PreMiEr
Precision Microbiome Engineering
NSF Engineering Research Center

This lesson plan was created by a teacher participating in the Research Experiences for Teachers program from the Precision Microbiome Engineering Research Center. Are you interested in spending part of your summer in a lab getting paid to do microbiome research and create lesson plans?

Learn more here: https://premier-microbiome.org/for-teachers-ret/

Lesson plan written by Kimberly Griffis

It All Matters!

Suggested Class size: Max 20 students

Learning Objectives:

3P.2.2 Students will know that all matter exhibits properties.Students know that gasses,

liquids, and solids are all made up of particles. Students will identify the three states of matter (gas, liquid, solid). Students will be able to explain that solids, liquids, and gasses (each) display unique properties characteristic of that particular state (phase) of matter.

3P.2.3 Students will understand that heating or cooling matter will alter the properties of that matter. Students will know that all matter has mass and volume

3.P.3.1 Students know that rubbing objects together results in friction which releases heat energy.

Objectives

Students will

- Study this topic.The State of Matter
- Explain that all things are made up of matter.
- Explain the properties of liquids and solids
- Observe that properties of matter change as phases of matter change.
- will create a liquid and then when heated observe the gas phase of matter.

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Content Standards

This lesson is appropriate for [third grade physical science] students and addresses the

following Standards:

3.P.2.2 Compare solids, liquids, and gasses based on their basic properties.

3.P.2.3 Summarize changes that occur to the observable properties of materials when different degrees of heat are applied to them, such as melting ice or ice cream, or boiling water or an egg, or freezing water.

3.P.3.1 Students know that rubbing objects together results in friction which releases heat energy.

Time Requirements (separate prep time 30 minutes, Total time on lesson 3 days, and after class time 30 minutes)

Materials:

Reusable materials:

(1)25 ml pipettes for each student

(10 cases) 20- 200 ml pipette tips

1000 ml bottle

1000 ml cylinder

50 ml flask

incubator shaker (set at 37 degrees) 135 roto by minutes (not required if premix is purchased)

measuring scale (not required if premix is purchased)

hot plate or microwave (for heating liquid)

magnetic bar (used to mix broth and agar)

distilled water (not required if premix is purchased)

(30) petri dish

Oven mitt (used to remove liquid media from hotplate/microwave)

LB Broth (preferably premade)

https://www.carolina.com/catalog/detail.jsp?prodId=776362&gclid=Cj0KCQjwzdOlBhCN
ARIsAPMwjbyS9jpDZ69c8MdhIVDkZGpXSUnYU-
BLH87nP4e9ZGyyasHI85jTkNcaAula
EALw_wcB

Agar (preferably premade)

https://www.sciencecompany.com/Nutrient-Agar-Ready-To-Pour-Kit-P16211

Perishable or disposable materials:

small latex gloves

lab coat

food coloring (blue, red and yellow)

small clear cups (2 per student)

Safety

Ensure that students understand and adhere to safe laboratory practices when performing any activity in the classroom or lab. Demonstrate the protocol for correctly using the instruments and materials necessary to complete the activities, and emphasize the importance of proper usage. Use personal protective equipment such as safety glasses or goggles, gloves, and aprons when appropriate. Model proper laboratory safety practices for your students and require them to adhere to all laboratory safety rules.

Background Information

Know the 3 states of matter. Understand how matter properties can change.

Medium Preparation

- **Preparation LB broth**
- Weigh 25 g of LB powder in an autoclavable 1000 ml bottle and adjust the volume up to 1000 ml of deionized water.
- then place the bottle on a magnetic stirrer to homogenize.
- Sterilize the medium by autoclaving at autoclaving 15 mins at 121°C.
- carefully place the medium on the safety chamber to cool.
- It can be stored in the refrigerator until needed

Preparation LB Agar

- Weigh 25 g of LB powder and 15 g of agar into an autoclavable 1000 ml bottle.
- Adjust the volume up to 1000 ml of deionized water.
- Then place the bottle on a magnetic stirrer to homogenize.
- Sterilize the medium by autoclaving at 15 mins at 121°C.
- Carefully place the medium on the safety chamber and allow it to get to room temperature.
- Then carefully and gently pour the medium on the petri dish and allow the medium to solidify.
- Once the medium is solidified, flip the plates upside down.
- It can be stored in the refrigerator until needed

Microwave- for warming solidified agar mixture for 1 to 3 minutes to completely dissolve the agar. Just like gelatin, agar needs heat for 1-3 minutes to properly dissolve gel, but gels are 25 degrees celsius. Be sure to watch while in the microwave for every 10-15 seconds.

