CEREAL CITY SCIENCE by BCAMSC

Teacher Guide and Student Journal
Sample Activity and Planning Pages

Structure and Properties of Matter 5PNG

SECOND EDITION

A fifth grade unit supporting Next Generation Science Standards
and Michigan Science Standards

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A fifth-grade unit supporting **Next Generation Science Standards** and the **Michigan Science Standards** developed and written by the Battle Creek Area Mathematics and Science Center for

CEREAL CITY SCIENCE™
by BCAMSC

Structure and Properties of Matter

Pre-activity Informational Pages

Activities

Appendix

PLANNING

NEXT GENERATION SCIENCE STANDARDS

Disciplinary Core Ideas	Activity
PS1.A: Structure and Properties 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; the effects of air on larger particles or objects. • The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. • Measurements of a variety of properties can be used to identify materials. (Boundary: At this grade level, mass and weight are not distinguished, and no attempt is made to define the unseen particles or explain the atomic-scale mechanism of evaporation and condensation.)	1,2,3,4,5,6,7,8
5-PS1-1: Develop a model to describe that matter is made of particles too small to be seen.	1,2,3,4
5-PS1-2: Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.	2,7
5-PS1-3: Make observations and measurements to identify materials based on properties.	2,3,7,8
PS1.B: Chemical Reactions • When two or more different substances are mixed, a new substance with different properties may be formed. • No matter what reaction or change in properties occurs, the total weight of the substances does not change.	5,6,7
5-PS1-2: Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.	5,6,7
5-PS1-4: Conduct an investigation to determine whether the mixing of two or more substances results in a new substance.	5,6,7

NEXT GENERATION SCIENCE STANDARDS

Science and Engineering Practices	Activity
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. • Develop a model to describe phenomena.	1,2,3,4,5,6,8
5-PS1-1: Develop a model to describe that matter is made of particles too small to be seen.	1,2,3,4,5,6,7
Planning and Carrying Out Investigations Planing and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions. • Conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. • Make observations and measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon.	1,2,4,5,6,7
5-PS1-4: Conduct an investigation to determine whether the mixing of two or more substances results in a new substance.	5,6,7
5-PS1-3: Make observations and measurements to identify materials based on properties.	1,2
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.	3,6
5-PS1-2: Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.	1,2

NEXT GENERATION SCIENCE STANDARDS

Crosscutting Concepts	Activity
Cause and Effect • Cause-and-effect relationships are routinely identified and used to explain change.	1,2,4,5,6,7
5-PS1-4: Conduct an investigation to determine whether the mixing of two or more substances results in a new substance.	
Scale, Proportion, and Quantity • Natural objects exist from the very small to the immensely large. • Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.	3,4,5,6,7
5-PS1-1: Develop a model to describe that matter is made of particles too small to be seen.	1,2
5-PS1-2: Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.	2,5,6,7
5-PS1-3: Make observations and measurements to identify materials based on properties.	1,2,3,4,5,6,7
Connections to Nature of Science **Scientific Knowledge Assumes an Order and Consistency in Natural Systems** • Science assumes consistent patterns in natural systems.	1,2,3,4,5
5-PS1-2: Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved.	2,4,5,6,7

UNIT AT A GLANCE

Activity	Time to Complete	Lesson Level Learning Goal	Phenomenon/ Engineering Challenge	Summary: Students will...
1 Where's the Skunk?	Preparation: 20 min. Activity: 2 classes Lesson 1A: 50–55 min. Lesson 1B: 50–55 min.	Ask questions about the cause of the detection of an odor at different strengths at different locations. Develop a model that explains initial ideas of the cause of why the odor is stronger in some areas and weak in other areas. Use data to map the strength of the odor in different locations.	Skunk odor is observed at different strengths throughout the neighborhood.	• Read a story, *Where's the Skunk*, Part 1, about a neighborhood that was bothered by a skunk odor. • Share ideas and previous understandings about skunks and skunk odors. • Raise questions about the skunk odor and the different strengths throughout the neighborhood.
2 Matter and Its Properties	Preparation: 10 min. Activity: 3 classes Lesson 2A: 50-55 min. Lesson 2B: 50-55 min. Lesson 2C: 50-55 min.	Develop a definition of matter through observation, data collection, and patterns of solids and liquids to apply to their understanding of gases or odors.	Skunk odor is observed at different strengths throughout the neighborhood.	• Read the story, *Where's the Skunk*, Part 2. • Share ideas and further questions about the skunk and its odor. • Conduct investigations into the physical properties of matter as a solid, liquid, and gas. • Complete an assessment probe on what makes matter, matter. • Obtain information from matter through text.

UNIT AT A GLANCE

Students Figure Out How To:	Practices and Crosscutting Concepts	PE at Lesson Level and Assessment
• Develop a model to explain their initial ideas of how the skunk odor is detected throughout the neighborhood. • Use a geographic mapping tool to determine the location of the skunk using data related to the strength of the odor. • Develop a scientific explanation based on their data and mapping outcomes.	Asking Questions and Defining Problems Developing and Using Models Constructing Explanations and Designing Solutions Cause and Effect Patterns	**Formative Assessment** Use the initial models to assess beginning ideas about odors and gases, how they travel, and why the skunk releases an odor. Use the Claim, Evidence and Reasoning in the Student Journal to assess initial ideas about gases, how gases behave, and odors.
• Make observations of physical properties of matter. • Analyze and compare observations to observe patterns. • Develop questions about the odor as related to their understanding of matter. • Develop a group definition of matter and compare with other groups. • Develop a consensus definition of matter based on observations. • Apply information from text to observations and findings.	Asking Questions and Defining Problems Constructing Explanations and Designing Solutions Obtaining, Evaluating, and Communicating Information Patterns	**Formative Assessment** Use the Science Talk, Journal Entry, and Physical Properties of Matter chart to assess early ideas and ability to sort and classify objects by properties. **Summative Assessment** Use the group discussions and definitions and Journal Entry to assess ability to construct explanations from observations. Use the group discussions and revisions and additions to definitions and Journal Entry to assess ability to obtain, evaluate, and communicate information from text.

UNIT AT A GLANCE

Activity	Time to Complete	Lesson Level Learning Goal	Phenomenon/ Engineering Challenge	Summary: Students will...
3 Measuring Matter	Preparation: 10 minutes Activity: 2 classes Lesson 3A: 60–65 min. Lesson 3B: 55–60 min.	Develop strategies and use tools to measure the weight and volume of solids and liquids.	Who gets more candy? The tall narrow container or the short, triangular-shaped container? Archimedes and Measuring Volume The Crow and the Pitcher	• Measure the weight of a variety of materials. • Measure the volume of a variety of materials. • Write an explanation using Claim, Evidence, and Reasoning. • Use displacement to measure irregular shaped items. • Question whether a gas (skunk odor) has mass and volume.
4 What is That Odor?	Preparation: 15 minutes Activity: 4 classes Lesson 4A: 60–65 min. Lesson 4B: 60–65 min. Lesson 4C: 60–65 min. Lesson 4D: 60–65 min.	Conduct investigations to find out if air (gas) is matter.	An odor in the classroom is detected at different times by students in different areas of the classroom.	• Conduct tests to find out if air is matter. • Develop a model to demonstrate how air has mass and takes up space. • Make observations of how peppermint extract evaporates and becomes a gas that fills the room.

UNIT AT A GLANCE

Students Figure Out How To:	Practices and Crosscutting Concepts	PE at Lesson Level and Assessment
• Construct an explanation about the amount of candy in the containers based on evidence. • Develop a model to explain how both solids and liquids have mass and volume. • Measure the volume of irregularly shaped items.	Using Mathematics and Computational Thinking Planning and Carrying Out Investigations Asking Questions and Defining Problems Analyzing and Interpreting Data Constructing Explanations and Designing Solutions Developing and Using Models Cause and Effect Scale, Proportion, and Quantity	**Summative Assessment** Use the student investigations and Activity Page to assess ability to measure the weight and volume of solids and liquids. Use the student investigations and class discussion to assess ability to plan and conduct simple investigations. Use the Claim, Evidence, and Reasoning to assess ability to construct an explanation based on evidence. Use the Activity Pages, Journal Entry, and Key Terms to assess understanding that matter has weight and volume and that can be measured.
• Determine if air has mass and volume. • Develop a model demonstrating the small particles that make up solids, liquids, and gases. • Develop a model to demonstrate how odors are detected and fill the room.	Planning and Carrying Out Investigations Developing and Using Models Scale, Proportion, and Quantity Cause and Effect	**Formative Assessment** Use the Activity Pages and Science Talk to assess ability to design and conduct an investigation to answer a question. Use the Science Talk to assess understanding that the amount of matter is conserved when it changes state and when it appears to vanish. **Summative Assessment** Use the Journal Entry and model presentations to assess ability to demonstrate that matter is made up of particles too small to see and that matter is conserved when it changes form.

