students provided at the start of the lesson. 2. Review students' original definition of "pure substance." If it is different from the new one agreed on in class, students will write the new one on the student sheet.		Evaluate data, hypotheses, and/or conclusions in scientific and technical texts in light of competing information or accounts.	Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.	Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used
Extend: How will students deepen their conceptual understanding through use in new context?	You can test the ink in a black marker to determine if it is a pure substance. Equipment and Materials: water-soluble black marker; colorless drinking glass or beaker; 10 cm strip of filter paper; tap water 1. Use the marker to draw a horizontal black line about 3 cm from the bottom of the strip of filter paper. 2. Pour water into the glass to a depth of about 1 cm. 3. Carefully stand the strip of filter paper in the glass of water. The black line should be close to the water, but not touching it (Figure 4). A. What happens to the black line on the paper after 1 min? After 5 min? B. Is the ink in a black marker a pure substance or a mixture?		Integrate qualitative and/or quantitative scientific and/or technical information in written text with that contained in media and visual displays to clarify claims and findings.	Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.	Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function

	What evidence supports this?				
What Happens When Substances are Mixed?/12					
Lesson Title/Number: What Happens When Substances are Mixed?/12		**Learning Objective(s):** 1) Make observations of what happens when different substances are mixed with water. 2) Identify the characteristics of solutions. 3) Define and use some terms that describe the parts of a solution and the processes that take place when solutions are formed.			**Lesson Duration:** 3 Periods
Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	KWL-Ask students what do they know or want to know about what happens to substances when they are mixed.	• Students will utilize a KWL Chart to record their initial knowledge. Students will also be directed to sheets of poster paper on which to write basic mixture-related words. Lesson 12.	Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations	Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.	Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Why doesn't the sand on this beach mix easily with the water in this lake? INTRODUCTION What happens when different substances are mixed with water? Do they all behave in the same way? Does the type of mixture that a substance forms with water depend on the properties of the substance? In this lesson, you will investigate what happens when you mix several pure substances with water. Using your observations, you will identify some of the	• Page 106 Properties of Matter Module	Develop and/or use a model to predict and/or describe phenomena	Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms	Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used

	characteristics of solutions. You will also discuss the terms that are used to describe the formation of solutions. GETTING STARTED 1. Each student group will group will be given a test tube containing a mixture of food coloring and water. In your science notebook, write all the properties of this mixture that you can observe. 2. The class will discuss these observations and relate them to the mixtures you will investigate in this lesson. 3. Students-Return the tube of food coloring to your teacher. Keep the beaker; you can use it to collect water for Inquiry 12.1. MATERIALS FOR LESSON 12 For you 1 copy of Student Sheet 12.1: Mixing Substances With Water 1 pair of safety goggles For you and your lab partner 1 test tube rack 5 test tubes 2 rubber stoppers 1 lab scoop 1 metric ruler 1 test tube brush Access to water For your group 5 jars containing these substances: Copper (II) sulfate Sodium chloride Zinc oxide Sulfur Confectioners' sugar 1 plastic cup 1 label				
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Inquiry 12.1 Adding Water to Substances PROCEDURE 1. In Inquiry 12.1, students will work in pairs, but will discuss				

	their results with the other members of each group. 2. One person from each group should collect a plastic box containing the materials. Check the contents of the plastic box against the materials list. Students will be sharing the jars containing the substances and the plastic cup with other members of each group, but make sure each pair of students has one set of the remaining pieces of the apparatus. 3. Students have samples of five different substances. Students are going to investigate what happens to each of them when adding water to them. 4. Put one lab scoop of copper (II) sulfate into a test tube. 5. Add water to a depth of 5 cm. 6. Seal the test tube with a rubber stopper. 7. Shake the mixture 10 times. Do not knock the tube against the desk. 8. Examine the contents of the tube (see Figure 12.1). Observe what happens to the solid substance you put in the tube. Write the name of the substance in Table 1 on Student Sheet 12.1. Describe the appearance of the contents in the appropriate space in the table. 9. Repeat the procedure with the remaining four substances. 10. Discuss results with the other members of your group. Complete the third column of Table 1. 11. Label the plastic cup with the names of the members of each				

