A GUIDE BY

WOZ ED

SCIENCE GRADE 5

SCIENCE

CHANGES IN MATTER AND ENGINEERING

SAMPLE LESSON

OVERVIEW

The 5th grade science kit will introduce students to the concept of matter. Students will discover how matter is made of atoms and how all matter can exist in three forms: solid, liquid, or gas. They also will conduct experiments to see how matter can change form when it undergoes heating or cooling. Additionally, students will conduct experiments to see how what happens to matter when two or more substances are mixed and they will observe properties of matter to test and identify different materials. Lastly, students will utilize the engineering design process to create a planter system that conserves or manages water, an essential form of matter.

MODULE 1: ZOOM IN TO MATTER 140 MINUTES

Students will explore science by making observations about matter. Combining hands-on demonstrations with video resources, students will see that matter can be divided up in small ways beyond what the eyes can see. Using this information, students will build a three-dimensional poster model to demonstrate their understanding.

MODULE 2: MEASURE, GRAPH, AND COMPARE CHANGES IN MATTER 145 MINUTES

Students will create demonstrations to explore what happens to matter when material is heated, cooled, or mixed. They will track the weight of the materials to observe how the total amount of matter stays constant, even when the form of matter changes. Students will create infographics to demonstrate their learning.

MODULE 3: MIXING IT UP 150 MINUTES

Students will explore how mixing two or more substances may lead to a new substance. Starting with a fun demonstration, students will observe experiments and watch closely for changes in matter. In the culminating activity, students will design an investigation for exploring substance changes.

MODULE 4: MATTER DETECTIVES 120 MINUTES

Students will make observations and test mystery substances to identify unnamed materials. They will work as a whole class to conduct initial investigations, then work in small teams to test and identify a variety of unknown substances. Through these investigations, students will sharpen their investigative and communicative skills, becoming Matter Detectives.

MODULE 5: ENGINEER A SOLUTION 235 MINUTES

Students will use creativity and engineering skills to develop a planter system. Working through the engineering design process, students will demonstrate creativity and science understanding. Students will design, test, and redesign their system before sharing and evaluating their final projects.

MEASURE, GRAPH, AND COMPARE CHANGES IN MATTER

OVERVIEW

Students will create demonstrations to explore what happens to matter when material is heated, cooled, or mixed. They will track the weight of the materials to observe how the total amount of matter stays constant, even when the form of matter changes. Students will create infographics to demonstrate their learning.

OBJECTIVES

Students will

- Conduct investigations to explore the amount of material that remains after heating, cooling, and mixing materials
- Track numeric data from their investigation
- Create infographics that show the results of their investigations

ADVANCED PREPARATION:

- **Prior to class, collect a water bottle and freeze it to be used during ENGAGE section. Additionally, set up Google Drive accounts (if not already established).**
- **Prior to ENGAGE section, hang student posters from Module 1 around the classroom.**
- **Prior to the EXPLORE section, watch the "Baking Soda and Vinegar Chemical Reaction" video [https://youtu.be/nRMyMIy7U6E] and the "Marshmallows in vacuum chamber" video [https://youtu.be/bWd31AefKns] to prepare for the class demonstrations; create a class chart for the Sugar and Water experiment; and set up a materials table.**

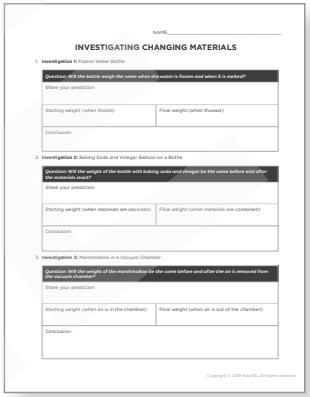
STANDARDS: BUILDING TOWARDS...		
Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Using Mathematics and Computational Thinking • Mathematical and computational thinking in 3–5 builds on K–2 experiences and progresses to extending quantitative measurements to a variety of physical properties and using computation and mathematics to analyze data and compare alternative design solutions. • Measure and graph quantities such as weight to address scientific and engineering questions and problems.	PS1.A: Structure and Properties of Matter • The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. PS1.B: Chemical Reactions • No matter what reaction or change in properties occurs, the total weight of the substances does not change. (Boundary: Mass and weight are not distinguished at this grade level.)	Scale, Proportion, and Quantity • Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.