UNIT AT A GLANCE

Activity	Time to Complete	Lesson Level Learning Goal	Phenomenon/ Engineering Challenge	Summary: Students will...
5 A Liquid to a Gas	Preparation: 20 minutes Activity 5: 6-7 classes Lesson 5A: 60–65 min. Lesson 5B: 60-65 min. 2-3 days Lesson 5C: 60–65 min. Lesson 5D: 60–65 min. Lesson 5E: 60–65 min.	Conduct investigations to find out the behavior of the particles that make up matter during phase change. Use observations of boiling, evaporation, and condensation to solve an evaporation problem and separate salt and water using a solar still.	A puddle in the driveway dries up by late afternoon. "The Puddle is Missing."	• Read about a puddle that "dries up." • Make observations and conduct investigations into evaporation with added thermal energy and at room temperature. • Make observations of condensation. • Conduct an investigation to find out the effect of temperature on phase change. • Obtain information about the chemistry of the skunk spray. • Observe chemical change through mixing substances to make the skunk deodorizer. • Research how to rescue and relocate the skunk.
6 Conservation of Matter	Preparation: 15 min. Activity 6: 3-5 classes Lesson 6A: 60-65 min. 2 days Lesson 6B: 60-65 min. Lesson 6C: 60-65 min. Lesson 6D: 60-65 min. Lesson 6E: 50-55 min. (with multiple days of observations of solar stills)	Conduct investigations to find out that matter is conserved even when it seems to disappear.	When the solid granules inside the Kool Aid packet are added to water, the solid granules seems to disappear and the water changes color. Engineering challenge: Separate water and salt from ocean water to provide fresh water on a desert island.	• Review observations of mixing the substances for the skunk deodorizer. • Share experiences with mixing. • Develop vocabulary: solute, soluble, dissolve • Solve an engineering problem and present solutions • Read information from text and relate to findings from investigations.

UNIT AT A GLANCE

Students Figure Out How To:	Practices and Crosscutting Concepts	PE at Lesson Level and Assessment
• Construct an explanation from investigations and evidence to explain phase change from liquid to a gas with and without adding thermal energy. • Determine the cause-and-effect relationship between temperature and phase change. • Design a device to solve an evaporation problem. • Obtain and relate information from text to support or dispute findings in student investigations. • Obtain information about the skunk habitat and how to safely relocate the skunk. • Develop a model that explains phase change before, during, and after evaporation occurs.	Constructing Explanations and Designing Solutions Developing and Using Models Planning and Carrying Out Investigations Obtaining, Evaluating, Communicating Information Cause and Effect Patterns	**Summative Assessment** Use the Science Talk and Journal Entry to assess the students' understanding of the phase change from a liquid to a gas and their ability to use their understanding of evaporation to solve a problem. Use the consensus model to assess understanding of how matter is made up of particles too small to see and when some matter is mixed, the particles rearrange and form new material. Use the Science Talk and Journal Entry to assess ability to use relevant information to provide a solution to a problem.
• Develop a model to explain the Kool Aid phenomenon • Plan and carry out investigations into mixing substances with water. • Raise questions for future investigations into dissolving. • Explain solubility as a property • Graph results of their investigations. • Construct explanations using Claim, Evidence, and Reasoning • Design a solar still to solve a problem • Develop a model to explain what happens when mixing lemonade.	Developing and Using Models Constructing Explanations and Designing Solutions Obtaining, Evaluating, Communicating Information Cause and Effect	**Summative Assessment** Use the Activity Pages and CER to assess ability to plan and carry out an investigation and construct explanations based on evidence. Use the Activity Page, Science Talk, and to assess ability to use solubility as a property of matter that can be helpful in identifying matter. Use the Activity Pages, Science Talk, CER, and Journal Entry to assess understanding that matter is made up of particles that are too small to be seen and the ability to use a model to describe the process. Use the Product Descriptor and Journal Entry to assess understanding of how matter is made up of particles and matter undergoes phase change with temperature change.

UNIT AT A GLANCE

7 **Ice Cream and Phase Change**	Preparation: 25 min. Activity 7: 4-5 classes Lesson 7A: 60-65 min. Lesson 7B: 60-65 min. Lesson 7C: 60-65 min. Lesson 7D: 60-65 min.	Determine the cause-and-effect relationship between temperature and phase change. Develop a container that will keep frozen treats from melting as rapidly as at room temperature.	When mixed and shaken in a super cold container, milk, sugar, and vanilla will change to ice cream. A chocolate chip will melt when held in a closed fist. Engineering challenge: Keep the frozen treats frozen for 40 minutes.	• Read about the history of ice cream • Make ice cream • Raise questions about melting and freezing • Melt a chocolate chip in a closed fist. • Determine that melting/ freezing points and boiling points are properties of matter that can be used to identify matter.
8 **Conductivity and Magnetism**	Preparation: 15 min. Activity 8: 2-3 classes Lesson 8A: 60-65 min. Lesson 8B: 60-65 min.	Conduct an investigation to determine that the property of conductivity can be used to help identify matter.	The slide is too hot! The electrical circuit is broken! The recycling separator can separate different materials.	• Watch two different videos about conductivity and one about magnetism • Investigate conduction of heat and electricity as properties. • Investigate magnetism as a property.

UNIT AT A GLANCE

• Determine the cause and effect relationship for a phase change. • Explain the transfer of energy within the ice cream maker system • Develop a model to explain the phase change in the ice cream. • Develop a device that will keep frozen treats frozen for 40 minutes. • Graph results from investigations. • Construct explanations using Claim, Evidence and Reasoning	Asking Questions and Defining Problems Planning and Carrying Out Investigations Developing and Using Models Constructing Explanations and Designing Solutions Obtaining, Evaluating, Communicating Information Cause and Effect	**Summative Assessment** Use the models and Journal Entry to assess understanding of the motion and arrangement of particles during a phase change and how the total weight of the substance does not change. Use the engineering projects, Student Journal, and presentations to assess understanding of how properties make things useful and of phase change due to temperature change. Use the investigations to assess ability to construct an investigation and collect data to provide evidence to answer questions. Use the CER to assess ability to construct an explanation using evidence. Use the Science Talk to assess their understanding that the measurement of the melting point can be used to help identify a variety of materials.
• Plan and carry out investigations into conductivity and magnetism. • Organize and analyze data to find patterns. • Use evidence to identify materials as conductive or magnetic.	Asking Questions and Defining Problems Planning and Carrying Out Investigations Developing and Using Models Constructing Explanations and Designing Solutions Patterns	**Formative Assessment** Use the class discussion to assess the students' early understanding of properties of conductivity and magnetism. Use the Activity Page to assess the students' ability to conduct an investigation collaboratively to produce data as evidence of the different properties they are investigating. **Summative Assessment** Use the Activity Pages and Journal Entry to assess the students' ability to conduct and investigation and construct explanations.

ACTIVITY 1

WHERE'S THE SKUNK?

Teacher Background Information

The universe is composed of matter. Matter is anything that has weight and volume (takes up space). The air we breathe, the food we eat, and the objects our senses respond to are all examples of matter. Some forms of matter are obvious and easily described. Matter in its solid and liquid form is an example of matter that is easily observed and described. Everything around us is matter, and all matter takes up space. Other forms of matter, such as gases and plasma, are not easily observed or described. At this grade level, students will focus on matter as a solid, liquid, or gas.

Matter can be described according to its properties, or attributes. Color, size, shape, smell, hardness, texture, flexibility, buoyancy, reactivity, reflectivity, solubility, and magnetic properties are observable attributes of matter specific to an object or substance. These are called physical properties and can help to distinguish one object from another. The properties of weight, volume, and density are physical properties that can be measured.

Lesson 1A introduces a storyline using the detection of a skunk odor throughout a neighborhood as the phenomenon. Students collaborate, share initial ideas, and raise questions about a story about a skunk odor that develops into a problem to solve with the opportunity for students to take action. The story, and problems within the story, drives the lessons as students investigate matter to solve the problem. The use of *Where's the Skunk?* storyline provides the opportunity to make connections to life science and engineering through the exploration of matter.

Considerations for Students with Special Needs

Read the story, "*Where's the Skunk?*" Part 1 aloud to the students and stop frequently and allow for students to ask questions and retell.

Lesson 1B provides the opportunity for students to develop a scientific explanation using Claim, Evidence, and Reasoning written response. Students who struggle to write may benefit from sentence prompts where they can fill in the appropriate science ideas and data. Use the example response in the teacher notes to generate the prompt. Example:

Claim: The highest concentration of strong skunk odor was in _____ area. The skunk is releasing its odor in that area.

ESTIMATED TIME

Lesson 1A: 50–55 minutes
Lesson 1B: 50–55 minutes

LESSON LEVEL LEARNING GOALS

Ask questions about the cause of the detection of an odor at different strengths at different locations.

Develop a model that explains initial ideas of the cause of how odors travel.

Use data to map the strength of the odor in different locations.

PS1.A: STRUCTURE AND PROPERTIES 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; the effects of air on larger particles or objects.
- ~~The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.~~
- ~~Measurements of a variety of properties can be used to identify materials.~~

MATERIALS NEEDED
For each student:
student pages
Where's the Skunk? booklet
For each group of 4:
chart paper/white boards
markers
Post-It Notes
For the class:
Internet access
Teacher Provides:
chart paper/white boards
markers
Post-It Notes
Internet access

TEACHING TIP
Throughout the activities in the Teacher Guide, you will notice that specific student instructions from the Student Journal pages are given first and italicized. Additional information for the teacher follows the italicized instructions in plain print.

Specific student questions from the Student Journal are also italicized in the Teacher Guide. Answers to the questions are surrounded by parentheses.

READING
Key Ideas and Details
RI.5.1: Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from text.

RI.5.2: Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.

