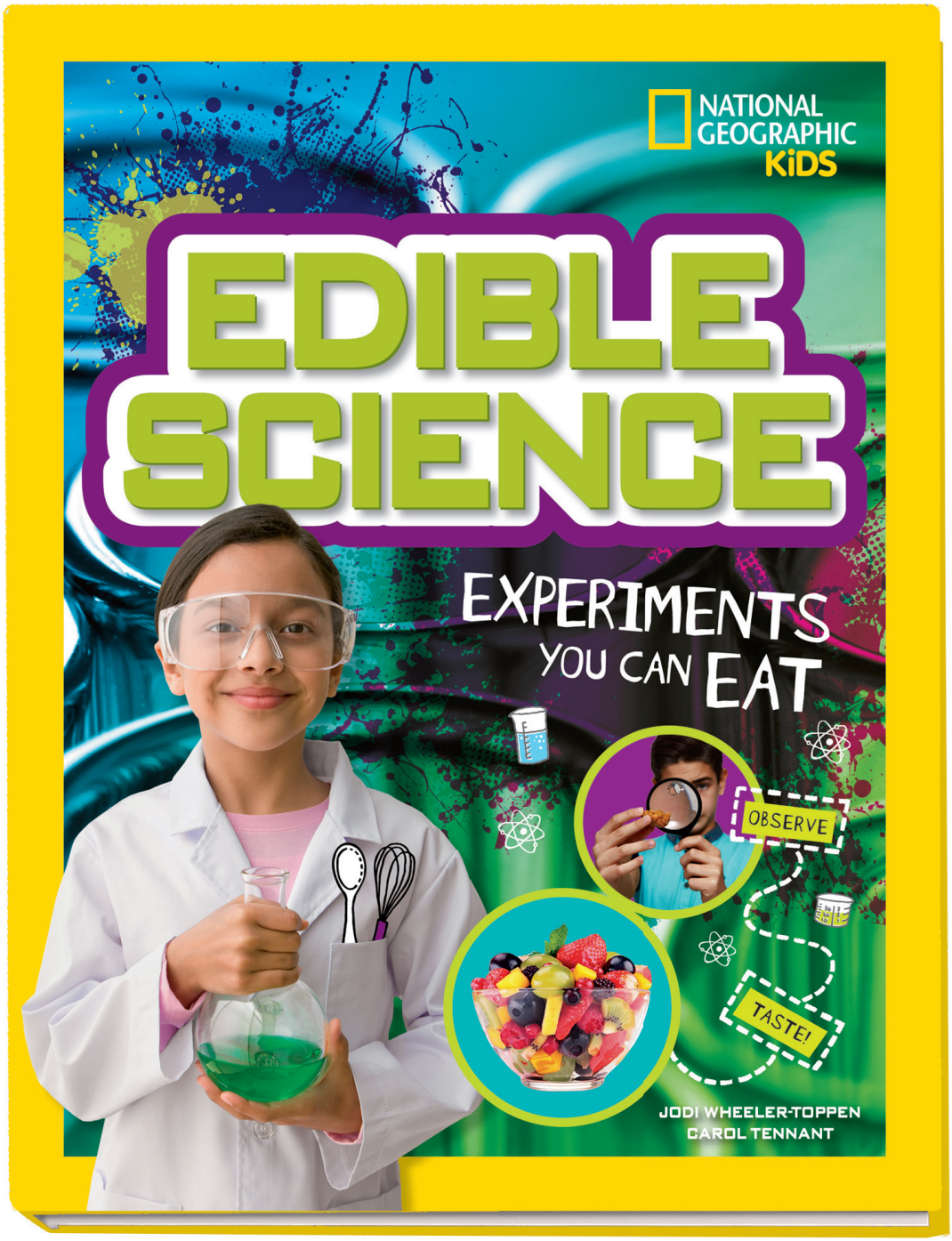
NATIONAL GEOGRAPHIC EDUCATOR'S GUIDE

NEXT GENERATION SCIENCE STANDARDS AND ACTIVITIES



NATIONAL GEOGRAPHIC KIDS

INSTRUCTIONAL NOTE:

The Next Generation Science Standards (NGSS) were developed by the National Research Council and are based on the Framework for K-12 Science Education. These standards describe important scientific ideas and practices that all students should learn and incorporate with relevant science, technology, engineering, and math (STEM) concepts. Each activity in this Educator's Guide introduces, reviews, or otherwise addresses a grade-level performance expectation outlined within the NGSS standards.