	group. Pour the two test tubes of copper (II) sulfate solution into the plastic cup. Store the cup in a safe, warm place. You will look at it again in Lesson 15. 12. Do not clean up your remaining materials until after the class discussion. Put the zinc oxide waste into the container provided. Wash the sulfur down the drain with a lot of water.				
Explain: How will you help students connect their exploration to the concept/topic under investigation?	Figure 12.1 Teachers ask the students- Look at your mixture. Is it transparent? Is it of uniform composition? Is it a solution?			Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms	Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	REFLECTING ON WHAT YOU'VE DONE 1. Discuss the results of Inquiry 12.1 with the rest of the class. 2. Students- Observe carefully as your teacher shows you what happens when water is added to potassium permanganate. After the demonstration, write on the student sheet a full description of what happened. Use the terms that have been discussed during the lesson. Look at the terms listed in Step 4 of this section if you are unsure what these words are. 3. The teacher will repeat the demonstration using sand. Students- Describe your observations as before. 4. Clean your pieces of apparatus and return them to the plastic box.		Evaluate data, hypotheses, and/or conclusions in scientific and technical texts in light of competing information or accounts.	Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.	Cause and effect relationships may be used to predict phenomena in natural or designed systems

Evaluate: How will students demonstrate their mastery of the learning objective(s)?	Students-Write on the student sheet a full description of what happened. Use the terms that have been discussed during the lesson. Look at the terms listed in Step 4 of this section if you are unsure what these words are.		Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations	Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms	Cause and effect relationships may be used to predict phenomena in natural or designed systems.
Extend: How will students deepen their conceptual understanding through use in new context?	Reading Selection, Lesson 12 Dissolving History A team of archaeologists, architects, ironworkers, and marble cutters has just started a new project. Its goal? To restore the Temple of Athena, a masterpiece of Greek architecture that was built in the fifth century B.C. The surface of the historic monument has been deteriorating for decades. It's time for temple-saving action. The workers know that they have a hard job ahead. Work on another famous Greek temple, the Parthenon, has been going on for nearly 60 years, and it's not done yet. These buildings, like many monuments, are built of marble—one of the hardest stones. Why are they in need of restoration? Wind and rain have always had an effect on buildings, but the main cause of deterioration is pollution. The problem is not just in Athens. In cities around the world, historic buildings are literally being dissolved away.				

	polluting factory The major culprits are acid rain and smog (visible as a reddish brown haze), which is a problem in most of the world's large cities. Both originate with the burning of fossil fuels, such as coal and petroleum. As these fuels burn, they give off gases, which include the pollutants sulfur dioxide and nitrogen oxides. One major source of nitrogen oxides is auto exhaust fumes. Sulfur dioxide is produced in particularly large quantities by coal-burning power plants and other industrial operations. These gases rise into the atmosphere, where they combine with oxygen and water vapor. The sulfur dioxide becomes sulfuric acid, and the nitric oxides become nitric acid. Together, they form an acid solution that falls to earth as acid rain (or acid sleet or snow).All rain is slightly acidic, but acid rain does much more damage to buildings. It is especially harmful to buildings made from rocks that contain calcium carbonate or magnesium carbonate. Marble, used in many Athenian buildings, and the softer, even more vulnerable, limestone both contain carbonates. As years pass, the acid solution reacts with the surfaces of monuments and buildings and turns them into soluble substances. Acid rain can also attack paint and metals, and it forms a crust on				

	the surface of glass Not only does acid rain harm buildings, it damages trees and kills aquatic life and other organisms. To fight these effects, people around the world are applying a great deal of ingenuity to solve the problem of acid rain. In many countries, fossil-fuel-burning power plants and other industrial plants now remove some acidic gases from the waste products that would otherwise be dispersed through smokestacks. Also, special devices are being fitted to car tailpipes to remove some of these gases from exhaust fumes. Until the source of the pollution is completely removed, any efforts to restore ancient buildings will be only stopgap measures. The team of workers on the Acropolis in Athens, in other words, is dealing with the symptoms, but not the cure. STUDENTS ANSWER THE FOLLOWING QUESTIONS- 1. How is acid rain formed? Write a short paragraph describing this process. 2. Do an Internet search to find additional information on acid rain and its effects. What Can You Do About Acid Rain? Use the car less. Carpool, use public transportation, ride a bike, or walk.				

	Conserve electricity. Most electricity is produced by coal-burning power plants, and coal emits a high amount of sulfur when it burns. Study historical sites, buildings, or cemetery headstones in your area. Try to find out how they have been affected by acid rain. Contact a local environmental group to see whether it has taken action about acid rain.				