Evidence: Our evidence shows that _____ students detected a strong skunk odor in _____ area. _____ Students who detected a weak or no odor were all located farther away from the strong odor area.

Reasoning: Odors are more concentrated nearest the _____ and the stronger odor is related to the quantity or amount of odor.

Some Student Journal entries may require a lengthy writing assignment. For students who struggle, reduce the length of writing, allow students to dictate responses, and/or use a word processor.

Engage the Learner
This phase of the learning introduces and activates prior knowledge regarding the structure and properties of matter and students' initial ideas about odors as related to gases in the air and their initial understanding of skunks. Students' ideas are recorded on the What We Think chart. The chart becomes the driving question board and storyline as students investigate, obtain information, and construct explanations to figure out the answers to their questions. The chart is referred to and updated throughout the lessons, providing students with a venue to make conceptual change regarding their understanding of the structure and properties of matter.

LESSON 1A: A SKUNK IN THE NEIGHBORHOOD

Advance Preparation
Pre-read the story, *Where's the Skunk?* and determine the reading strategy that is best for your class. For this lesson, students will only read Part 1 of the story.

Make copies of the Handout: *Mapping Data of Skunk Smell* (data set of addresses of students in the story).

Prepare a space for Science Talk so all students are standing or sitting in a circle and have eye contact with one another. (See Science Talk and Developing Effective Questions in the Appendix.)

Prepare a space for a What We Think Chart that includes the driving question and an activity summary table. Plan to have the chart visible throughout the activities. The What We Think chart is also available as a Jamboard on the Cereal City Science Online site.

Example: What We Think chart

What We Think	Questions We Have	What We Did	What We Figured Out	How Does This Help Us to Figure Out the Phenomenon?
Students' initial ideas about skunks, odors, and strength of odor	Students' initial questions about skunks and odors and strength of odors	Description of what students did (related to the science and engineering practices).	New information as a result of the lessons	Application of new findings to phenomenon.

Write the following headings at the top of four pieces of chart paper:

Asking Clarifying Questions

Asking a Probing Question

Adding to an Idea

Respectfully Disagreeing with an Idea

Procedure

Engage the learner.

Introduce the lesson by asking students if they have ever smelled a skunk or encountered a skunk. Allow time for students to share stories and ideas freely at this time. Listen for possible questions about skunks and their odor as the students discuss their ideas. All ideas are valued and welcome.

Introduce Part 1 of the story, *Where's the Skunk?* to the class. Distribute the booklet, *Where's the Skunk?* Part 1 to each student and ask them to read the story and record their ideas on the chart in the Student Journal.

As you read the story, "Where's the Skunk?" Part 1 with your group, take notes and write ideas on the chart below. Include questions about key terms, and ideas that you think are important in understanding the problem the class is trying to figure out.

Observations	*Questions*

Divide the class into groups of four. Ask students to share their observations and questions from the story. Encourage students to add to their own ideas with ideas from their classmates.

ASKING QUESTIONS AND DEFINING PROBLEMS

Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships.

- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause-and-effect relationships.

TEACHING TIP

Listen for student ideas that the odor is a gas that spreads from the source outward. Students may not mention that they are smelling a gas, but have some idea that the odor is invisible. Students may also have an idea that the skunk squirts a liquid and there is a phase change into a gas. Ask students to elaborate on that idea of liquid to gas and how/why we smell odors in the air.

CAUSE AND EFFECT

- Cause-and-effect relationships are routinely identified and used to explain change.

SCALE, PROPORTION, AND QUANTITY

- Natural objects exist from the very small to the immensely large.
- Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.

DEVELOPING AND USING MODELS

Modeling in 3–5 builds on K–2 experiences and progresses to building and reviewing simple models and using models to represent events and design solutions.

- Use models to describe phenomena.
- Develop models to describe phenomena.

TEACHING TIP

Develop a class rubric for the common components in the student models. Explain that models in science are a tool that make thinking visible and ideas public. Models throughout the unit are generally drawings with labels and symbols of student thinking that demonstrate progression in understanding as the unit develops. Example of components of the odor models: skunk, odor, motion of odor, strength of odor, arrows, labels, and a key if necessary.

SYSTEMS AND SYSTEM MODELS

A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.

- A system can be described in terms of its components and their interactions.
- A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot.

Facilitate the sharing of information and ideas by circulating among the groups and listening to their initial responses to the reading. To help students elaborate on their explanations, ask:

- What do you think a good inquiry question might be for the 5th grade classroom? What problem are they trying to solve?
- What makes you think that? What other questions can you think of that will need to be answered to get to the big question?
- What do you mean when you say…?
- Tell me more about why you think some students smelled a strong odor and others detected a faint smell and some didn't smell the skunk at all?
- What do you think caused that to happen?
- Are there some similar observations and questions that the group has discussed? Why do you think they are important in finding out more about the skunk and odor in the neighborhood?
- What do you think the class should do first? What information will they gain using your idea? What data do they already have that will be helpful? do you think they could add to that data?
- What do you think we would see if we had a special instrument and could "zoom in" on the air where the odor is the strongest?
- Do the rest of you agree? Why or why not?
- Can someone build on _____'s idea?

As a class, establish the question the children in the story are trying to answer. Explain that the class is also going to try to answer the question and solve the problem of the skunk odor in the neighborhood.

Read the prompt on the Activity Page as a class. Ask students to work individually to draw a model of their ideas of how to explain the phenomenon of the skunk odor in the neighborhood. Then have students share ideas and work in a group. Discuss the prompt and ask a student volunteer to rephrase or explain what the groups are trying to do.

1. *Use the space below to develop a model of your thinking that explains why and how the skunk odor is detected throughout the neighborhood. Hint: Reread the story to include the student observations and possible answers to their questions.*

2. *Next, work with your group and share your ideas. Collaborate among the group and use the space below to draw and label a model that explains why and how the skunk odor is detected throughout the neighborhood.*

Distribute chart paper and markers to each group. Facilitate the group model development by circulating among the students and listening and observing their progress. Distribute chart paper and markers or assign Jamboards to each group. To help students get started and collaborate to include all ideas, ask:

- What ideas have you discussed so far?
- What is the relationship between the odor and the skunk? How can you represent that idea on a model?
- What is the cause and effect relationship between the skunk and the odor?
- _____,I heard you use the term _____. Can you say more about that?
- What does _____ represent on your model? How can you make that more clear to observers?
- In the story, one student did not smell the odor at all, others detected a faint odor, and some detected such a strong odor they were awakened or sickened by it. What do you think about that? Should your ideas about the strength of the odor be part of the model?

Science Talk

After the groups have had the opportunity to complete their group models, establish classroom norms for Science Talk. In order to conduct a friendly, non-threatening critique, as a class, establish some guidelines and rules in their critiquing methods. Ask students to create four anchor posters that will guide the class throughout the unit when sharing ideas.

Display the four charts with the questioning and critiquing categories. As a class, have students suggest how they might start a question that asks a group to clarify, probe or dig deeper, disagree, and add to an idea. It is important for success in student to student interactions for the anchor charts to be develop by the students.

Example Charts:

Respectfully Disagreeing With an Idea

I agree with ... but...
I disagree with....because...
I agree with part of your model but disagree with this part...
I respectfully disagree because...

CAUSE AND EFFECT

- Cause-and-effect relationships are routinely identified and used to explain change.

TEACHING TIP

Science Talk is a conversation among students that allows them to have the opportunity to orally express their ideas and listen to the ideas of others. During **Science Talk** students may engage in argumentation, raise more questions, and construct explanations. The purpose of gathering in a circle is so students face one another and address one another. No student has his or her back is to a classmate. The teacher serves only in the role of facilitator and record keeper. As they take turns discussing their ideas, they should address one another and not discuss ideas through the teacher. Good, effective Science Talk should develop as students become more comfortable with collaboration.

Allow sufficient time for each student to express ideas and opinions. Encourage student-led conversation in the classroom.

Science Talk is a meaning-making and pre-writing strategy used throughout the unit.

TEACHING TIP

The initial lessons provide the framework for the storyline and Driving Questions throughout the unit. The use of the What We Think chart combined with a Driving Questions and Summary Board will make visible students' initial ideas and questions, what they did, what they found out, and questions they have answered and questions they still have.

Be sure the chart is revisited, revised, and reviewed often throughout the unit.

SYSTEMS AND SYSTEM MODELS

A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.

- A system can be described in terms of its components and their interactions.
- A system is a group of related parts that make up a whole and can carry out functions its individual parts cannot.

I understand where you are coming from, but have a different idea.
I agree with you but also think...
I see your reasoning but I disagree with some of the ideas because...

Asking a Clarifying Question

What do you mean by...?
Can you be more specific about...?
What makes you think that?
What evidence do you have that supports that?
How do you know?
Can you tell us more about...?
What do you mean by...?

Asking a Probing Question

What do you mean by...?
What makes you think that?
If that were true, then wouldn't _____ be true?
Where did you get this idea?
How did you come up with...?

Adding to an Idea

I agree with you, but also...
I would like to add ...
I agree but also think...
I agree with this part, but could you add...?
Do you think adding _____ would make it more clear?
I agree but have an idea that might add more clarity or information.
Would it make it more clear if you added...?