COMMON CORE STATE STANDARDS CONNECTIONS: ELA/LITERACY	
W.5.7	Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. (5-PS1-2)
W.5.8	Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work, and provide a list of sources. (5-PS1-2)
W.5.9	Draw evidence from literary or informational texts to support analysis, reflection, and research. (5-PS1-2)
COMMON CORE STATE STANDARDS CONNECTIONS: MATHEMATICS	
MP.2	Reason abstractly and quantitatively. (5-PS1-2)
MP.4	Model with mathematics (5-PS1-1)
MP.5	Use appropriate tools strategically. (5-PS1-2)
5.MD.A.1	Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real-world problems. (5-PS1-2)

ENGAGE 20 MINUTES

MATERIALS

- student posters from Module 1—available to students
- computer linked to projector displaying "Solids, Liquids, Gases" video [http://studyjams.scholastic.com/studyjams/jams/science/matter/solids-liquids-gases.htm]
- frozen water bottle—1 per class (provided by teacher)
- food scale—1 per class
- Investigating Changing Materials handout—1 per student


INVESTIGATING CHANGING MATERIALS

INVESTIGATING CHANGING MATERIALS

See actual on page 28-29

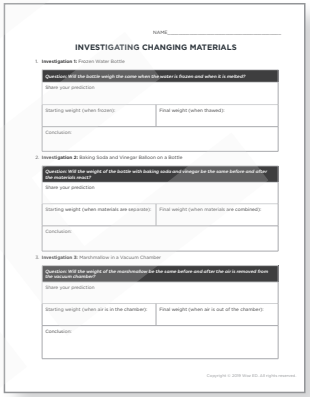
PROCEDURE

1. Remind students of the information they learned in the previous module by inviting students to tour the Module 1 posters.
   a. Instruct students to find a partner and to verbally share the information they recall from Module 1.
2. Play the "Solids, Liquids, and Gases" video and invite students to sing along to the song.
3. Show students the frozen water bottle and ask them, "When the bottle thaws, will the same amount of material be there? How could we tell?"
   a. Allow students to brainstorm ways to measure the material.
   b. If no students think to weigh the bottle in the frozen state and later when thawed, propose the idea to students.
4. Distribute the *Investigating Changing Materials* handout.
5. Weigh the frozen water bottle and direct students to note the starting weight on the *Investigating Changing Materials handout*.

EXPLORE 60 MINUTES

MATERIALS

- Investigating Changing Materials handout—1 per student
- balloon—1 per team
- empty water bottle—1 per team (provided by teacher)
- baking soda—1 tablespoon per team
- measuring tablespoon – 1 per class
- vinegar—200 mL per team
- food scale—1 per class
- marshmallow—available to students
- vacuum chamber—1 per class
- water—500 mL per class
- sugar—30 packets per class
- cylinder—1 per class
- chart paper—1 per class
- markers—1 per teacher


INVESTIGATING CHANGING MATERIALS

NAME

INVESTIGATING CHANGING MATERIALS

1. **Investigation 1:** Frozen Water Bottle

Question: Will the bottle weigh the same when the water is frozen and when it is melted?

Share your prediction:

Starting weight (when frozen):	Final weight (when thawed):

Conclusion:

2. **Investigation 2:** Baking Soda and Vinegar Balloon on a Bottle

Question: Will the weight of the bottle with baking soda and vinegar be the same before and after the materials react?

Share your prediction:

Starting weight (when materials are separate):	Final weight (when materials are combined):

Conclusion:

3. **Investigation 3:** Marshmallow in a Vacuum Chamber

Question: Will the weight of the marshmallow be the same before and after the air is removed from the vacuum chamber?