How Much Solute Dissolves In a Solvent?/13

Lesson Title/Number: How Much Solute Dissolves In a Solvent?/13	**Learning Objective(s):** 1) Make solutions using different amounts of solute. 2) Discover what is meant by the term “saturated solution.” 3) With your class, design and conduct an experiment to determine the solubility of two different substances. 4) Discuss the design of your inquiry. 5) Discuss solubility as a characteristic property of matter.	**Lesson Duration:** 3 Periods

Learning Cycle ***What lesson elements will support students' progress towards mastery of the learning objectives(s)?*** ****Elements do not have to be in conducted in sequence.***	***Learning Activities*** ***What specific learning experiences will support ALL students' progress towards mastery of the learning objective(s)?***	***Resources/Materials*** ***What curricular resources/materials are available to facilitate the implementation of the learning activities?***	***Science and Engineering Practices*** ***What specific practices do students need to use in order to progress towards mastery of the learning objective(s)?***	***Disciplinary Core Ideas*** ***What core ideas do students need to understand in order to progress towards mastery of the learning objective(s)?***	***Crosscutting Concepts*** ***What crosscutting concepts will enrich students' application of practices and their understanding of core ideas?***
Elicit: How will you access students' prior knowledge?	KWL-Ask students what do they know or want to know about what happens to substances when they are mixed.	Students will utilize a KWL Chart to record their initial knowledge. Students will also be directed to sheets of poster paper on which to write basic mixture-related words. Lesson 13.	Communicate scientific and/or technical information (e.g. about a proposed object, tool, process, system) in writing and/or through oral presentations	Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.	Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)
Engage: How will you capture students' interest and get students' minds focused on the concept/topic?	Teacher states- Solid soluble salt and water are seen next to each other in this lake in Namibia, Africa. How can solid soluble salt and water exist in the same place? INTRODUCTION As you know from Lesson 12, solutions are made from solvents and solutes. When you add a spoonful of common salt (sodium chloride) to a pan of water, it dissolves. Salt is soluble in water. Add a second spoonful, and that also dis- solves. But what would happen if you kept adding salt? Would it continue to dissolve? Could you add more salt than there was water, or would the salt eventually stop dissolving? What would happen if you used a soluble sub- stance other than salt? Would the same amount of that substance dissolve? These are some of the questions you will try to answer in this les- son. You will start by	Properties of Matter Module- Lesson 13	Develop and/or use a model to predict and/or describe phenomena	Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.	Proportional relationships (e.g. speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes

	examining a blue liquid and explaining your observations of the liquid on the basis of what you already know. You will then investigate two white crystalline sub- stances. One is sodium chloride, and the other is sodium nitrate. They look almost the same, but as you will discover, they have different characteristics when they are added to water. Could these different characteristics be used to help identify these two substances?				
Explore: What hands-on/minds-on common experience(s) will you provide for students?	Getting Started 1. One student from each group should collect the plastic box containing the materials. 2. Students-Take out the test tube rack and the test tube containing the blue liquid. Pass the test tube around each group so that each member of each group can examine it closely. Discuss with other members of each group precisely what is observed in the tube. Write your observations in your science notebook. What can you conclude from your observations? 3. Participate in a class discussion of your observations. 4. Before proceeding with Inquiry 13.1, hand in the test tube containing the blue liquid. Clean the remaining test tube. Return the test tube rack to the plastic box. MATERIALS FOR LESSON 13 For you 1 copy of Student Sheet 13.1: Saturating a Solution				

	1 copy of Student Sheet 13.2: Determining Solubility 1 pair of safety goggles For you and your lab partner 1 100-mL graduated cylinder 2 test tubes 1 test tube rack 2 rubber stoppers 1 lab scoop 1 jar containing sodium chloride 1 jar containing sodium nitrate Access to an electronic balance For your group 1 test tube containing a blue liquid PROCEDURE 1. Check the materials in your plastic box against the materials list, and divide them equally between the two pairs in your group. 2. How much salt (sodium chloride) can you get to dissolve in a test tube filled halfway with water? Fill one test tube halfway with water. Add one level lab scoop of salt to the test tube. Shake the mixture to help the salt dissolve faster. If it completely dissolves, add more salt. Keep adding salt until no more dissolves. 3. Answer the following questions on Student Sheet 13.1: How many scoops of sodium chloride dissolved in the water? How did you know that no more would dissolve? 4. After a short class discussion, write your definition of a saturated solution on the student sheet. 5. Think about how you could adapt the technique you used in Step 2 to find out how many				