Ask the groups to bring their models and form a circle for discussion and sharing. Ask each group to display and discuss their models and as a class look for common ideas, unique ideas, and questions. To help students elaborate on their explanation of their models, ask:

- _____, I heard you use the term _____. Can you tell us more about that?
- What does _____ represent on your model? What makes you think that?
- What common components are present in all or most models?
- Tell us more about what you mean by _____.
- How can we make our wonderings about the skunk and odor into questions we can investigate?

- Are there any other examples you can think of that might create an odor that spreads throughout a neighborhood?

Ask the class if the development and presentation of the models gave them more ideas and questions about the relationship between the skunk and the odor throughout the neighborhood.

Display the What We Think chart and as a class write their ideas in the first column and their questions about the skunk and odor in the second column. Explain that they will enter their findings in the final three columns as the lessons progress and they gain further information about the phenomenon. Explain that the What We Think chart will remain on display to revise and use as the unit progresses.

Take this opportunity to develop the Driving Questions for following lessons by building on student ideas. Help students to turn their wonderings into questions that can be answered in future activities. Driving Questions may include questions similar to:

- What is the relationship between the skunk and how the odor is detected throughout the neighborhood?
- How does the skunk odor travel throughout the neighborhood?
- How far away can the odor travel?
- What is an odor and how does it travel?

Distribute Post-It notes to each group. Have students write their questions on the notes. Have students limit themselves to one question per note and encourage groups to generate at least three questions for the board.

After the groups have generated at least three questions, ask one group to share one of their questions. Ask the group to describe what might have led to that question. Ask remaining groups if they have a similar question. Collect and post all similar questions in the Questions column. Ask the class how they could categorize the initial questions. Examples of categories for initial questions:

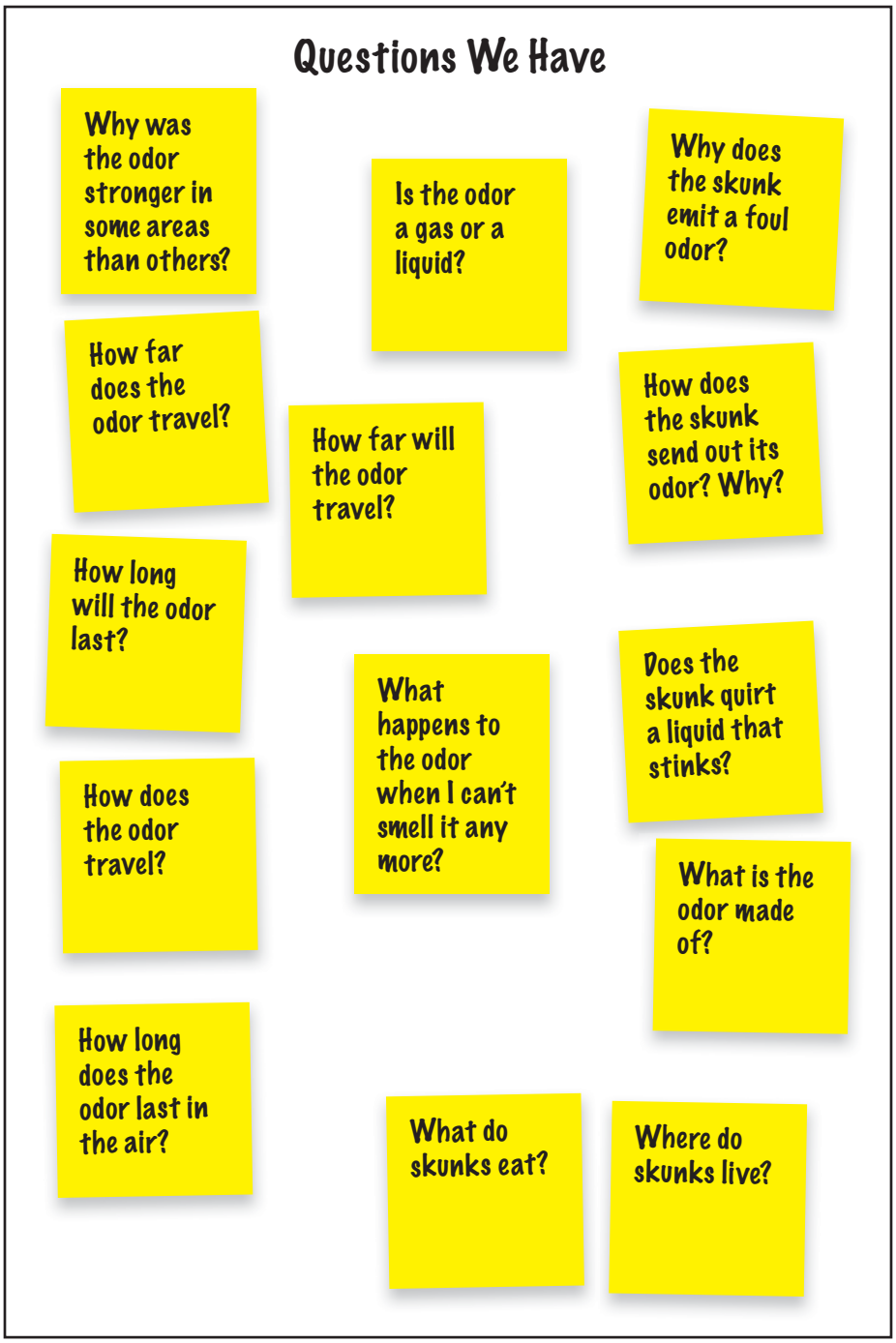
- Skunk questions
- Odor questions
- Movement of odor
- Disappearance of odor
- Composition of odor (matter)
- Reaction to odor

ASKING QUESTIONS AND DEFINING PROBLEMS

Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships.

- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause-and-effect relationships.

Continue the process until all questions are valued, recognized, posted, and categorized. (See example Questions We Have column below.)



Assessment: Formative
Use the initial models to assess the students' beginning ideas about odors and gases, how they travel, and why the skunk releases an odor.

LESSON 1B: MAPPING THE ODOR IN THE NEIGHBORHOOD

Teacher Background Information
In this lesson, students continue to explore the skunk in the neighborhood phenomenon with a focus on questions related to the difference in the strength of the odor among the students. They engage in mapping data of the strength of the odor as detected by students in the story.

Advance Preparation
Make copies of the handout, *Mapping Data of the Skunk Odor* for each student.

Each student will need colored pencils with the same four colors.

Procedure
Explore the concept.
Review the story, *Where's the Skunk?*, Part 1 and the students' comments about the strength of the odor. Ask the class for their ideas of why the odor was strong for some students, somewhat strong for others, weak for some students, and why a few students did not smell the odor at all.

Review the What We Think chart for initial ideas and questions about the strength and distribution of the odor. Ask how they can figure out the difference in the strength of the odor. Listen for ideas that relate to or may suggest that mapping of the different locations where the strength of the odor varied may help them locate where the skunk might live.

Distribute the map of the neighborhood that surrounds the school. Discuss how to read the map and locate different addresses. As a class, establish a color key for the strengths of the skunk odors detected by the students in the story. Have students create the key using four colors to represent "strong", "somewhat strong", "weak", and "no odor".

Have the students plot the odors individually and then form a group of four to compare, discuss, and construct an explanation for their data on the maps. Facilitate the group sharing and discussion by circulating among the students and listening to their ideas of their mapping and information. To help the students elaborate on their explanations, ask:

- _____, I heard you use the term _____. Can you tell us more about your thinking?
- Does anyone have anything they can add to _____'s idea?
- What patterns do you see in your mapping data?

MATERIALS NEEDED
For each student:
student page
Handout: *Mapping Data of the Skunk Odor*
colored pencils, 4 different colors
For each group of 4:
Post-It Notes
Teacher Provides:
Post-It Notes
colored pencils, 4 different colors

PS1.A: STRUCTURE AND PROPERTIES 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; the effects of air on larger particles or objects.
- ~~The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.~~
- ~~Measurements of a variety of properties can be used to identify materials.~~

TECHNOLOGY INTEGRATION
To help students use technology tools to solve problems, this lesson provides the opportunity to use ArcGIS to map skunk odor in the neighborhood. Refer to Section 5: Technology for instructions to access and use ArcGIS mapping tools.

CONSTRUCTING EXPLANATIONS AND DESIGNING SOLUTIONS

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to use evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- **Construct an explanation of observed relationships.**
- **Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.**

PATTERNS

- Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.

ANALYZING AND INTERPRETING DATA

- Represent data in tables and/or various graphical displays (bar graphs, pictographs, and/or pie charts) to reveal patterns that indicate relationships.
- **Analyze and interpret data to make sense of phenomena, using logical reasoning, mathematics, and or computation.**
- **Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.**
- ~~Analyze data to refine a problem statement or the design of a proposed object, tool, or process.~~

- What do you think caused that pattern to occur?
- Can someone repeat or expand on _____'s explanation.
- What does that tell you about where the skunk odor is coming from? What makes you think that?
- Who can explain why some students did not smell the odor at all? What makes you think that?
- What causes some to detect a strong odor and others cannot smell it at all?
- What have you learned from mapping the data?
- Do the rest of you agree? Why or why not?
- As a class, discuss the results of the plotting and what information they have gained from their maps. Ask:
- What do you notice about where the strongest odor was detected? What do you think caused that to happen?
- Where were the most no-odor locations? What does that tell you?
- What can you say about the "somewhat strong" and "weak" dots? What do you think caused that to happen?
- Who can summarize our results? What claim can we make about our findings? What evidence do we have to support that claim? Is that reasonable? What do we know about odors that supports our findings?
- Can someone add on to or rephrase what _____ just said?
- Do the rest of you agree? Why or why not?

