

States of Matter

Teacher's Guide

1.0 Summary

States of Matter is the sixth activity to be done after the pre-test. This activity should take approximately one class period.

2.0 Learning Goals

Driving Question: How do different phases of matter behave at the molecular level ?

This activity provides an overview of the different phases of matter. Each of the three most common phases of matter are viewed at the molecular level. The students will have the opportunity to look at solids, liquids and gases. Differences can be observed in both the speed of the molecules and the distance between the molecules. These differences help explain the behavior of each phase.

Learning Goals

- Students will understand that gas molecules move quickly and have space between them.
- Students will learn that gases are compressible.
- Students will understand that liquid molecules moves more slowly than gases.
- Students will understand that liquid molecules are usually in contact with each other.
- Students will understand that solid molecules move very slowly.
- Students will understand that solid molecules are in contact with each other.
- Students will review the very small size of molecules.
- Students will learn that some materials like glass blur these boundaries.

Additional Teacher Background

Molecules are attracted to each other. These attractions, combined with the average kinetic energy of the molecules (which is the temperature) affect the phase of the molecules. Strong attractions favor liquids and solids. Weak attractions favor gases and liquids. As kinetic energy increases, (as temperature goes up) substances are more likely to overcome their attractive forces and move toward existing as a liquid or gas.

	Low Temperature	Medium Temperature	High Temperature
Strong attraction	Solid	Liquid	Gas
Medium Attraction	Solid / Liquid	Liquid / Gas	Gas
Weak attraction	Liquid / Gas	Gas	Gas

State	Speed	Space
Solid	slow	touching
Liquid	medium	Usually touching
Gas	fast	Rarely touching

3.0 Standards Alignment

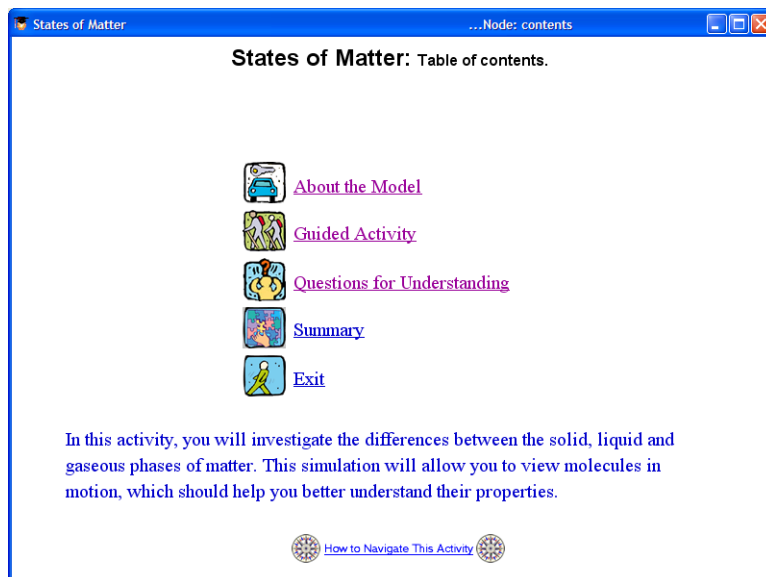
Alignment to National Math and Science Standards (NCTM or NSES)

Objective	Standards
Students will understand how different phases of matter look at the molecular level	<ul style="list-style-type: none">• Varies by state.
Students will understand that gases molecules move quickly and have space between them	<ul style="list-style-type: none">• Varies by state.
Students will understand that liquids moves at intermediate speeds and are usually in contact	<ul style="list-style-type: none">• Varies by state.
Students will understand that solids move slowly and usually stay in contact with the same molecules	<ul style="list-style-type: none">• Varies by state.