Note: Please be aware of any student allergies prior to making any of the products featured in these experiments.

GRADE 3

PERFORMANCE EXPECTATION:
Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. (3-PS2-1)

Supplies
- Cotton swabs, small glass jars, modeling clay, straws, mirrors

Ingredients
- Food coloring
- Marshmallows

Materials
- Plain white paper
- Rulers
- Pencils

Illustrate Inflatable Marshmallows
Read aloud pages 42–43 of Chapter 3, "It's a Gas." As you read, pause to discuss relationships between the text, photos, diagrams, and illustrations.

Provide access to the supplies and ingredients required for this investigation. Have students conduct the experiment with a partner or on their own. Remind students to follow the instructions closely. Assist students when needed, and suggest that they refer to the photos for guidance as well.

After students complete the experiment, discuss the results. Review the sidebar "The Science Scoop" to ensure that students understand how and why their marshmallows changed shape.

Then give each student a piece of plain white paper. Instruct students to fold their papers in half. Ask them to fold the papers in half two more times. Then have students unfold their papers. Each paper should be divided into eight equal spaces. Instruct students to use a ruler and pencil to draw a straight line down each crease.

Inform students that they will now create a comic strip about their marshmallows. Tell them to write the name of their comic strip in the first cell. Challenge students to use the seven other cells to illustrate what happened in the experiment.

Ask students to create a new setting. The story doesn't have to take place within a jar. However, each story line must make a clear connection between the flow of air and the shape of the marshmallow, so readers understand what air pressure is and how it forces marshmallows to change shape.

Give students time to write and illustrate their comic strips. Invite them to share their finished strips with the class. If you wish, encourage students to suggest ideas for illustrating and explaining other experiments as you review the rest of this chapter with the class.

GRADE 4

PERFORMANCE EXPECTATION:

Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. (4-LS1-2)

Supplies

- 9-inch pie dish or tart pan, large saucepan, measuring spoons and cups, knife

Ingredients

- 2 ready-made refrigerated or frozen pie dough rounds, softened according to package directions
- 2 cups water
- 1½ cups sugar
- 1½ tsp. cream of tartar
- 25 round buttery crackers, such as Ritz
- ½ tsp. cinnamon
- 2 Tbsp. butter, cut into small chunks

Materials

- Paper plates
- Forks
- Magazines with photos of foods

Fool the Senses

Prior to reading Chapter 5, "Biology in Your Kitchen," bake a mock apple pie as outlined on pages 64–65. Warm the pie just before class begins.

Display the pie. Instruct students to describe what they see and smell. Cut the pie, and give each student a small piece. Encourage students to describe what they taste and feel. Challenge the class to identify the food they just ate.

Then have students read pages 64–65 of Chapter 5 in pairs, in small groups, or on their own. As they read, encourage students to make connections between the text, photos, and the food they were just served.

After reading, invite students to share their thoughts. Which senses were fooled? (Sight, smell, taste, touch?) Read the sidebar "The Science Scoop" to learn why.

Explain to students that advertisers understand how senses work. That's why food in magazine photos always looks so good. Display a photo of food from a magazine advertisement. As a class, evaluate the photo to determine what the advertisers want our senses to believe about the food.

Divide the class into small groups. Give each group a magazine. Encourage students to identify one photo of food that does a good job of fooling the senses. Invite groups to share their photos and answer three questions about the image they selected: What does the photo show? What does it make our brain think? What is real?

After all groups have presented their findings, review the other experiments in the chapter. Challenge students to explain how each substance produced is connected—or misconnected—to the senses.

GRADE 5

PERFORMANCE EXPECTATION:

Develop a model to describe that matter is made of particles too small to be seen. (5-PS1-1)

Supplies

- 2 qt.-size ziplock bags, 1 gal.-size ziplock bag, dish towel

Ingredients

- ¼ cup heavy cream
- ¼ cup whole milk
- ½ tsp. vanilla extract
- 1 Tbsp. sugar
- 4 cups crushed ice
- 4 Tbsp. rock salt

Note: If you wish to conduct this experiment in groups, you will need additional quantities of each supply and ingredient.

Materials

- Plain white paper
- Colored pencils

Model Matter

Invite students to read pages 6–7 of Chapter 1, "Mixing and Unmixing," in pairs, in small groups, or on their own. As students read, encourage them to pause to discuss relationships between the text, photos, and illustrations.