Take this opportunity to develop a class scientific explanation for their findings using Claim, Evidence, and Reasoning. As a class, develop a claim. Example:

Claim: The highest concentration of strong skunk odor was in _____ area. The skunk is releasing its odor in that area.

Evidence: Our evidence shows that _____ students detected a strong skunk odor in _____ area. _____ students detected a weak or no odor were all located farther away from the strong odor area.

Reasoning: Odors are more concentrated nearest the source of the odor and the stronger odor is proportional to the quantity of odor.

Allow time for students to collaborate and decide on the scientific explanation that makes sense to them. As the unit progresses, they may wish to revisit and add to or elaborate on their ideas. Have them record their initial explanation in the Student Journal.

Journal Entry
With your classmates, develop a scientific explanation for your findings by mapping odor strength on the map. Use Claim, Evidence, and Reasoning in your explanation.

Claim:
The claim should be supported by evidence directly from the investigation.

Evidence:
The evidence comes directly from the data collected in the investigation and should cite actual numbers or observations from a data table, chart, or graph.

Reasoning:
Reasoning ties what the student knows about the strength of odors and movement of gases to the claim and evidence.

Refer to the What We Think chart and focus the class attention on the What We Did and What We Figured Out columns. Ask students to summarize what they did (mapped locations of odor according to strength) and what they figured out (the strongest odor detected is in one area of the neighborhood, the skunk released its odor in the area where it was the strongest, stronger odor is proportional to the quantity of odor).

Have students identify what questions that were answered through mapping the odor. Move the Post-It Notes with questions that were answered to the What We Figured Out column.

Have students revisit their initial models and make additions and revisions based on their mapping investigations.

Assessment: Formative
Use the Claim, Evidence and Reasoning in the Student Journal to assess the students' initial ideas about gases, how gases behave, and odors.

CAUSE AND EFFECT
- Cause-and-effect relationships are routinely identified and used to explain change.

SCALE, PROPORTION, AND QUANTITY
- Natural objects exist from the very small to the immensely large.
- Standard units are used to measure and describe physical quantities such as weight, time, temperature, and volume.

WRITING
Text Types and Purposes
W.5.2: Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

a. Introduce a topic clearly, provide a general observation and focus, and group related information logically; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension.

Production and Distribution of Writing
W.5.4: Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3.)

Research to Build and Present Knowledge
W.5.7: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.

ACTIVITY 2

MATTER AND ITS PROPERTIES

Teacher Background Information

In the previous lesson, students generated questions about the skunk and the odor that spread throughout the neighborhood and began a discussion about their ideas of what makes up odor. Before students can successfully understand odors, gases, and structures of matter, it is imperative that they have a student-developed, operational understanding of matter that can become more refined and scientific as student knowledge becomes more sophisticated. Students take time to develop a definition of matter through observation, data collection, and patterns of solids and liquids that they can use to apply to odors and gases.

The storyline of the skunk odor continues and the students use their mapping data to investigate further. The students in the story as well as, the students in your classroom, raise further questions and continue to investigate the skunk odor.

The beach ball and clump of clay are solids that have an odor and the vinegar is a liquid with an odor. The detection of the odors from solids is evidence of a phase change from solid to gas, a process called sublimation. 5th graders are able to understand the concept of sublimation through examples like frost going away from windows without their seeing actual liquid, the odor from a new ball or plastic toy, and room air fresheners. If they "get" that things have to be gaseous in order for our noses to detect them then they can infer that if we smell something, it must be in a gaseous state, there is a gas in the air made up of particles too small to see.

Considerations for Students with Special Needs

Read the story, *Where's the Skunk?* Part 2 aloud to the students and stop frequently and allow for students to ask questions and retell.

Some Student Journal entries may require a lengthy writing assignment. For students who struggle, reduce the length of writing, allow students to dictate responses, and/or use a word processor.

Explore the Concept

In the explore phase of the learning, students investigate solids and liquids and develop a rule for classifying things as matter and use the rule to justify ideas when classifying something as matter in their exploration of gases.

This phase of the learning also includes the measurement of weight and volume of solids and liquids. At this level no attempt is made to distinguish between mass and weight.

ESTIMATED TIME

Lesson 2A: 50-55 minutes
Lesson 2B: 50-55 minutes
Lesson 2C: 50-55 minutes

LESSON LEVEL LEARNING GOALS

Develop a definition of matter through observation, data collection, and patterns of solids and liquids to apply to their understanding of gases or odors.

MATERIALS NEEDED

For each student:
- student pages

For each group of 4:
- 1 index card
- 9" pie pan
- pipette
- cup, 9 oz.
- 1 jar with water and lid
- 1 jar with air and lid
- 1 wooden cube
- 1 beach ball (deflated)
- 1 washer
- 1 screw
- 1 marble
- 1 golf ball
- 1 sugar cube
- 1 clump of clay
- 1 soufflé cup with 1 Tbsp. kosher salt
- 1 soufflé cup with 1 Tbsp. vinegar

For the class:
- 1 precision balance
- kosher salt
- 4 air pumps
- vinegar, white, bottle
- 1 Tbsp. measure

Teacher provides:
- water
- chart paper
- markers

PS1.A: STRUCTURE AND PROPERTIES 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; the effects of air on larger particles or objects.
- ~~The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.~~
- Measurements of a variety of properties can be used to identify materials.

READING

Key Ideas and Details

RI.5.1: Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from text.

RI.5.2: Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.

RI.5.3: Explain relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in a text.

Craft and Structure

RI.5.4: Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area.

LESSON 2A: EXPLORING MATTER

Advance Preparation

Prepare a materials table with the aluminum pie pans, beach ball, small jars with water, small jars with air, screws, washers, marbles, golf balls, wooden cubes, sugar cubes, small soufflé cup with 1 Tbsp. kosher salt, souffle cup with vinegar, and clumps of clay. Secure the lids on the jars of water and the jars of air. (See Materials Needed.)

Display the classroom balance. Students will be given formal instruction on the use of the balance in following lessons. If students would like to use the balance in their explorations and observations of their objects in this activity, use that opportunity to pre-assess their understanding of measuring the weight of objects.

Review the student generated questions and models from the previous lessons that focus on the composition of the odor or what the odor is made of. This lesson will build on their initial ideas of matter and that all matter is made up of particles too small to see and that all matter has weight (mass) and volume. They apply their knowledge of solids and liquids to gases.

Make a class chart that will serve to organize the students' descriptive words into properties. Leave the headings blank for students to decide on titles of the categories. Example:

Physical Properties of Matter							
Item	(Color)	(Size)	(Shape)	(Texture)	(Hard/ Soft)	(Weight)	(Odor)
jar with water							
washer							
wooden cube							

Pre-read *Where's the Skunk?*, Part 2 and determine a reading strategy for your class.

Procedure

Explore the concept.

Review phenomenon of the skunk and odor with the students and what they are trying to figure out. Focus their attention on the questions that were categorized as composition of the odor and any initial ideas about the odor as a gas. Review any words that students used to describe their experiences with the skunk odor and the words the characters in the story used to describe the odor. Discuss the different words students use to describe an odor.

Introduce Part 2 of the story, *Where's the Skunk?* to the class. Distribute the booklet, *Where's the Skunk?* Part 2 to each student and ask them to read the story and record their ideas on the chart in the Student Journal.

As you read the story, "Where's the Skunk?" Part 2 with your group, take notes and write ideas on the chart below.

As you read the story, "Where's the Skunk?" Part 2 with your group, include questions about key terms and ideas that you think are important in understanding the problem the class is trying to figure out.

Part 2 of *Where's the Skunk?* is intended to inspire further questions about odors and the skunk. Take this opportunity to review the story and develop more questions for the Questions We Have column of the What We Think chart. (See example at the end of this lesson.)

Discuss, as a class, what they need to know about different materials that will better help them understand odors. Elicit ideas by drawing attention to the different items on the material table (See Advance Preparation). Ask students to describe properties of the different items. Listen for ideas that include properties of solids, liquids, and gases.

Read the last sentence of the story:

"Mr. Peterson suggested that it might be helpful to learn more about odors through investigations into matter as solids, liquids, and gases."

Ask: What do we need to find out about properties of materials in all states, solids, liquids, and gases to figure out the phenomenon of the skunk odor throughout the neighborhood?

Listen for ideas that relate to gases having some of the same properties as solids and liquids. Suggest to the class that they review what they know about the properties of solids and liquids and look for patterns that they can use to apply to the odor or gases.

Show the class the materials table and ask one representative from each group to retrieve an aluminum pie pan and one of each of the items on the table. In their groups, discuss the difference between trying to describe an odor and describing something that is a solid or a liquid.

Display the Precision Balance and instruct the class in how to weigh items using the balance. To help save time, assign items for each group to find the weight and post to share with the rest of the class. Each group does not have to weigh every item.

TEACHING TIP

Students may demonstrate prior knowledge related to properties of matter from the second-grade unit.

It is important to try and elicit student ideas of how to investigate what makes up the odor and/or gases to continue to answer their questions and figure out the skunk odor.

ASKING QUESTIONS AND DEFINING PROBLEMS

Asking questions and defining problems in 3–5 builds on K–2 experiences and progresses to specifying qualitative relationships.

- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause-and-effect relationships.

TEACHING TIP

Carry a clipboard and paper and pencil as you facilitate the group observations and discussion. Be sure to record ideas to refer to during the science talk that will encourage questions, different ideas, and perhaps argumentation. Record ideas about the properties of liquids compared to solids and compared to gases.

CONSTRUCTING EXPLANATIONS AND DESIGNING SOLUTIONS

Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to use evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to design problems.

- **Construct an explanation of observed relationships.**
- Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation ~~or design a solution to a problem.~~

PATTERNS

- Similarities and differences in patterns can be used to sort, classify, communicate, and analyze simple rates of change for natural phenomena.

Give the groups sufficient time to complete the *Physical Properties of Matter* chart in the Student Journal.

Make observations of the different items. Record your observations on the chart below.

Physical Properties of Matter							
Item	*color*						
Wooden Cube							

Facilitate the groups' exploration of the different material by circulating among the students and observing their collaboration of ideas. To check student progress, ask:

- Can you explain what you have done/observed so far?
- Tell me more about this property.
- How have you described the jar with water? Without water?
- What do you mean when you say…? How can you find out if your thinking is correct?
- How have you described the properties of the salt?
- What property might you test for using the pipette and a drop of water?
- What patterns are you discovering in your observations? How can you use the patterns to sort or classify the objects you are observing?
- Can we use any of the physical properties we use to describe solids and liquids to describe the skunk odor? What is the difference that makes it difficult to describe the properties of an odor?
- Did you detect an odor with any of the solids? How about the liquids? Can you explain what causes some things to have an odor and others do not?
- Tell me more about the beach ball. What properties did you observe? Inflated? Deflated?
- What can you say about the air inside the beach ball?
- How might knowing the properties of different objects help in understanding those objects?

Science Talk
After the students have had sufficient time to complete their observations and recording of properties, ask each group to share their findings and place the group results on the class Physical Properties of Matter chart.

Allow sufficient time for each group to add to the chart and explain their headings and reasoning for the categories. Facilitate the Science Talk by asking a group to share their ideas about one of the items. Use your notes from facilitation of the group observations to start the conversation. Ask:

- _____I heard you discussing in your group the beach ball with air compared to without air. Can you explain your group's thinking to the rest of the class?
- Did any other groups have a similar observation? Can you elaborate on your group's conversation?
- Can someone add on to that idea?
- Do the rest of you agree? Why or why not?
- Who would like to share their observations of the small container of vinegar?
- Can anyone add on to that idea?
- How does that compare with the jar of water? What do you think causes that difference?
- Can someone share their ideas about the jar without water?
- _____, I noticed that your group used _____ as a category for _____. Can you explain your thinking behind choosing that category/term?

Listen for any groups that may have suggested that the jar was filled with air. Ask students to describe the matter present in the jars and the beach ball. Ask students what more information they need about matter, if odors are matter, and if air is matter, to figure out the skunk odor in the neighborhood.

Make new additions to the What We Think chart. Introduce the term matter and discuss their initial ideas. Have the students complete the *How Can You Tell If It Is Matter?* probe in the Student Journal.

TEACHING TIP

Science Talk is a conversation among students that allows them to have the opportunity to orally express their ideas and listen to the ideas of others. During **Science Talk** students may engage in argumentation, raise more questions, and construct explanations. The purpose of gathering in a circle is so students face one another and address one another. No student has his or her back is to a classmate. The teacher serves only in the role of facilitator and record keeper. As they take turns discussing their ideas, they should address one another and not discuss ideas through the teacher. Good, effective Science Talk should develop as students become more comfortable with collaboration.

Allow sufficient time for each student to express ideas and opinions. Encourage student-led conversation in the classroom.

Science Talk is a meaning-making and pre-writing strategy used throughout the unit.

Journal Entry/Assessment Probe
How Can You Tell If It Is Matter?

Look at the list of things. Place an X by the things that are NOT matter. (wood, paper, plastic, glass, air, water, electricity, Earth, fire, metal, lightning, thunder, smoke, odors, heat, cell phones, germs, helium, gravity, magnetism, lemonade, soil, friction, ideas, sound, light, wind, flour, oxygen, animals) Write how you know when something is matter.

Assessment: Formative
Use the Science Talk, Journal Entry, and Physical Properties of Matter chart to assess the students' early ideas and ability to sort and classify objects by properties.

LESSON 2B: DEFINING MATTER

Teacher Background Information

The students may come with some prior knowledge of distinguishing between solids and liquids from the second-grade *Properties of Matter Make Things Useful* unit. They have defined solids and liquids at the second-grade level (solids hold their shape, liquids take the shape of the container and can pour from one container to another). In the fifth grade, gases are introduced as a phase of matter.

Advance Preparation

Prepare a materials table with the items from the previous lesson.

Display the What We Think and Physical Properties of Matter charts from the previous lesson.

Display the classroom balances.

Prepare a *Word Sort Card Set* for each group of four students (see Materials Needed).

Procedure

Explain the concept and define the terms.

Review the phenomenon of the skunk odor in the neighborhood that the class is trying to figure out and what they have done and figured out so far. Discuss the *How Can You Tell If It Is Matter?* assessment probe in the Student Journal from the previous lesson. Ask students why they think describing matter and identifying matter might help them to figure out the skunk odor. Accept all ideas at this time.

Have students share their choices of what is matter and what is not matter. Make a chart on the board to display their choices in the assessment probe.

Ask one representative from each group to retrieve one pie pan with one of each item. Review the student data on the *Physical Properties of Matter* chart. Ask students to review any patterns or trends in their observations. Point out that most of the items they observed have at least one thing in common. Challenge the groups to sort their items and find the property that most of the items from the material table have in common. Check for understanding that most of the items were solids. (Students may select the jar with water and jar with air as solids because the jars and lids are solids.) Have the students make a check mark by the items that are solids in the *How Can You Tell If It Is Matter?* Student Journal prompt.

MATERIALS NEEDED

For each student:
- student pages

For each group of 4:
- 1 index card
- 9” pie pan
- pipette
- cup, 9 oz.
- 1 jar with water
- 1 jar with air
- 1 wooden cube
- 1 beach ball (deflated)
- 1 washer
- 1 screw
- 1 marble
- 1 golf ball
- 1 sugar cube
- 1 clump of clay
- 1 soufflé cup with 1 Tbsp. kosher salt
- 1 souffle cup with vinegar
- *Word Sort Card Set* (matter, weight, volume, classify, solid, liquid, gas)

For the class:
- 1 precision balance
- kosher salt
- 4 air pumps

Teacher provides:
- water

CONSTRUCTING EXPLANATIONS AND DESIGNING SOLUTIONS

- **Construct an explanation of observed relationships.**
- Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.

PS1.A: STRUCTURE AND PROPERTIES 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; the effects of air on larger particles or objects.
- Measurements of a variety of properties, can be used to identify materials.

TEACHING TIP

Key Terms—The development of their own glossary of key terms is essential for students to be able to use, recognize, and apply the terms to the appropriate science concepts and reasoning through new discoveries. Students may take considerable time developing a reasonable definition that is useful and meaningful for their learning.

TEACHING TIP

Science Talk is a conversation among the students that allows them to have the opportunity to orally express their ideas and listen to the ideas of others. Allow sufficient time for each student to express ideas and opinions. Encourage student-led conversation in the classroom.

Review the properties that describe a solid. Write the term solid on the board. As a class, discuss the meaning of the term. Check for understanding that solids keep their shape unless a force is applied.

Some students may suggest that all solids are hard; use the clay as an example of a solid that changes shape when a force is applied. The clay can be made into the shape of a sphere or cube and will remain in that shape until it is manipulated (force applied) to make a new shape. Only after the class is satisfied with their definition of a solid, have them record the definition in the Key Terms of the Student Journal.

Ask groups to place the jar with water in the middle of their table. Ask students to focus on describing the material inside the jar and not the jar and lid. Give the groups a few minutes to make observations of water. Facilitate the group observations by circulating among the students and listening to their descriptions and explanations. To check student progress, ask:

- Can someone explain what you have observed so far?
- What can you say about the properties of the water in the jar?
- Do the properties of water apply to all liquids? Tell me more about…
- How does this relate to or differ from the properties of solids?

Conduct a whole-class sharing of the group observations of the jar with water. Hold up the jar with water. Ask: What are the properties of a *liquid*? How are they different from the properties of solids?

Review the *How Can You Tell If It Is Matter?* list. Have the students determine which items on the list are liquid and if they classified the item as matter. Discuss the students' ideas of properties that are used to describe liquids. Ask them to relate the properties that describe solids to the properties that describe liquids and build on that understanding.

If students do not respond readily, pour water from one container to another and ask: Can solids do this? What is the difference between the shape of solids and the shape of liquids? At this point students should recognize that liquids take on the shape of their containers. Write the term liquid on the board, have the students decide on a definition that describes liquids, and write the definition in the Key Terms of the Student Journal.

After defining solids and liquids, ask the class to discuss the meaning of the term matter. Review their classification of the terms in the *How Can You Tell If It Is Matter?* prompt. Ask:

What do all the items that you have classified as matter have in common? Are there any patterns you can recognize? Is there something we can observe, measure, or feel that would help to describe what makes up matter?