4.0 Activity Sections

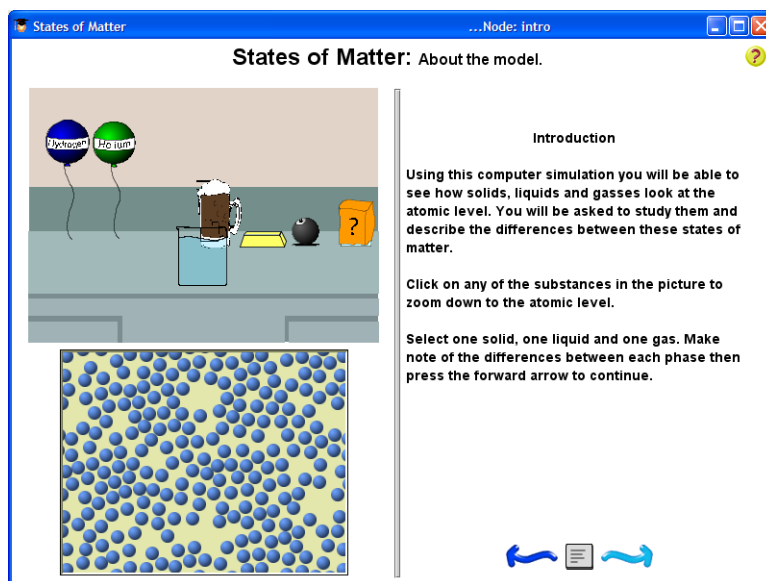
4.1 Table of Contents

This activity has 4 sections.



4.2 About the model

In this step students are presented with seven different substances. Clicking on each substance causes the magnification window to emerge. This window will allow students to zoom in on the molecules of each substance. Students should be encouraged to play with one substance of each phase.



4.3 Guided activity

This section allows students to further explore the model. For this question students should select a solid (double-click on one of the objects) and choose both of the "Highlight molecules" buttons on the bottom of the page. This will allow the students to observe how the molecules are moving relative to each other.

Molecules in a solid move slowly and stay in about the same position relative to each other.

States of Matter: Describing a solid.

Choose one of the solids and then select both of the "Highlight Molecules" buttons. This will make it easier to track the movements of specific molecules.

1. Molecules in a solid:


- Move quickly in all directions and have lots of space between them.
- Move quickly in all directions and are close together.
- Move slowly and stay in about the same positions relative to each other.
- Don't move at all.

On the next page, students are asked to explore a liquids behavior. Molecules in a liquid move in all directions and are close together. The next screen asks the students to select a gas and observe its properties. Gas molecules move quickly in all directions and usually have lots of space between each molecule.

In this screen, students identify a mystery substance. Students should select the mystery substance and determine that is a solid:

States of Matter ...Node: question 4

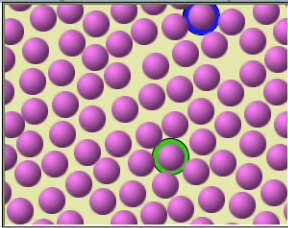
States of Matter: Describing the state of the mystery substance.



Now select the mystery substance.

4. Is it a:

- Solid
- Liquid
- Gas




Highlight Molecule 1 Highlight Molecule 2

On the next screen students are asked to draw conclusions about the macroscopic properties of each phase. Solids usually retain their shape because the molecules stay in the same relative positions. Liquids flow because the molecules are touching but are able to slide past each other.

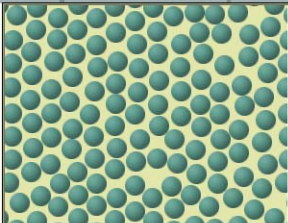
States of Matter

States of Matter: Explaining the properties of solids and liquids.



