

Lesson Plan: Models Matter

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Target Grade: 5th

Teacher Prep Time: 10 minutes

Lesson Time: 3 days, 2 hour 30 minutes total

Learning Goals:

- Students will be able to develop a model of solids, liquids, and gases on the molecular level.

NGSS:

- 5-PS1-1 Develop a model to describe that matter is made of particles too small to be seen.
- Science and Engineering Practice
 - #2 Developing and Using Models
 - Modeling in 3-5 builds on K-2 experiences and progresses to building and revising simple models and using models to represent events and design solutions.
 - Developing a model to describe phenomena
- Disciplinary Core Ideas
 - PS1.A Structure and Property of Matter
 - Matter of any type can be subdivided into particles that are too small to see, but even then the matter still exists and can be detected by other means. A model showing that gases are made from matter particles that are too small to see and are moving freely around in space can explain many observations including the inflation and shape of a balloon and the effects of air on larger particles or objects.
- Cross Cutting Concepts
 - #3 Scale, Proportion, and Quantity
 - Natural objects exist from the very small to the immensely large.

Where this lesson fits in:

- This lesson should be done at the beginning of your chemistry unit. Students should know what physical properties are and be able to use them to describe objects. This lesson should be done before matter, physical changes, or chemical reactions are formally discussed.

Materials Needed:

All glassware in this lab needs to be safe to eat out of. The glassware must be clean because students will be tasting things out of the glassware.

- Glass 400 mL beakers (2 per group)
- Glass 100 mm × 10 mm Petri dishes (1 set per group)
- Hot plate (1 per group)
- Water (20 mL per group)
- Sugar cubes (1 per group)
- Digital scales - must read to the hundredths place and display masses up to 200.00 g (1 per group)
- 3" disposable ice cream tasting spoons (amazon)
- Large poster paper (5 pages each group)

Teacher Prep:

- Make sure that all glassware is safe for students to taste water out of.
- Prepare the following for each group: 1 beaker with 20 mL of water, top of a Petri dish with a sugar cube, empty beaker, and empty other bottom of Petri dish.
- Have scales and hot plates around the room for use during the lab.
- Have a sugar cube in a beaker with Petri dish on top and heat it on a hot plate. Make sure that hot plate is not turned on hotter than 95°C. It is important that you do not melt the sugar.

15 minutes	Beginning Thoughts <ul style="list-style-type: none">• Have students seated in groups of ~5 students.• Pass out <i>Models Matter</i> packet.• Have students fill out the questions: “What is matter?”, “Are water and sugar matter?” and “Why or why not?” (page 1)• Have students discuss their ideas as a class. (the teacher should not give any formal definition or explanation at this point)<ul style="list-style-type: none">○ Key ideas can be recorded on the board.
30 minutes	Model 1: Initial model of solids and liquids <ul style="list-style-type: none">• Pass out the one sugar cube (in a Petri dish), ~20 mL of water (in a beaker), additional beaker, and additional Petri dish to students.• Have students make 5 observations of each substance. (page 1)<ul style="list-style-type: none">○ Place scales around the room so students can determine the mass of the water and the sugar.○ Remind students that the sugar and the water should not be put on the scale directly. You can show them how to tare (reset scale to zero) the scale or tell them that they will need to subtract the weight of the container from their measurements.• Have students share out a few of their observations as well as discuss which observations are true for all liquids and solids.<ul style="list-style-type: none">○ Observations should be recorded by the teacher on the board.• Have students answer the next two questions about what they think are the smallest pieces of water and sugar. (page 2)<ul style="list-style-type: none">○ ESR (expected student response):<ul style="list-style-type: none">▪ A drop of water and a grain of sugar• Have students develop their first model of liquids and solids. (page 2)• Once students have come up with individual models, have them share their ideas with their group and record the group consensus on large poster paper which they will share with the class.• Ask students, “What are key differences/observations between solids and liquids that any model should account for?” Write a list of these on the board.<ul style="list-style-type: none">○ ESR:<ul style="list-style-type: none">▪ Liquids take the shape of their container while solids do not.▪ Liquids can move around and solids do not.▪ You can remove different size pieces of the solid or liquid from the main source.• Have a few groups share their models.<ul style="list-style-type: none">○ For each model have students identify if the model explains the key differences/observations that they identified.○ It is important that the teacher only asks questions and does not do any formal teaching at this point.

