1 Exploring Materials

TALKING IT OVER
1 CLASS SESSION

ACTIVITY OVERVIEW

NGSS CONNECTIONS

Students begin to gather and synthesize information about the physical and chemical properties of three materials—glass, aluminum, and plastic. They assess how this information might be used as evidence for making a decision about which material to use for a drink container in relation to the structure and function of that object.

Prepare to teach the unit by reviewing the *Quick Start to Issues and Science*, found at the front of this Teacher Edition. This guide breaks down the resources and equipment needed to teach the unit. It calls out critical planning tools including the *NGSS Overview*, the *Phenomena, Driving Questions, and SEPUP Storyline* overview and the *SEPUP Scoring Guides*. For more detailed information on the program as a whole, see the "Issues and Science Program Overview" section of the *Teacher Resources*.

If this is your **first** SEPUP unit, read through "Planning for First-Time Users," found on the last page of the *Quick Start*.

NGSS CORRELATIONS

Performance Expectations

Working toward MS-PS1-3: Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.

Disciplinary Core Ideas

MS-PS1.A Structure and Properties of Matter: Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.

Science and Engineering Practices

Obtaining, Evaluating, and Communicating Information: Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used and describe how they are supported or not supported by evidence.

Asking Questions and Defining Problems:

Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles.

Ask questions to identify and clarify evidence of an argument.

Analyzing and Interpreting Data: Analyze and interpret data to determine similarities and differences in findings.

Crosscutting Concepts

Structure and Function: Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.

Connections to Engineering, Technology, and Applications of Science: Interdependence of Science, Engineering, and Technology: Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems.

Connections to Engineering, Technology, and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World: The use of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. Thus, technology use varies from region to region and over time.

Common Core State Standards—ELA/Literacy

WHST.6-8.1: Write arguments focused on discipline-specific content.

INVESTIGATIVE PHENOMENA AND SENSEMAKING

Materials like plastics, metals, and glass are all useful, but they can also affect the environment.

Investigative Phenomena, Sensemaking

Students draw on their prior knowledge of and experience with three common materials—aluminum, glass, and plastic—to make initial comparisons of the properties of these materials. Students are introduced to the crosscutting concept of *structure and function* and evidence and trade-offs. They discuss what further questions need to be answered to make a more informed decision about the best material for a single-use drink container.

WHAT STUDENTS DO

Students brainstorm and discuss what they know about the properties of aluminum, glass, and plastic as materials for producing single-use drink containers. They discuss their current understanding of the advantages and disadvantages of each material and develop a list of questions needed to decide which is better for single-use drink containers. They then examine four graphs of data on the materials to help inform their choices.

MATERIALS AND ADVANCE PREPARATION

- *For the teacher*
  - 1 Visual Aid 1.1, "Group Interactions Classroom Rubric" (optional)
  - 1 Visual Aid 1.2, "Keeping a Science Notebook" (optional)
  - 1 Scoring Guide: EVIDENCE AND TRADE-OFFS (E&T) (optional)
  - Driving Questions Board cards and instructions
  - * 1 plastic drink bottle
  - * 1 glass drink bottle
  - * 1 aluminum can

- *For each student*
  - 1 Student Sheet 1.1, "Writing Frame: Evidence and Trade-Offs" (optional)
  - 1 Student Sheet 1.2, "Interpreting Graphs" (optional)
  - 1 Student Sheet 1.3, "Evaluating Group Interactions" (optional)
  - 1 Student Sheet 1.4, "Guidelines for Safety in the Science Classroom" (see Safety Note below)
  - 1 Scoring Guide: EVIDENCE AND TRADE-OFFS (E&T) (optional)

* *not included in kit*

The EVIDENCE AND TRADE-OFFS (E&T) Scoring Guide can be found in the Assessment tab in the back of this Teacher Edition. Students can find "Evaluating Group Interactions" in Appendix E: Literacy Strategies in the Student Book.

The Driving Questions Board cards and instructions can be found in the front pouch of your printed Teacher Edition or as a download on the "Tools and Resources" page in your online Teacher Portal.

SAFETY NOTE

Develop a classroom safety plan. Review any safety materials provided by your district. Select the safety contract and guidelines that you will use in this course—either developing your own, using those provided by your district, or using Student Sheet 1.4, "Guidelines for Safety in the Science Classroom." Copy the materials for each student. Students can find "Science Safety Guidelines" in Appendix B: Science Safety in the Student Book.