Share your prediction:

Starting weight (when air is in the chamber):	Final weight (when air is out of the chamber):

Conclusion:

INVESTIGATING CHANGING MATERIALS
See actual on page 28-29

PROCEDURE

1. Divide class into teams of three and instruct them to work in these teams for the class demonstrations.
2. Explain students will first see the Baking Soda and Vinegar in a Bottle demonstration.
   a. Describe the investigation to the students and pose the question, "Will the weight of the bottle with baking soda and vinegar be the same before and after the materials react?"
   b. Instruct students to discuss their ideas with their teams and write their predictions on their *Investigating Changing Materials* handouts.
   c. Distribute an empty water bottle and a balloon to teach team.
   d. Invite one member from each team to visit the materials station to add a tablespoon of baking soda to the inside of the balloon.
      i. Instruct students to twist the balloon valve shut after adding the baking soda.
   e. Invite a different member from each team to visit the materials station to add 200 mL of vinegar to the empty water bottle.
   f. Invite the third team member of each team to visit the materials station to weigh the balloon and water bottle on the scale.
      i. Instruct students to record this data on the *Investigating Changing Materials* handout as the starting weight.
   g. Instruct students to attach the balloon to the bottle without untwisting the balloon to begin the experiment.
      i. Groups should conduct the investigation one at a time so that everyone can watch the demonstration multiple times.
      ii. As each group conducts the investigation, discuss what is happening with the chemical reaction and mention the carbon dioxide being created during the demonstration.

h. After every group has conducted the experiment, instruct students to send one group member to the materials station to weigh the balloon and bottle combination.
    i. Remind students to record this data on the *Investigating Changing Materials* handout as the final weight.
    ii. Instruct students to share what they noticed and write a conclusion on the *Investigating Changing Materials* handouts.
    iii. Remind students to use specific vocabulary (such as "chemical reaction" and "carbon dioxide") in their conclusion.

i. Instruct students to clean up their desks to prepare for the next demonstration.

3. Explain students will now conduct the Marshmallow in a Vacuum Chamber demonstration as a class.
    a. Invite one student to visit the materials station to weigh two marshmallows on the scale.
        i. Instruct students to record this data on the *Investigating Changing Materials* handout.
    b. Invite one student to draw a face on one marshmallow.
    c. Instruct this student to place the marshmallows in the Microscale Bell Jar and Vacuum Set.
        i. Instruct students to make a prediction about the weight of the marshmallow after the air is pulled out of the vacuum chamber and to record the predictions on the Investigating Changing Materials handout.
    d. Instruct students to observe what happens as you conduct the investigation.
        i. Repeat the investigation several times with several marshmallows.
        ii. As you conduct the investigation, discuss what is happening in the chamber and what students are observing.
    e. After you have conducted several investigations, instruct one student to visit the materials station to weigh the post-experiment marshmallows.
        i. Remind students to record the final weight of the post-experiment marshmallows on the Investigating Changing Materials handout.
        ii. Instruct students to share what they noticed and write a conclusion on the Investigating Changing Materials handouts.
        iii. Remind students to use specific vocabulary (such as "vacuum chamber") in their conclusion.
    f. Instruct students to clean up their desks and the materials station to prepare for the next demonstration.
4. Explain students will now conduct the Sugar and Water demonstration.
    a. Inform students you will mix water and sugar in the graduated cylinder by adding three packets of sugar at a time.
        i. Instruct students to observe how the weight of the cylinder changes as you add the packets.
        ii. Ask students, "What do you think will happen each time we add a packet of sugar to the water?"
        iii. Instruct students to record their predictions on the Investigating Changing Materials handout.
    b. Invite one student to weigh 3 sugar packets on the scale.
        i. Instruct students to record this weight on the Investigating Changing Materials handout.
    c. Fill the graduated cylinder with 500 mL of water and invite one student to weigh the cylinder on the scale.

d. Instruct students to record this weight on the Investigating Changing Materials handout.
    i. As students are recording this data on their handouts, record this information on the chart paper at the front of the classroom.