30 minutes	<p>Model 2: Revising model of solids and liquids</p> <ul style="list-style-type: none"> • Make sure the hot plate with the sugar cube in a beaker is somewhere students can see. • Have students set their beakers with water and Petri dish on top of a hot plate and start heating. (see student worksheet for picture) <ul style="list-style-type: none"> ○ Turn the hot plate to 95°C. If the water starts to boil, have students turn down the hot plate. • After the water is put on the hot plate, have students look and record observations of the sugar and then have them go back and make observations of the water. (page 3) • Have students answer the questions: “Where did the water on the Petri dish come from and how did it get there?” “What happened to the amount of water in the beaker?” (page 3) • Have students revise their models. (page 4) • Once students have come up with individual models have them share their ideas with their group and record the group consensus on large poster paper which they will share with the class. • Have students help you revise the class list of key differences/observations between solids and liquids. <ul style="list-style-type: none"> ○ ESR: <ul style="list-style-type: none"> ▪ When a solid is heated the solid seems unchanged and no particles appear on the Petri dish. ▪ When a liquid is heated although no particles are seen in the gas phase (students will say air) the liquid appears on the Petri dish. ▪ Individual water particles must be too small for us to see. • Have a few groups share their models. <ul style="list-style-type: none"> ○ For each model have students identify if the model explains the key differences/observations that they identified. ○ It is important that the teacher only asks questions and does not do any formal teaching at this point. • Have students discuss and then fill in the question “If you leave a beaker with water and another beaker with a sugar cube on the counter for one week, the water beaker will be empty and the sugar cube beaker will still have sugar. Apply your model to explain this.” (page 4)
30 minutes	<p>Model 3: Developing a model of solid/liquid solutions</p> <ul style="list-style-type: none"> • Have students generate a model for what will happen when the sugar cube is put into the water as well as answer the question about how they could test their model. (page 5) • Once students have come up with individual models have them share their ideas with their group and record the group consensus on large poster paper which they will share with the class. • Have a few groups share their models and what evidence they could collect to support their model. <ul style="list-style-type: none"> ○ Make sure that students generate the idea of tasting the solution to see if it contains the sugar particles. ○ Ask students if they think they will see the sugar particles when they are in the water and what this means. • Pass out tasting spoons. Remind students that once they use their tasting spoon they need to throw it away. If they have to taste something else they will get a new spoon.

	<ul style="list-style-type: none"> • Have student put the sugar cube into the beaker with water and swirl it until the sugar cube dissolves. <ul style="list-style-type: none"> ○ It will take about a minute of swirling to make the sugar dissolve. • Have students answer the questions: “How do you know that sugar is in the water?” “And What does this tell you about the relative size of sugar particles?” (page 6) • Have students help you revise the class list of key differences/observations between solids and liquids. <ul style="list-style-type: none"> ○ ESR: <ul style="list-style-type: none"> ▪ Individual solid particles are too small to be seen. • Tell students that when you look at the sugar cube you see small particles. Ask students if these are individual sugar particles and what evidence that they have for this. <ul style="list-style-type: none"> ○ Students should realize that the grains of sugar that they see in the sugar cube must be made up of many sugar particles because when the sugar was put into water the sugar particles were too small to be seen. • Work on the matching question as a class. (page 6) <ul style="list-style-type: none"> ○ Students should make the following matches. <ul style="list-style-type: none"> ▪ Approximate mass of sugar that you used (g) = 4 ▪ Approximate mass of water that you used (g) = 15 ▪ Approximate number of people on the earth = 7,000,000,000 ▪ Approximate number of sugar particles in a sugar cube = 10,000,000,000,000,000,000,000
30 minutes	<p>Model 4: Developing a model of heating solid/liquid solutions</p> <ul style="list-style-type: none"> • Have students generate a model for what will happen when the sugar/water solution is heated as well as answer the question about how they could test their model. (page 6) • Once students have come up with individual models have them share their ideas with their group and record the group consensus on large poster paper which they will share with the class. <ul style="list-style-type: none"> ○ Make sure students discuss if they think that water, water and sugar, or nothing will be on the Petri dish when the liquid is heated. ○ Ask them how we would be able to tell between each of these options. • Have them heat their solution and taste the liquid on the top of the Petri dish. <ul style="list-style-type: none"> ○ Have students turn the hot plate to 95°C. If the water starts to boil, have students turn down the hot plate. ○ It takes about 15 minutes to collect enough water to taste (10 minutes to heat (on hotplate) and 5 minutes to cool (on table)). Therefore, have students work on the final models of solids, liquids, and gases while waiting to taste the water on the Petri dishes. • Have students revise their model if needed. (page 6)
15 minutes	<p>Model 5: Final models of solids, liquids, and gases</p> <ul style="list-style-type: none"> • As a group, have students come up with a model of solids, liquids, and gases showing key differences between the states. (page 7) • Have students share their models with the class.