5. Solids don't normally change their shape. How can you explain this on the basis of what you have seen?

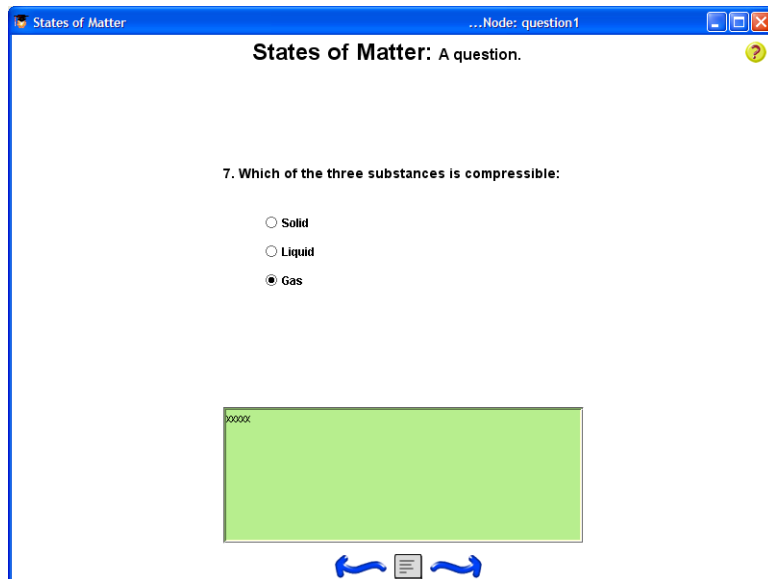
6. Liquids normally flow. How can you explain this on the basis of what you have seen?



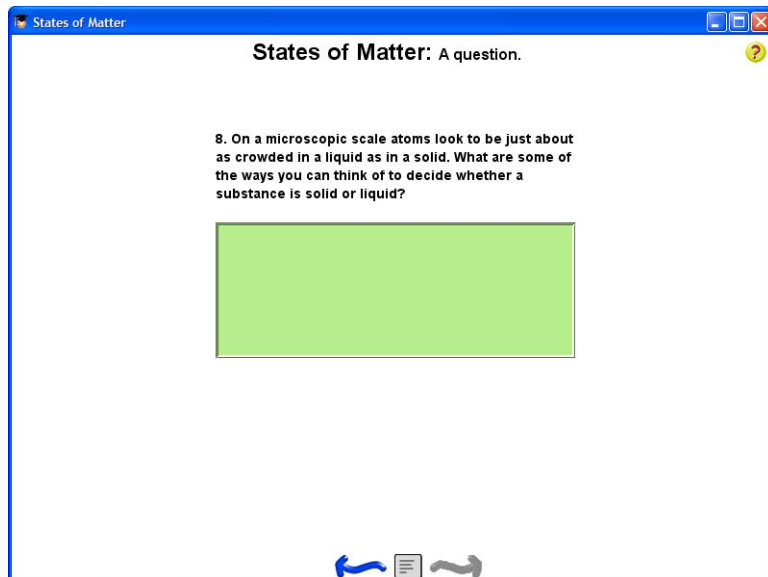
Highlight Molecule 1 Highlight Molecule 2

4.4 Questions for Understanding

In the first question, gases will be compressible because there is lots of space between the molecules:



In the next question both liquid and solid molecules are in contact with each other, however solid molecules stay close to the same molecules, while liquid molecules are moving around and frequently are finding new neighbors. It is worth thinking about the ability of the molecules to slide past each other:



In this last question, glass is introduced. It is actually classified as an amorphous solid. This means that glass behaves like a solid in the short run, but overtime the molecules creep like a liquid. A potential topic for class discussion is how some substances do not fit into clear categories.

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States of Matter: A question.

9. Glass appears solid, yet over time it flows. This is sometimes noticeable in the windows of very old houses.

Do you think glass is a:

Solid

Liquid

Gas

Something else

Explain your answer:

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4.5 Summary

This section shows student answers to all the questions. There is an icon on the lower left that will print each student's answers. After the students click the icon, s/he will be asked to type in their name. This is only for the printout; their name is not saved in our database. Then, a web page is generated with the answers. This process may take a few moments. The standard print dialog box will open and the student can select the appropriate printer.

5.0 Student Reports

Your students' work with the States of Matter activity is logged and viewable on the MAC Project Web Portal at <http://mac.concord.org>. For each student, you can view a report containing questions and answers. The next activity in the Chemica sequence is Phase Change.