

Phases of Matter Teaching Tips

INTRODUCTION

These Teaching Tips will help you prepare for and use this interactive lesson in your classroom. At the end of this document is the correct answer (or a version of it) to the full lesson-review “Arrange It” activity on Page 8, as well as general advice and a rubric for lesson assessment.

This lesson expands some of the concepts students learned in the Meaning of Matter Interactive Lesson (Is) on PBS Learning Media, with a focus on the definition, characteristics, and molecular actions of the three phases (or states) of matter—solids, liquids and gases.

A quick note regarding the use of “phase” of matter as opposed to “state” of matter: At the middle school level the two terms can be used interchangeably. With a middle school audience in mind, we made every effort to use “phase” consistently to avoid potential confusion. For those who are interested, the phase is generally the set of conditions that causes matter to be in a specific state. For example, when water is below 0C/32F and at atmospheric pressure, it is a solid. The water’s state is solid and it is in the solid phase, or in the conditions where it is a solid.

The lesson begins with a short engagement video; a list of key glossary terms follows, featuring both word definitions, and short video demonstrations that show the terms in action. After these introductory pages, students will watch two short animations, which respectively 1) define the three phases of matter according to their characteristics and actions of atoms and molecules and 2) describe how the addition and removal of thermal energy impact those atoms and molecules and lead to changes in phase.

The lesson also includes two formative online assessments—one following each animation. Students will use their notes and responses collected throughout the lesson to organize, and then complete, their final assignment, for which they can write an essay or produce a multimedia project, and then submit it on the final page of the interactive lesson.

Standards

This lesson supports the following state and national standards:

- Next Generation Science Standards (NGSS) DCI MS-PS1.A

- North Carolina Essential Science Standards (NCES) 6.P.2.2
- English Language Arts Standards (ELA) CCSS.ELA-LITERACY.WHST.6-8.6

The lesson is designed for grades 6-8, and continues many of the concepts that address the inquiry posed in the K–12 NGSS framework MS-PS1-1: Matter and Its Interactions: “How do atomic and molecular interactions explain the properties of matter that we see and feel?”

This lesson aligns fully to the unpacked 6.2.2 objective as stated in the North Carolina Essential Science Standards: “A substance in a: Solid phase is relatively rigid, has a definite volume and shape. The atoms that comprise a solid are packed close together and are not compressible. Because all solids have some thermal energy, its atoms do vibrate. However, this movement is very small and very rapid, and cannot be observed under ordinary conditions. When heat is added a solid can become a liquid. Liquids have a definite volume, but are able to change their shape by flowing. Liquids are similar to solids in that the particles touch. However the particles are able to move around. Since particles are able to touch the densities of liquid will be close to that of a solid (water is a special exception). Since the liquid molecules can move they will take the shape of their container. When heat is added a liquid can become a gas. Gases have no definite volume or shape. If unconstrained gases will spread out indefinitely. If confined they will take the shape of their container. This is because gas particles have enough energy to overcome attractive forces. Each of the particles is well separated resulting in a very low density. Energy appears in different forms. Heat energy is in the disorderly motion of molecules. Atoms and molecules are perpetually in motion. Increased temperature means greater average energy of motion so most substances expand when heated. Most substances can exist as a solid, liquid or gas depending on temperature.

Additional standards the lessons supports include Common Core English Language Arts Literacy (ELA) Writing History, and Science and Technical Subjects (WHST) objectives.

Assigning and Monitoring Lessons

To make the most effective use of ILs, you will want to assign them to your students through PBS LM. (You will need Internet access and multiple digital devices.)

Once the lessons are assigned, you can monitor whether students have begun or completed and submitted the lessons, and you can also view the work they have saved in their lessons. Note that teachers—and their students—must be logged in to be able to use, assign, and monitor lessons.

You will follow these steps (those related to student accounts and class rosters only need to be done once for the year):

- Set up your own PBS LM account (which you probably have already done) and log into the service.
- Set up accounts for your students (or have them create their own accounts if they are aged 13+).
- Create classes and invite your students to log in and join your classes.
- You may assign ILs to the entire class, to small groups, or to individual students. Students will be able to see a list of which lessons they have been assigned.
- Check back to monitor students' progress and view their work.

You will find detailed instructions on how to set up and manage accounts, class rosters, and assignments in the [Help](#) section of PBS LM.