Science Talk

Distribute an index card to each group. Have the students brainstorm ideas for explaining or defining the term matter. Give the groups sufficient time to come to a consensus and write their ideas on the index card. Facilitate the group brainstorming by circulating among the students and listening to their exchange of ideas. To help students collectively make sense of the concept and problem solve, ask:

- Can someone explain what you have established about the term matter so far?
- Do all of you agree? Why or why not?
- Does anyone have the same idea but a different way to explain it?
- Do you understand what _____ is saying?
- What do you need to find out? What do you already know about solids and liquids that might help you?
- Can you think of a way to use your definitions about solids and liquids to help you explain matter?
- Have you established that both solids and liquids are matter? What makes you think that? How does that help you define matter?
- Can you choose one item from the list in the Student Journal probe that you classified as matter and one that is not matter? How does that help you to define matter?
- Can you think of matter in terms of measurement? How does that help you to define matter?

After the groups have had sufficient time to agree upon a definition of the term, ask them to post it on the board to compare with the rest of the class definitions.

Review the class collection of definitions on the index cards. Encourage the groups to challenge and exchange ideas. Look for ideas that matter can be described as something that has weight and volume or takes up space. Ask if any groups used the balance to weigh their items. Take this opportunity to review how to use the balance and make accurate measurements. Ask:

- Do all the items have weight?
- How do you know?

SPEAKING AND LISTENING COMPREHENSION AND COLLABORATION: CCSS.ELA-LITERACY.SL.5.1

Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grade 5 topics and texts, building on others' ideas and expressing their own clearly.

CCSS.ELA-LITERACY.SL.5.1.B

Follow agreed-upon rules for discussions and carry out assigned roles.

CCSS.ELA-LITERACY.SL.5.1.C

Pose and respond to specific questions by making comments that contribute to the discussion and elaborate on the remarks of others.

CCSS.ELA-LITERACY.SL.5.1.D

Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.

WRITING

W.5.2: Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

a. Introduce a topic clearly, provide a general observation and focus, and group related information logically; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension.

W.5.4: Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3.)

Check for any groups/students who address the air in the jar as matter. Ask students if the air in the jar fits with their definitions or understanding of matter.

Have the students enter their definition of matter in the Key Terms section of the Student Journal and complete the Journal Entry.

Pre-Writing Strategy: *Word Sort Card Set*

Divide the class into their investigation groups. Encourage the students to discuss their ideas for responses to the Student Journal prompts. Distribute the *Word Sort Card Set* to each group. Encourage groups to discuss the terms and how they might be useful in writing their responses to the Journal Entry. Allow sufficient time for the students to orally discuss their ideas and listen to the ideas of others.

Journal Entry

1. *Write a rule that applies to things that can be classified as matter.*
2. *Write about one thing that you classified as "not matter" and explain how it does not follow the rule.*
3. *Write if you think the skunk odor is matter. Explain why you think that.*

Assessment

Use the group discussions and definitions and Journal Entry to assess the students' ability to construct explanations from observations.

LESSON 2C: OBTAINING INFORMATION ABOUT MATTER

Teacher Background Information
This lesson includes a reading integration using the book, *The Solid Truth About Matter*. Students compare their initial ideas and ideas from their observations to information gained from the text.

Considerations for Students with Special Needs
Read the selection in *The Solid Truth About Matter* aloud to the students and stop frequently and allow for students to ask questions and retell.

Advance Preparation
Pre-read pages 4-21 of *The Solid Truth About Matter*. Decide on reading groups and strategies best suited for your classroom.

Procedure
Elaborate on the concept.
Have the students revisit the *How Can You Tell If It is Matter* list and determine which items on the list have weight and volume. Discuss different ways that the weight and volume of the items could be measured. Record their ideas as a reference for future activities.

Introduce the book *The Solid Truth About Matter*. Have the students read the first chapters of the book (pp. 4–21).

As a class, complete the pre-reading strategies in the Student Journal.

Before reading pages 4-21 of "The Solid Truth About Matter", preview the reading selection. Use the Tool for Pre-Reading Notes to record your initial ideas.

List the titles and subtitles of the reading.

Write the main idea or questions you will focus on during the reading.

Write any information you learned from pictures, graphs, or charts in the preview.

What questions do you think the reading is attempting to answer?

After the class has completed the *Pre-Reading Notes*, review the Note-taking Tool for Reading in Science.

As you read pages 4-21 of "The Solid Truth About Matter", complete the Note-Taking Tool for Reading in Science.

MATERIALS NEEDED
For each student:
student pages
For each group of 4:
Word Sort Card Set (matter, weight, volume, classify, solid, liquid, gas)
For the class:
book: *The Solid Truth About Matter*

READING
KEY IDEAS AND DETAILS
RI.5.1: Quote accurately from a text when explaining what the text says explicitly and when drawing inferences from text.

RI.5.2: Determine two or more main ideas of a text and explain how they are supported by key details; summarize the text.

RI.5.3: Explain relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in a text.

CRAFT AND STRUCTURE
RI.5.4: Determine the meaning of general academic and domain-specific words and phrases in a text relevant to a grade 5 topic or subject area.

RI.5.5: Compare and contrast the overall structure (e.g., chronology, comparison, cause/effect, problem/solution) of events, ideas, concepts, or information in two or more texts.

INTEGRATION OF KNOWLEDGE AND IDEAS
RI.5.8: Explain how an author uses reasons and evidence to support particular points in a text, identifying which reasons and evidence support which point(s).

TEACHING TIP

The book *The Solid Truth About Matter* refers to steam and clouds as a gas. To be accurate, water in its gaseous form is water vapor. Steam and clouds are made up of water droplets that we can see. Steam from a boiling teapot is still in liquid form and will quickly change to water vapor and spread through out the room.

WRITING

W.5.2: Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

a. Introduce a topic clearly, provide a general observation and focus, and group related information logically; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension.

W.5.4: Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience. (Grade-specific expectations for writing types are defined in standards 1–3.)

Title of Chapters:

Read the first selected section to get a good idea of the material, then go back and reread to take notes:

- *Write the main idea or concept of the selection in your own words.*
- *Write the meaning of key terms in your own words.*
- *Review and compare your notes with a partner.*

Continue to read the next selected section.

- *Write the main idea or concept of the selection in your own words.*
- *Write the meaning of key terms in your own words.*
- *Review and compare your notes with a partner.*

Compare and combine the pre-reading notes with the notes from the reading.

- *How did the reading answer the question?*
- *How did the reading cover the main idea?*
- *Write the meaning of unfamiliar terms in your own words.*

List questions or concepts that are unclear in the reading.

Have students read in small groups or independently to gather information about matter.

When students have completed the reading, conduct a whole-class reading conference. Ask students to identify the main idea and supporting details from each chapter. Discuss the model that the author uses to describe the difference between solids, liquids, and gases. Ask students what the bees represent in the model.

Refer to the What We Think chart, and make additions to the What We Figured Out column as students get further information from the text.

Page 15: Take this opportunity to address the common misrepresentation authors sometimes use of steam as a gas. Water in its gaseous state is *water vapor*. Water vapor and steam are not in the same state. Steam is still in a liquid state. We cannot see water vapor until it condenses and becomes water droplets or fog, steam, or clouds. Reread the section on page 15, Squeezing Gases, and have the students replace the term *steam* with *water vapor* for scientific accuracy. Then have students turn to page 19 and explain that water from the snowman evaporates to invisible water vapor and then may condense on very small particles of solids in the air to become clouds.

Have students use evidence from the book and from their own experiences to describe matter as a solid, liquid, or gas.

Discuss the structure the author used in the book to present information to the reader. Have students cite where the author used evidence and reasoning to present information.

Have the students complete the Respond to Text in the Student Journal.

Complete the Main Idea and Supporting Details Chart. Write the main idea for pages 4–21 from The Solid Truth About Matter and list 3 or 4 details that support the main idea.

Evaluate the students' understanding of the concept.

Science Talk

Discuss the main idea in the reading selection. Ask students if their ideas about matter from the previous lesson is consistent with that of the author's. Ask students to cite passages from the text that supports their ideas.

Revisit the What We Think chart and discuss new ideas introduced and discrepancies in their initial thinking. Have students cite passages from the text that support or dispute their ideas. Add to the What We Did and What We Figured Out columns. Check to see what questions were answered on the Questions We Have column and move the to the What We Figured Out column.

Revisit the student responses to the Journal Entry in Lesson 2B. Allow time for students to make additions and revisions to their initial responses.

Assessment

Use the group discussions and revisions and additions to definitions and Journal Entry to assess the students' ability to obtain, evaluate, and communicate information from text.

PS1.A: STRUCTURE AND PROPERTIES 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; the effects of air on larger particles or objects.
- ~~The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish.~~
- ~~Measurements of a variety of properties can be used to identify materials.~~

OBTAINING, EVALUATING, AND COMMUNICATING INFORMATION

Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods.

- **Read and comprehend grade-appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence.**
- **Obtain and combine information from books and/or other reliable media to explain phenomena or solutions to a design problem.**

APPENDIX

ENGINEERING DESIGN PROCESS

The Engineering Design Process provides students with a series of steps to guide them as they solve problems and design and test products, models, and solutions. The process is cyclical, yet not necessarily in an order. Students are encouraged to evaluate as they progress through the process, revisit the mission often, and revise thinking and their plan multiple times as the process unfolds.