NUMBER OF SUGAR PACKETS ADDED	WEIGHT OF CYLINDER
0	
3	
6	
9	
12	
15	
18	
21	
24	
27	
30	

e. Invite one student to add 3 sugar packets to the cylinder (which is on the scale). Ask students, "What do you observe?"
    i. Record the post-sugar weight on the chart paper and instruct students to record this weight on their *Investigating Changing Materials* handouts.
    ii. Continue this procedure (a student adds three packets of sugar and calls out the weight of the cylinder; you record data on the chart paper, while students record the data on their *Investigating Changing Materials* handouts) until 30 packets have been added.

f. After 30 packets have been added to the cylinder and the data has been recorded, ask students to help evaluate the data. Ask students the following questions:
    i. What do you notice?
    ii. What is the range in weight?
    iii. Based on what you know about matter, does the data make sense?
    iv. How can you use this information to complete the graph on the *Investigating Changing Materials* handout?

g. Lead students in creating the data graph.
    i. Remind students to put the number of sugar packets on the x-axis and the weight of the cylinder on the y-axis.
    ii. Allow students time to plot the data on their graphs.

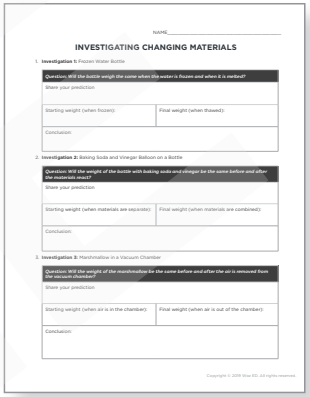
h. After students have completed their graphs discuss the data results.
    i. Instruct students to write their conclusions about the experiment on their *Investigating Changing Materials* handout.

i. Instruct students to clean up their desks and the classroom.

EXPLAIN 20 MINUTES

MATERIALS

- thawed water bottle—1 per class (provided by teacher)
- food scale—1 per class
- **Investigating Changing Materials handout**—1 per student



NAME _____

INVESTIGATING CHANGING MATERIALS

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Question: Will the bottle weigh the same when the water is frozen and when it is melted?

Share your prediction:

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Conclusion:

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Question: Will the weight of the bottle with baking soda and vinegar be the same before and after the materials react?

Share your prediction:

Starting weight (when materials are separate):	Final weight (when materials are combined):

Conclusion:

3. **Investigation 3:** Marshmallow in a Vacuum Chamber

Question: Will the weight of the marshmallow be the same before and after the air is removed from the vacuum chamber?

Share your prediction:

Starting weight (when air is in the chamber):	Final weight (when air is out of the chamber):

Conclusion:

INVESTIGATING CHANGING MATERIALS

See actual on page 28-29

PROCEDURE

1. Inform students you are going to reconsider the frozen water bottle question.
   a. Invite one student to weigh the thawed bottle.
   b. Instruct students to record this data on their *Investigating Changing Materials* handout.
   c. Instruct students to discuss the results with a neighbor and then to record their conclusions on their *Investigating Changing Materials* handout.
2. As a class, review the results of all of the demonstrations.
   a. Ask students, "What big idea do you think these demonstrations show us?"
   b. Allow students to brainstorm and share their ideas.
   c. Require students to cite specific data/evidence to support their answers.
3. Instruct students to write their conclusions about this module's big idea on their *Investigating Changing Materials* handout.
   a. Student answers should reflect the following statement: "Regardless of the type of change that occurs after heating, cooling, or mixing substances, the total amount of matter is conserved."

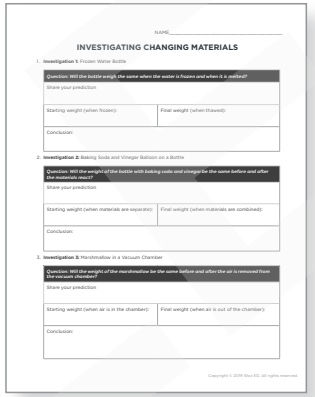
EVALUATE 30 MINUTES

MATERIALS

- device with access to Google Drive—1 per student
- Investigating Changing Materials handout—1 per student

PROCEDURE

1. Instruct students to sign into their Google Drive accounts.
    a. Remind students they will use their completed *Investigating Changing Materials* handouts for this assignment.
2. Inform students they will be creating a new Slides presentation.
    a. Inform students they will only be using one slide to create their infographics.
3. Project the sample infographic and model each of the following steps for students as you discuss the directions and they build their infographics.
4. Instruct students to complete the following steps to create their infographics:
    a. Create a file name for the project.
    b. Change the background color of the slide.
    c. Add the title "Investigating Changing Materials" to the slide.
    d. Divide the slide into 4 sections to share the information from the different investigations.
    e. Insert a final conclusion statement at the bottom of the slide.
        i. Remind students that this conclusion should relate to how the weight of the material stayed the same regardless of being heated, mixed, or put into the vacuum chamber.
5. Instruct students to share their completed infographic slides with you for assessment and/or to print and hang up around the room.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Share your prediction

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Question: Will the weight of the bottle with baking soda and vinegar be the same before and after the materials react?