Interactive Tools

Students are assisted in their inquiry by a variety of tools. The information they save or submit in most of these tools, including their notes, is automatically collected in their “My Work” record, which you can access when you have assigned a lesson to a student. This lesson makes use of the following tools:

Take Notes

Throughout the lesson, this tool records students' notes in response to onscreen prompts. Students may be asked to respond to a question, list information, analyze a primary source (including photographs or visual images), or react to the videos. In some cases, there is a free-text field for entering notes, and in others, there is a table or chart with blank cells for students to complete.

Review It! (Quizzes)

Students can answer multiple-choice or true/false questions and get feedback.

Match It!

Students can complete cloze-style exercises to review vocabulary.

Students can drag text or images into place on a graphic organizer image.

COMPLETING THE LESSONS

Before the Lesson

Use these tips to help you become familiar with the lessons and adapt them, as necessary, for the needs of your students.

- Go through each page, including all the interactive tools, so that you can experience ahead of time what students will be doing. As you go through each page, jot down your own expectations for students' responses.
- After you have reviewed the lesson, decide whether you will need to provide additional background information for students so that they can better understand the context of the lesson.
- Review common note-taking techniques with students. As you may have already discussed in class, notes can be words, phrases, or sentences and should represent what students think are the most important aspects of what they see and hear.
- Determine if students will be working individually, in pairs, or in groups, or if you will be presenting all or parts of the lesson to the whole class at once.
- Decide whether you want to expand the lesson to include class discussion, debate, or other whole-group activities. If so, determine where students should pause their independent work so that everyone is at the same place for the discussion or activity.
- Explain to students the timeline for completing the lesson. Mention the different types of activities they will encounter and let them know how you expect them to submit their work. You may want to provide an outline of this information on a chart, chalkboard, or whiteboard, or as a handout. The interactive lesson, together with the 5E lesson, should take from 6 to 8 classes to complete.
- Remind students that they can watch the video and animation segments as many times as they choose. Transcripts have been provided for reference as well.

During the Lesson

In most cases, students are expected to work through the lesson on their own or in pairs, except for classes that may require teacher facilitation throughout (such as for younger students). Even when students are working on their own, teachers should be available to keep the lesson on track, organize groupings, facilitate discussion, answer questions, and ensure that students meet all learning goals. It may be useful to review students' notes midway through the lesson to make sure they have understood the materials thus far. Be sure that they are taking adequate notes so that they can complete the final assignment. If students show interest in a particular element of the lesson, you may pause the lesson for a class discussion.

ASSESSMENT Modification of the Final Assignment If appropriate to your curriculum, or if students would benefit from differentiated instruction, you may want to modify the final assignment or activity. In this case, provide students with alternative instructions in a separate printout.

Sharing, Reflection, and Self-Assessment After students have submitted their final assignments, offer them a chance to share their written ideas or expressions with the whole class, such as by posting their work on a class website. Have students discuss both what they have learned and the self-paced process they used. You may want to use the following questions:

- What did you learn?
- What was surprising?
- What questions do you still have?
- What was the easiest for you to understand and do? What was the most difficult?

Peer Review Once students have submitted their completed assignments, consider incorporating peer review into the process, using your preferred method or one of the following:

- **Praise/Question/Polish:** Have student reviewers praise the work, ask any questions he or she may have, and offer one suggestion for improvement.
- **Keep/Change/Add/Delete/Move:** Ask student reviewers to pick three of these five “verbs” and give their feedback accordingly.
- **Claim/Evidence:** Have student reviewers complete the following sentences:
 - 1 The main idea of this assignment is _____.
 - 2 The most compelling evidence offered in this assignment is _____.

Lesson Assessment

In addition to the final assignment, the work that students do throughout the lesson should be monitored so that it serves as part of a formative assessment. You may also include a student's participation in class discussion (if you have added that to the lesson).

Below is a rubric that you may use for assessing the final project:

Excellent: Provides an accurate response to the question in a well-organized format that includes descriptions and applications of all terms in a clear and compelling manner. Project content should be complete and thorough; essays should all follow the essay structure—introduction, three supporting paragraphs, and conclusion. Subject-specific vocabulary is used in the correct context.

Good: Provides an adequate response to the question. Projects show solid knowledge of the characteristics of the three phases of matter, the actions of atoms and molecules for each, and the effect of the addition and removal of thermal energy, though the narrative might be lacking adequate flow. Essays meet basic structure requirements. Ideas are generally well organized/

Fair: Provides a generally accurate narrative that addresses the lesson's main concepts (the three phases of matter, their characteristics, and how each responds to the addition or removal of thermal energy). Responses may follow part of the essay structure.

Poor: Provides an inaccurate response to the assignment question or fails to define and describe at least "phases of matter," "solid," "liquid," "gas," "thermal energy" correctly.