Engineers do not always follow the Engineering Design Process steps in order, one after another. It is very common to design something, test it, find a problem, and then go back to an earlier step to make a modification or change the design. Engineers must always keep in mind the mission or problem they are trying to solve and the limitations (cost, time, material, etc.) that are part of the solution to the problem. Two key elements in working as an engineer are teamwork and design-test-and-redesign.

Mission
- Defines the problem and what the engineers are trying to design or build.
- Describes the limitations within which the engineers must solve the problem.

Brainstorm Ideas
- Imagine, discuss, and sketch possible solutions.
- Conduct research into what has already been done.
- Discover what materials are available, time frame, and other limitations.

Plan and Design
- Draw and write a plan.
- Design your solution through drawing and manipulating materials.
- Develop a plan or steps and a schedule.

Build
- Construct your engineering device or project.
- Follow your plan.
- Adjust and test along the way.

Test and Adjust
- Test your device to see if it solves the problem within the mission and limitations.
- Make your project better based on tests: Test → Revise → Test.
- Improve based on feedback of others.

Present Your Solution
- Demonstrate how your solution solves the problem.
- Define problems and limitations.
- Describe the challenges and limitations in solving the problem.
- Describe additional revisions that could improve the device or project.

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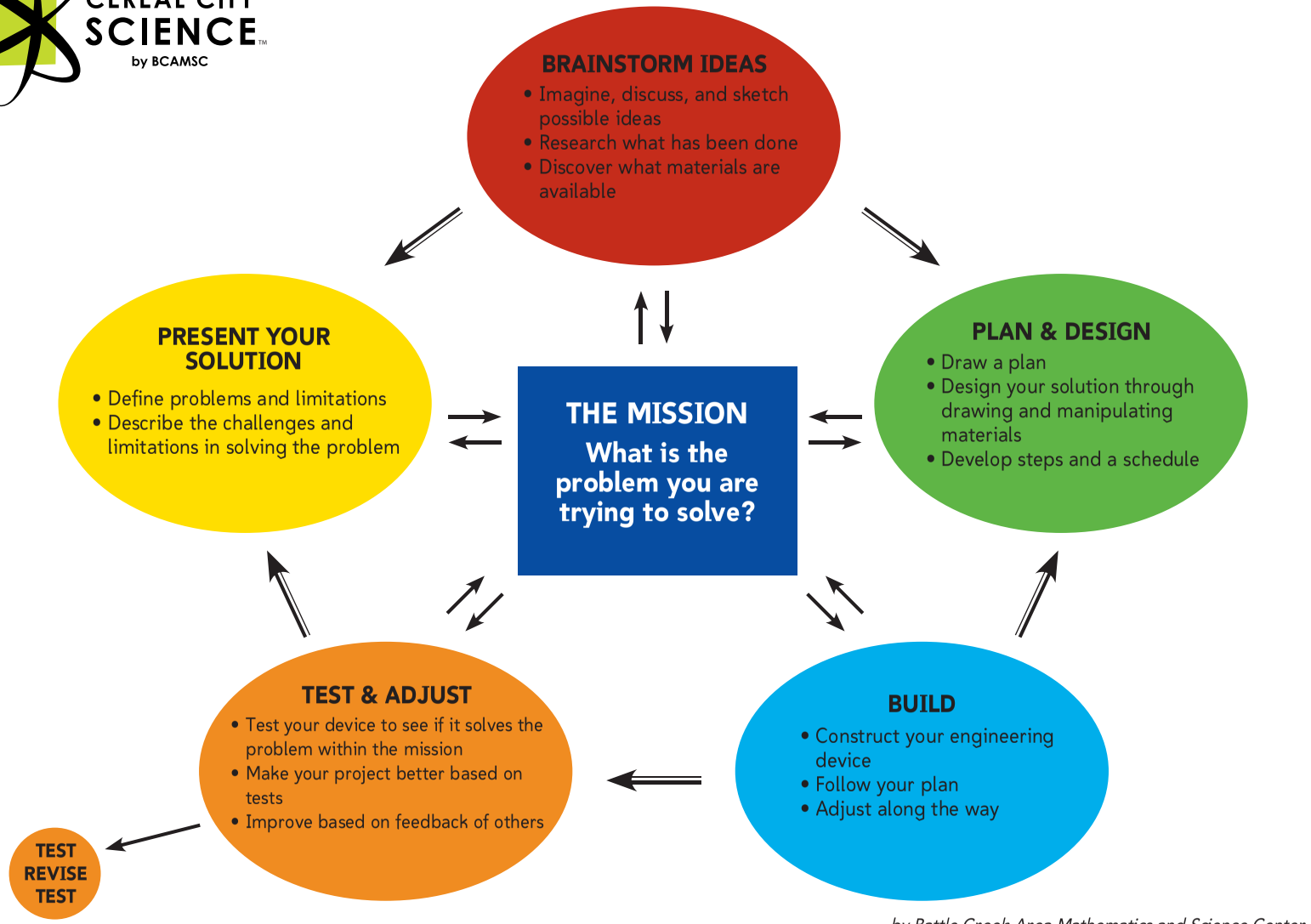
ENGINEERING DESIGN PROCESS



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CEREAL CITY SCIENCE by BCAMSC

Student Journal
5.PS.NGSS

Structure and Properties of Matter 5PNG

SECOND EDITION

A fifth grade unit supporting Next Generation Science Standards
and Michigan Science Standards

Name:_____

Name: _____

ACTIVITY **1A**

Where's the Skunk?

Date: _____

As you read the story, *Where's the Skunk?* Part 1 with your group, take notes and write ideas on the chart below. Include questions about key terms and ideas that you think are important in understanding the problem the class is trying to figure out.

Observations	Questions

1A ACTIVITY
Where's the Skunk?

Name: _____

Date: _____

1. Use the space below to develop a model of your thinking that explains why and how the skunk odor is detected throughout the neighborhood. Hint: Re-read the story to include the student observations and possible answers to their questions.

Name: _____

Date: _____

2. Next, work with your group and share your ideas. Collaborate among the group and use the space below to draw and label a model that explains why and how the skunk odor is detected throughout the neighborhood.

Name: _____

Date: _____

With your classmates, develop a scientific explanation for your findings by mapping odor strength on the map. Use Claim, Evidence, and Reasoning in your explanation.

Claim:
The claim should be supported by evidence directly from the investigation.

Evidence:
The evidence comes directly from the data collected in the investigation and should cite actual numbers or observations from a data table, chart, or graph.

Reasoning:
Reasoning ties what the student knows about the strength of odors and movement of gases to the claim and evidence.

Name: _____

Date: _____

As you read the story, *Where's the Skunk?* Part 2 with your group, take notes and write ideas on the chart below.

Main Idea: *Where's the Skunk?* Part 2
Supporting Details

Name: _____

Date: _____

As you read the story, *Where's the Skunk?* Part 2 with your group, include questions about key terms and ideas that you think are important in understanding the problem the class is trying to figure out.

Name: _____

Date: _____

ACTIVITY **2A**

Exploring Matter

Make observations of the different items. Record your observations on the chart below.

Items	Physical Properties of Matter Properties					
	color					
wooden cube						

Name: _____

Date: _____

How Can You Tell If It Is Matter?
Look at the list of things. Place an X by the things that are NOT matter.

List of Things			
wood		cell phones	
paper		germs	
plastic		helium	
glass		gravity	
air		magnetism	
water		lemonade	
electricity		soil	
Earth		friction	
fire		ideas	
metal		sound	
lightning		light	
thunder		wind	
smoke		flour	
odors		oxygen	
heat		animals	

Name: _____

Date: _____

Write how you know when something is matter.

Name: _____

Date: _____

1. Write a rule that applies to things that can be classified as matter.

2. Write about one thing that you classified as “not matter” and explain how it does not follow the rule.

Name: _____

Date: _____

3. Write if you think the skunk odor is matter. Explain why you think that.

Name: _____

Date: _____

Before reading pages 4-21 of *The Solid Truth About Matter*, preview the reading selection. Use the Tool for Pre-Reading Notes to record your initial ideas.

Title of chapter or article:	
List the titles and subtitles of the reading.	
Write down the main ideas or questions you will focus on during the reading.	
Write any information you learned from pictures and graphs or charts in the preview.	
What question(s) do you think this reading is attempting to answer?	

Name: _____

Date: _____

Obtaining Information About Matter

As you read pages 4-21 of *The Solid Truth About Matter*, complete the Note-Taking Tool for Reading in Science.

Title of chapter or article:	
Read the first selected section to get a good idea of the material, then go back and reread to take notes: • Write the main idea or concept of the selection in your own words. • Write the meaning of key terms in your own words. • Review and compare your notes with a partner.	
Continue to read the next selected section. • Write the main idea or concept of the selection in your own words. • Write the meaning of key terms in your own words. • Review and compare your notes with a partner.	
Compare and combine the pre-reading notes with the notes from the reading. • How did the reading answer the question? • How did the reading cover the main idea? • Write the meaning of unfamiliar terms in your own words.	
List questions or concepts that are unclear in the reading.	

Obtaining Information About Matter

Name: _____

Date: _____

Complete the Main Idea and Supporting Details Chart. Write the main idea for pages 4-21 from *The Solid Truth About Matter* and list 3 or 4 details that support the main idea.

Main Idea
Supporting Details