Share your prediction

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Conclusion:

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Question: Will the weight of the marshmallow be the same before and after the air is removed from the vacuum chamber?

Share your prediction

Starting weight (when air is in the chamber): | Final weight (when air is out of the chamber):

Conclusion:

INVESTIGATING CHANGING MATERIALS

See actual on page 28-29

SAMPLE INFOGRAPHIC

See full-size on page 30

EXTEND 15 MINUTES

MATERIALS

- computer linked to projector displaying student infographics and the video "Vacation or Conservation (Of Mass): Crash Course Kids #23.1" [https://www.youtube.com/watch?v=3lHHOiTdmK4]

PROCEDURE

1. Project student infographics.
    a. As you view each infographic, discuss the following topics:
        i. common themes among all infographics.
        ii. the unique organization of each infographic.
        iii. the final conclusions of each infographic.
2. After viewing student infographics, project the video "Vacation or Conservation (Of Mass): Crash Course Kids #23.1."
    a. Discuss the video and wrap up the concepts in this module.

NAME_____

INVESTIGATING CHANGING MATERIALS

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Share your prediction	
Starting weight (when frozen):	Final weight (when thawed):
Conclusion:	

2. **Investigation 2:** Baking Soda and Vinegar Balloon on a Bottle

Question: Will the weight of the bottle with baking soda and vinegar be the same before and after the materials react?	
Share your prediction	
Starting weight (when materials are separate):	Final weight (when materials are combined):
Conclusion:	

3. **Investigation 3:** Marshmallow in a Vacuum Chamber

Question: Will the weight of the marshmallow be the same before and after the air is removed from the vacuum chamber?	
Share your prediction	
Starting weight (when air is in the chamber):	Final weight (when air is out of the chamber):
Conclusion:	

4. **Investigation 4:** Sugar and Water

Question: Will the weight of the water be the same before and after sugar is dissolved into it?	
Share your prediction	
Weight of 3 sugar packets:	Weight of 500 ml of water:
Sugar and Water Graph 	
Conclusion:	

Big Idea:

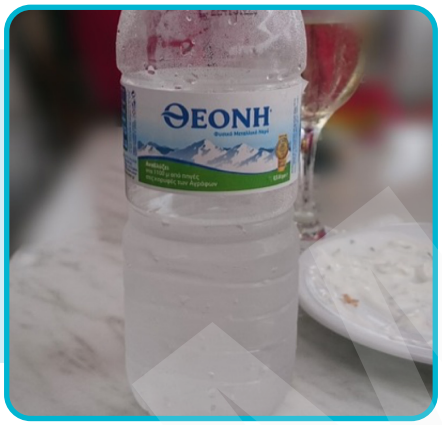
INVESTIGATING CHANGING MATERIALS

FROZEN WATER BOTTLE

Results:

Beginning weight:

Ending weight:

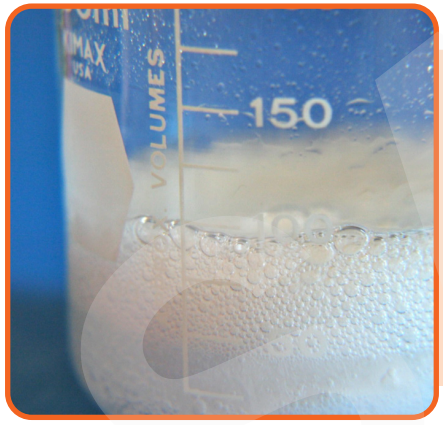


MARSHMALLOW IN A VACUUM CHAMBER

Results:

Beginning weight:

Ending weight:



BAKING SODA AND VINEGAR IN A BOTTLE

Results:

Beginning weight:

Ending weight:

SUGAR AND WATER

Results:

Beginning weight:

Ending weight:

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