Lesson Topic: States of Matter and their Structure

Objective:

Students will be able to:

1. Understand the molecular structure of solids, liquids, and gases
2. Explain the differences between the structure of each state.

Time Required: 90 minutes

Materials Needed:

- Ice cubes
- Beaker
- Hot plate
- Teacher computer with internet access
- Projector/Smartboard
- 1 computer/laptop/iPad per student with internet access
- States of Matter handout (attached)

Teacher Preparation:

- Assign a Legends of Learning Instructional Quick Play playlist for the day(s) you will be teaching the lesson.
    - Instructional - Middle School - States of Matter and their Structure
- Assign a Legends of Learning Content Review Quick Play playlist for the day(s) you will be teaching the lesson.
    - Content Review - Middle School - States of Matter and their Structure
- Make copies of States of Matter and their Structure handout (1 per student)
- Set aside a few ice cubes in a beaker and place in the freezer
- Set aside a few ice cubes in a beaker and keep on counter/desk during the entire class period

Engage (15 minutes):

1. Break students into small groups (4-5) and give each group a designated area to stand in the classroom, ideally spaced apart from other groups.
2. Explain they are going to become “molecules” and their movement will change based on what type of matter they become.
3. Begin by instructing molecules to move freely in the classroom, walking quickly or bouncing around spot to spot. After several seconds, bring the class together and explain that they were air molecules. Ask students how they would characterize air molecule structure and movement?
    a. Answer: Molecules move freely and quickly in gases
4. Next, still within groups, instruct students to link arms with a partner and skip together in designated space. Be very adamant that students can not leave designated space, where as in the gas phase they were unconfined. After a few moments, bring the class together and explain this time they were liquid molecules. Ask students how they would characterize liquid molecule structure and how it differed from gas structure?

   a. Answer: Molecules slide around each other fluidly and are confined in their space (container). They move more slowly than gases movements and are less erratic.
5. Finally, instruct students to cluster together within their groups. They should not be moving independently of one another, but have to move together as a group while staying clustered. After a few moments, bring the class back together and explain they were molecules in a solid state. Ask students how they would characterize the structure of solids and how it differed from liquids and gases?
   a. Answer: Molecules in a solid state are clustered and fixed to one another. They are not able to move freely.
6. Explain to students that they will use this knowledge of molecules and their structure to explore more about the states of matter.

Explore (30 minutes):

1. Have your students sign in to Legends of Learning. Instruct students to complete the Instructional playlist.
2. As students complete the assigned game, students should fill out the top portion of the States of Matter Handout by drawing in what the molecules look like for each state.
3. Assist students as needed during game play, pause playlist if you need to address content or questions to the entire class.

Explain (10 minutes):

1. Review answers to States of Matter Handout by drawing diagrams on board or using Smartboard.
2. Show Youtube video to go over properties of each state of matter.
   a. States of Matter video
3. Pose questions to class: What are some properties specific to solids?
   a. Answer: definite shape, mass, and volume
4. What are some properties specific to liquids?
   a. Answer: definite volume and mass, but not a definite shape. Liquids take the shape of their containers.
5. What are some properties specific to gases?
   a. Answer: definite mass, but not a definite shape or volume
6. Explain to the class that they will use knowledge of states of matter and their properties to experiment with one substance and take it through all three states of matter.

Elaborate (25 minutes):

1. Take out ice from the freezer. Depending on materials available, this activity can be done as a full class demonstration, in partners, or small groups.
   a. Have students fill out the bottom portion of the States of Matter handout as you are conducting the experiment.
2. Take ice cubes that have been sitting out all class and the ice cubes from the freezer, and have students make observations between the two and ask why there is a difference.
   a. Answer: The ice that has been sitting out is melted, while the ice cubes from the freezer are completely solid. This happened because heat was added to

change the water from a solid to a liquid.

3. Now take the melted water and ice and put in a beaker to heat on a hot plate. Turn on heat and watch what happens as the water heats up. Have students make observations, relating what is happening to the structure of molecules as discussed earlier in the lesson.
4. Students should fill out last section of hand out with what they see happening.

Evaluate (10 minutes):

1. Collect hand out as needed and instruct students to log back into Legends of Learning to complete the Content Review playlist.
2. Analyze student results to determine what concepts need to be a focus for reteaching.

Additional Lesson Strategies:

- To use Legends for additional instruction, create a custom playlist with an instructional game and pre and post assessment.
- To use Legends for a quick formative assessment, create a 5-question assessment in a playlist.
- To use Legends for a student-directed experience, create a targeted freeplay playlist.
- Encourage students to play on their own at home in Legends of Learning: Awakening for a student-driven experience including avatars, battling, and quests all centered around topics they are covering in class.

States of Matter

Directions: Use the space below to draw a picture of the molecules for each state of matter.

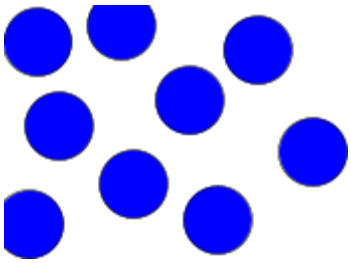
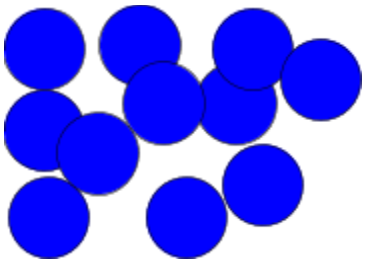
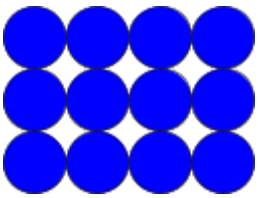
Gas	Liquid	Solid

Fill in the chart with words or pictures to represent each part of the demonstration.

	State	Add	New State	Example
1.				
2.				

States of Matter Key

Directions: Use the space below to draw a picture of the molecules for each state of matter.

Gas	Liquid	Solid
		

Fill in the chart with words or pictures to represent each part of the demonstration.

	State	Add	New State	Example
1.	*Solid - ice* **accept drawings that represent words in boxes**	*heat*	*Liquid - water*	*melting*
2.	*Liquid - water*	*heat*	*Gas - water vapor*	*evaporation*