CAUTION: Adult supervision is required to boil water. If you are using a microwave oven to boil the mixture, be careful not to let it boil over. The mixture should be clear with no particles floating in it after boiling. **Be sure to use an oven mitt to remove agar from the microwave or hotplate.**

(Day 1 of 3 45 minutes)

Activating Prior Knowledge

- Let's think about liquids and their attributes. Turn to your partner and name one liquid and how you know that it's a liquid.
- Choose a couple of students to share examples of liquids.
- Could you walk across water? Why or why not?
- Would you run through a brick wall? Why or why not?

Guiding the lesson using the 5E Learning Cycle
Engage

1. Tell the students that there are three states of matter: solids, liquids, and gasses. The focus today will be investigating solids and liquids

2. Students will watch a video on solids and liquids.

States of matter for kids - What are the states of matter? Solid, liquid and gas

3. After video review vocabulary (matter, solids, liquids, gas, volume, and mass)

Then, explain to students that they will be using pipettes to create solids using a liquid broth.

Next, explain the importance of holding the pipette correctly and not turning the dial past 10 or 25 ml or the pipette will break. Also, explain that the pipette is not a toy to play around with.

Vocabulary:

- **boiling point** – the temperature at which a liquid boils and turns to vapor
- **cooling** – having the effect of losing heat (thermal energy)
- **condensation** – gas which cools and collects as droplets converting back to a liquid
- **evaporation** – the process of liquid changing to vapor (a gas)
- **freezing point** – the temperature at which a liquid turns into a solid when cooled
- **gas** – matter in a state in which it will expand freely to fill the whole of a container,having no fixed shape and no fixed volume
- **heating** – the transfer of energy from one substance to another as a result of a difference in temperature (increase)
- **liquid** – matter that flows freely but is of a constant volume and mass (no definite shape)
- **mass** – a property of matter relating to how much matter makes up the object
- **matter** – material substance that I observable and is most familiarly found as solids, liquids, or gasses

• **phase change** – a change from one state (solid, liquid, or gas) to another without a change in chemical composition or makeup.

• **solid** – state of matter having definite mass, volume, and shape

• **state of matter** – most commonly – solids, liquids, and gas

• **volume** – property of matter measuring how much space it takes up

Explore (15 minutes)

1.Teacher will pass out a 25 ml pipette to each student.

2.First model for students how to hold the pipette.

● Then explain that there is a first level and a second level. Have students pick up their pipette so they can feel the stopping point of the first level and then the second level Explain that the different levels are friction because it is the rubbing of the two things to cause the object to stop. Explain that the first stopping point will suck up the liquid. Let students practice stopping on the first level. Then explain that the second level will be what releases the liquid. Students should practice stopping on the second level.

3. Today we will make liquid matter. You will practice making liquid matter using food coloring. We will use food coloring to create the colors green and orange. When you use each color, be sure to change out your tips by disposing each tip into your trash bag. (Be sure to model placing tip on pipette and disposing tip) As you are creating the colors, I want you to analyze what you are observing happening to the colors.

● First, you will put 25 ml of yellow coloring and 25 ml of red food coloring into the bowl of water. What color do you see?

● Next, in the other bowl of water place 25 ml of blue and 25 ml of red. (Remember to change out your tip after using each color) What color do you see?

Questions to ask:

● What colors did you create?

- How did you create each color?
- Which food coloring was the dominant color? Why do you think that was the dominant color?
- What did you observe?
- What states of matter do you see?

Differentiation

- Students at or above grade level can be given a task card explaining the directions for mixing the colors independently.
- Students below or close to grade level should follow along with teacher as direct instructions are given.

Explain (10 minutes)

1.First we will take the liquid matter using a broth that was prepared prior to class today.

(Show students the media in the 1000ml bottle) I will pour each of you some of the liquid media in your flask.