	grams of sodium chloride dis- solved in water. 6. Rinse the test tube with water. Put the test tube in the test tube rack. Inquiry 13.2 Determining Solubility PROCEDURE 1. Using the apparatus you have been given, how could you compare how much of each of the two substances (sodium nitrate and sodium chloride) will dissolve in water? Here are some questions you need to discuss with your partner: A. What will you need to measure? B. How will you know when you have a saturated solution? C. How will you calculate the amount dissolved? 2. Your teacher will conduct a short brain- storming session. Be prepared to con- tribute to the discussion. By the end of the brainstorming session, the class will have agreed on a procedure for determining solubility. 3. Answer the following questions on Student Sheet 13.2: What are you trying to find out? What materials will you use? What is your procedure? 4. Under Step 4 of Student Sheet 13.2, design a data table to record your results and calculations. 5. Follow the class procedure for determining solubility, and record your results in the data table. When you have finished, pour the solutions down the drain with lots of water. Clean the test				

	tubes and return the materials to the plastic box.				
Explain: How will you help students connect their exploration to the concept/topic under investigation?	SOLUBILITY AND SATURATED SOLUTIONS At room temperature, a solvent (such as water) can dissolve only a certain amount of solute. For example, in Inquiry 13.1, after adding a few lab scoops of sodium chloride to the water, you could see a white solid (undissolved sodium chloride) at the bottom of the tube. The white solid indicated that the water could not dis- solve any more sodium chloride. When this hap- pens, the solution is called saturated. The mass of solute dissolved in a given volume or mass of a solvent is its solubility. Solubility is usually measured in grams of solute per unit volume of solvent (for example, grams per liter) or in grams per 100 g of solvent.		.		
Elaborate: How will students apply their learning and develop a more sophisticated understanding of the concept/topic?	REFLECTING ON WHAT YOU'VE DONE 1. Students will have an opportunity to look at the results of other pairs. Be prepared to discuss how these results could give a more accurate measure of the solubility of these two substances. 2. Answer the following question on Student Sheet 13.2: How could you use the property of				

	solubility to help you identify a type of matter? 3. Read “Solubility and Saturated Solutions.” The solubility of a solute changes with changing temperature. For example, sodium nitrate becomes more soluble as the temperature rises. It is about twice as soluble at 80 °C as it is at 1 °C. There are some substances that become less soluble as the temperature rises. When you heated water in Lesson 7, you may have noticed that bubbles appeared, even though the water was well below the boiling point. These were bubbles of gases, such as oxygen and nitrogen, that were dissolved in the water. The gases became less soluble as the water was heated, and they were released from solution.				
Evaluate: How will students demonstrate their mastery of the learning objective(s)?	INQUIRY 13.1 1. Answer the following questions on Student Sheet 13.1: 1.How many scoops of sodium chloride dissolved in the water? 2. How did you know that no more would dissolve? 3. After a short class discussion, write your definition of a saturated solution on the student sheet. 4. Think about how you could adapt the technique you used in Step 2 to find out how many grams of sodium chloride dis-solved in water. I NQUIRY 13.2 1. Answer the following questions on Student Sheet 13.2: What are you trying to find				

	out? What materials will you use? What is your procedure? 2. Under Step 4 of Student Sheet 13.2, design a data table to record your results and calculations.				
Extend: How will students deepen their conceptual understanding through use in new context?	Students read this article- SOLUBILITY AND SATURATED SOLUTIONS At room temperature, a solvent (such as water) can dissolve only a certain amount of solute. For example, in Inquiry 13.1, after adding a few lab scoops of sodium chloride to the water, you could see a white solid (undissolved sodium chloride) at the bottom of the tube. The white solid indicated that the water could not dis- solve any more sodium chloride. When this happens, the solution is called saturated. The mass of solute dissolved in a given volume or mass of a solvent is its solubility. Solubility is usually measured in grams of solute per unit volume of solvent (for example, grams per liter) or in grams per 100 g of solvent. The solubility of a solute changes with changing temperature. For example, sodium nitrate becomes more soluble as the temperature rises.				

	It is about twice as soluble at 80 ° C as it is at 1 ° C. There are some substances that become less soluble as the temperature rises. When you heated water in Lesson 7, you may have noticed that bubbles appeared, even though the water was well below the boiling point. These were bubbles of gases, such as oxygen and nitrogen, that were dissolved in the water. The gases became less soluble as the water was heated, and they were released from solution. QUESTION Why is it that when you put sugar in iced tea, the sugar tends to sink to the bottom as crystals, but when added to hot tea, it tends to dissolve readily?				