Provide access to the supplies and ingredients required for this investigation. Have students conduct the experiment in small groups or as a whole-class activity. Remind students to follow the instructions closely. Suggest that they refer to the photos for guidance if needed.

After students complete the experiment, discuss the results. Then ask the class what this experiment showed (how matter combines to form a mixture). Draw students' attention to the sidebar "The Science Scoop" on page 7. Examine the diagrams of water molecules. Explore the connection between the diagrams in the sidebar and the results of the experiment.

As a class, scan the rest of the chapter. Point out that each experiment models a way that matter can combine or separate. Each experiment also has a sidebar called "The Science Scoop" that explains why this occurs. However, only the sidebar on page 13 has diagrams to show what happens to molecules of matter in each instance.

Encourage students to review the remaining experiments in the chapter. If possible, have them conduct the experiments, too. After each, give students access to plain white paper and colored pencils. Challenge them to draw diagrams that illustrate what happens to molecules of matter in each example. Invite students to share and discuss their diagrams in small groups.

GRADE 5

PERFORMANCE EXPECTATION:

Conduct an investigation to determine whether the mixing of two or more substances results in new substances. (5-PS1-4)

Materials

- Access to research resources, such as the Internet
- Manila folders
- Scissors
- Glue
- Art supplies
- Digital cameras (optional)

Examine Actions and Reactions

Invite students to read Chapter 4, "Actions and Reactions," in pairs, small groups, or on their own. As they read, instruct students to pause and discuss relationships between the text, photos, and illustrations.

After reading, review the experiments one at a time with the class. Challenge students to identify the substances mixed and the new substance created in each investigation. Guide students to recognize that the ingredients in each recipe form a new product after undergoing a chemical reaction. If possible, gather the necessary supplies and have students conduct one or more of the experiments so they can see first-hand what happens during a chemical reaction.

Divide the class into small groups. Instruct groups to identify another food product that is the result of chemical reaction. Encourage students to search food websites for a simple recipe and images of the finished product and the ingredients it contains. If you wish, provide digital cameras so students can take photos of their own.

Challenge students to then write a short paragraph describing the chemical reaction needed to create their product. Suggest that they refer to the chapter's "The Science Scoop" sidebars for ideas. If necessary, encourage students to conduct additional research to learn more about chemical reactions.

Then give each group a manila folder. Instruct students to compile their materials to create an informational packet about their product. Display the finished packets and invite groups to share what they learned about chemical reactions that take place in the kitchen.

MIDDLE SCHOOL

PERFORMANCE EXPECTATION:

Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. (MS-PS1-4)

Supplies

- Supplies will vary depending on experiments conducted

Ingredients

- Ingredients will vary depending on experiments conducted

Materials

- Access to research resources, such as the Internet
- 1 digital video camera per group

Investigate Heat

Invite students to read Chapter 2, "Solids, Liquids, and Yum!" (pages 19–32) in pairs, small groups, or on their own. As students read, encourage them to pause to discuss relationships between the text, the photos, and the illustrations.

After students finish reading and discussing, point out that the experiments in this chapter address three scientific concepts—insulation, crystal formation, and osmosis—and how they are affected by heat.

Tell students to imagine that they work for a television show called *The Science of Cooking*. This show is targeted toward children in grades 3–8. While it uses cooking to teach scientific concepts, the show also brings in examples with which students are most likely familiar to help them better understand each topic. For example, wool socks are excellent insulators. That's why they keep your toes nice and warm on cold, snowy days.

Tell students that the show has just begun production on an upcoming episode about heat. The three topics this episode will cover are insulation, crystal formation, and osmosis.

Divide the class into three groups. Assign each group one topic. If possible, allow students to conduct the experiments about their assigned topics as outlined in the chapter. If not, encourage them to review relevant photos and text within their groups. Instruct students to conduct additional research to find everyday examples that will help viewers fully understand their scientific concept and how it is affected by heat.

Challenge groups to combine cooking and everyday information to create an informative, educational, and engaging three-minute segment addressing their assigned scientific concept. Invite groups to present their finished episodes to the class.

NEXT GENERATION SCIENCE STANDARDS

GRADE 3

Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object. (3-PS2-1)

GRADE 4

Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways. (4-LS1-2)

GRADE 5

Develop a model to describe that matter is made of particles too small to be seen. (5-PS1-1)

Conduct an investigation to determine whether the mixing of two or more substances results in new substances. (5-PS1-4)

MIDDLE SCHOOL

Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. (MS-PS1-4)