2. Next, you will create a liquid using agar and water to create a liquid matter.

Questions: Before/During/ After

1. What states of matter are we beginning with? petri dish (solid), Agar/Broth (liquid)
2. How would you describe the properties of the liquid matter? Solid?
3. How would you describe the changes that the liquid matter went through?

Elaborate (Expected timing 10 minutes)

1. Now using the agar. Pour the agar into the petri dish only filling the dish halfway. Be sure to model for the students and point out the halfway mark on the petri dish.

2. Carefully, pour the hot agar mixture into the petri dishes. it should gel within an hour.

Refrigerate to observe on **Day 2**.

Day two: Petri dishes from Day One should be placed on student desks.

Engage (Day 2 of 3 Time: 15 minutes)

● Tell the students that there are three states of matter: solids, liquids, and gasses.

The focus today will be investigating solids, liquids, and gasses.

● Students will watch a video. 3 States of Matter for Kids (Solid, Liquid, Gas): Science for Children - FreeSchool

● After the video, review vocabulary (matter, solids, liquids, gas, volume, and mass)

● **Turn to your partner-** Partner A tells partner B one thing you learned from the previous lesson. Then partner B tells partner A to share what they learned. Call on a couple of students to share what they learned from the previous lesson.

● Then, explain to students that they will analyze the properties that they observe in their petri dish.

Vocabulary:

• **boiling point** – the temperature at which a liquid boils and turns to vapor

• **cooling** – having the effect of losing heat (thermal energy)

• **condensation** – gas which cools and collects as droplets converting back to a liquid

• **evaporation** – the process of liquid changing to vapor (a gas)

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• **gas** – matter in a state in which it will expand freely to fill the whole of a container,

having no fixed shape and no fixed volume

• **heating** – the transfer of energy from one substance to another as a result of a difference in temperature (increase)

• **liquid** – matter that flows freely but is of a constant volume and mass (no definite shape)

• **mass** – a property of matter relating to how much matter makes up the object

• **matter** – material substance that I observable and is most familiarly found as solids, liquids, or gasses

• **phase change** – a change from one state (solid, liquid, or gas) to another without a change in chemical composition or makeup.

• **solid** – state of matter having definite mass, volume, and shape

• **state of matter** – most commonly – solids, liquids, and gas

• **volume** – property of matter measuring how much space it takes up

Day 2 Explore (15 minutes)

1. Have students analyze the state of matter in the petri dish.

2. Have students write down all the properties that they observe.

Questions to ask:

● How has the matter in the petri dish changed from what it was yesterday?

● Why do you think the properties of the matter changed?

● If we were to let the petri dish sit for a while, what do you predict will happen ?

Day three:

Evaluate (45 minutes Day 3 of 3)

Assessment: Have students complete the graphic organizer describing the different

states of matter and their properties characteristics. As an extension of their learning

they can also draw illustrations of the different states of matter that they observed.On

Day 3 have students write a summary of their observations. What are the three states of

matter that they observed? What are the different properties and characteristics?

Describe what each state of matter looked like. What happened between each state of
matter for it to change? Remind students to use linking words such as (first, next, then,
finally).

Questions to ask to assure that the stated learning objectives were met?

1. Describe the properties of liquids? Solids? Gasses?
2. How does temperature affect liquids? Solids? Gasses?
3. Classify at least 3 liquids, solids, and gasses.
4. Is matter the same even though it has changed its state? How do you know?
5. What state of matter would you use to bathe with?
6. What state of matter would you use to build a house?
7. Describe the changes that the three states of matter go through.

Explore Task Card - Day One

Today we will make liquid matter. You will practice making liquid matter
using food coloring. We will use food coloring to create the colors green
and orange. When you use each color, be sure to change out your tips by
disposing each tip into your trash bag. (Be sure to model placing tip on
pipette and disposing tip) As you are creating the colors, I want you to
analyze what you are observing happening to the colors.

- First, you will put 25 ml of yellow coloring and 25 ml of red food

coloring into the bowl of water. What color do you see?

- Next, in the other bowl of water place 25 ml of blue and 25 ml of red.

(Remember to change out your tip after using each color) What color do you see?

- Finally, what could you have done differently? How would the outcome be different?

Three States of Matter

State of Matter	Define	Properties	Illustration
Liquid			
Solid			
Gas			