Example Student Work:

Name: Dorly
 Group Members: Sierra and Emily
 Date: 6/8

Models Matter

Beginning Thoughts

What is matter?
Everything is made of matter. Matter is the word for all things that have mass.

Are water and sugar matter? Why or why not?
Water and sugar are matter because they have mass.

Understanding Water and Sugar

Make 5 observations about the water (you may not use the word liquid). Feel free to pour the water between the beakers. Then circle the observations that would hold true for all liquids.

- Clear
- Fill in bottom of container
- Moves around in the container
- Can be poured from one container to another
- Reddy

Make 3 observations about the sugar cube (you may not use the word solid). Then circle the observations that would hold true for all solids.

- White
- Cubic
- Large cube made up of small pieces
- All pieces move together
- 378g

When you pour the water between the beakers do you pour the same amount each time? What do you think is the smallest amount of water that could be moved from one beaker to the other?
No you do not pour the same amount each time. The smallest amount you could pour is a drop.

If you smashed the sugar cube would all the pieces be the same size? What do you think is the smallest piece that could be removed from a sugar cube?
No not all of the pieces would be the same size. The smallest piece that could be removed is a grain.

Model 1

Generate models that can explain the observations that you made about liquids and solids using your choice of words, pictures, and/or numbers.

Liquid

Solid

*When you are finished combine your ideas with your group and put your combined model on a poster.

Place a Petri dish face down on the beaker with water (as shown in the picture). Then place on the hot plate and gently heat (95°C). If the water starts to boil then turn down the hot plate. Record 3 observations about the beaker with the water.

- Water drops appear on Petri dish
- No water droplets can be seen in air
- Water at bottom appears unchanged (same size, color, shape)

Record 3 observations about the beaker with the sugar cube the teacher is heating at the front of the room.

- Sugar still in cube in bottom of beaker
- Nothing appears on side or top of Petri dish
- Nothing seen in air above sugar

Where did the water on the petri dish come from and how did it get there? What happened to the amount of water in the beaker?
The water must have come from the water at bottom of beaker. The particles must be too small to see and must have come off the water and been deposited on the Petri dish. The mass of water in bottom of the beaker must have gone down.

Model 2

Revise your models of liquids and solids to incorporate your new findings using your choice of words, pictures, and/or numbers.

Liquid

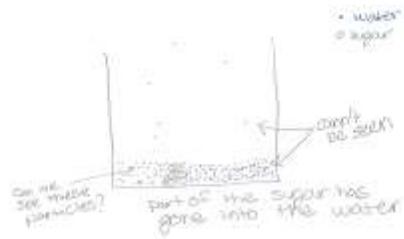
Solid

*When you are finished combine your ideas with your group and put your combined model on a poster.

If you leave a beaker with water and another beaker with a sugar cube on the counter for one week, the water beaker will be empty and the sugar cube beaker will still have sugar. Apply your model to explain this.
Water is made up of small particles that are too small to be seen. These particles can separate from the liquid water and go into the air causing the water to leave the beaker after a week. The sugar particles are too big to come off and therefore will not leave the sugar cube.

Model 3

Generate a model of what you think will happen if you put the sugar cube into the water using your choice of word pictures, and/or numbers.



When you are finished combine your ideas with your group and put your combined model on a poster.

What evidence could you collect to support your model?

We could taste the water to see if it is sweet.

How do you know that sugar is in the water?

The liquid tasted sweet so the sugar must be in the water

What does this tell you about the relative size of sugar particles?

The grains that we see must be made up of smaller particles that are too small to be seen

Match the following number to the correct description

- | | |
|----------------------------|---|
| 7,000,000,000 | Approximate mass of sugar that you used (g) |
| 4 | Approximate mass of water that you used (g) |
| 15 | Approximate number of people on earth |
| 10,000,000,000,000,000,000 | Approximate number of sugar particles in a sugar cube |

Model 4

Draw a model of what will happen when sugar/water is heated with a lid over it using your choice of words, pictures, and/or numbers.



When you are finished combine your ideas with your group and put your combined model on a poster.

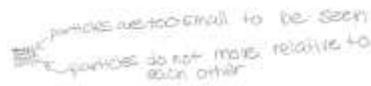
What evidence could you collect to support your model?

Taste liquid on petri dish.

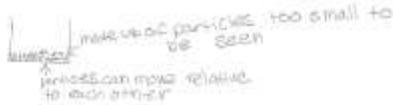
Test your model and revise your model if necessary.

As a group, generate a general model of solids, liquids, and gases using your choice of words, pictures, and/or numbers. Record your model on a poster.

Solid



Liquid



Gas