TEACHING SUMMARY

GET STARTED

1. Initiate students' sensemaking by drawing on their prior knowledge and experiences with different materials.
    a. Have students read the vignette that opens the unit.
    b. Introduce the issue by showing the drink containers to the class and asking students which material—aluminum, glass, or plastic—would make the best single-use drink container.
    c. Begin a Driving Questions Board.
    d. Read aloud the introduction and the guiding question.

DO THE ACTIVITY

2. If you have not previously done so, introduce the SEPUP model for collaborative work.
    a. Introduce SEPUP's 4–2–1 model for collaborative work.
    b. Clarify which situations are appropriate for collaboration and which are appropriate for working independently.
    c. Introduce strategies for effective group interactions.
3. Introduce the use of a science notebook and the preparation of lab reports.
4. Students compare the properties of glass, aluminum, and plastic.
    a. Assist students as needed in setting up their data tables.
    b. Distribute Student Sheet 1.2, "Interpreting Graphs," and use them to support students' skills in analyzing the graphs and descriptions. (optional)
    c. Have students share their materials choices and the reasoning for their choices.
    d. If you have not previously done so, introduce safety in the science classroom.

BUILD UNDERSTANDING

5. Introduce crosscutting concepts.
    a. Explain that crosscutting concepts bridge disciplines.
    b. Give an example that makes sense for students.
    c. Introduce the crosscutting concept of *structure and function*.
    d. Relate *structure and function* to this activity.
6. Introduce the concept of evidence and trade-offs.
    a. If you have not previously done so, introduce the meaning and use of evidence in science.

b. Distinguish evidence from opinion.

c. Discuss the sources, quality, and quantity of evidence.

d. Introduce the idea that decisions about solutions to scientific and engineering problems often involve trade-offs.

e. Provide an example of trade-offs.

f. Develop some examples of trade-offs in students' lives.

7. (OEC QUICK CHECK; E&T ASSESSMENT) If you have not previously done so, introduce the SEPUP Assessment System.

a. Provide an overview of the Scoring Guides.

b. Explain the expectations for student growth over time.

c. (LITERACY) Support students' writing with Student Sheet 1.1, "Writing Frame: Evidence and Trade-Offs." (optional)

TEACHING STEPS

GET STARTED

1. Initiate students' sensemaking by drawing on their prior knowledge and experiences with different materials.

a. Have students read the vignette that opens the unit.

Anchoring Phenomenon

The vignette of Theresa and her mom's conversation about materials engineers is derived from the front cover photo of the Student Book. After reading the text, have students examine the photo. Ask them to generate any questions they have about the materials shown in the photo, and why those particular materials were used to make the various objects. If students are not familiar with the term *phenomenon* (or its plural form, *phenomena*), explain that a *phenomenon* is an observable fact or event. In this unit, the focus is on investigating phenomena related to different materials being used for different purposes.

b. Introduce the unit issue by showing the drink containers to the class and asking students which material—aluminum, glass, or plastic—would make the best single-use drink container.

Defining Issues

Have the students read the description of what they will investigate in this unit on the bottom of the vignette page and discuss how the unit may or may not answer the questions they have about materials and their uses. Most importantly, identify that students will investigate the issue of how properties of materials determine their uses and effect on the environment. Explain this issue in broad terms, and let students know that they will look at specific examples of this issue in everyday life. Show students the drink containers, and ask which materials would make the best single-use drink

container. Have students record their initial responses and rationales in their science notebooks. You may wish to pass the containers around the class or leave them somewhere accessible for students to examine during the activity.

c. Begin a Driving Questions Board.

Driving Questions Board

In SEPUP, the Driving Questions Board elicits students' initial wonderings about the unit issue and the investigative phenomena; the class is then prompted to revisit the Driving Questions Board throughout the unit. Ideally, student questions generated at the start of each learning sequence can be condensed through class discussion into a unified driving question. As a scaffold to teachers who are new to this teaching strategy, Driving Questions Cards are provided for each learning sequence and can be displayed as the unified driving question. The suggested driving question for this learning sequence is: How do a material's properties affect its uses?

The driving questions are also identified on the Phenomena, Driving Questions, and SEPUP Storyline overview found in the NGSS and Common Core tab at the back of this Teacher Edition.

d. Read aloud the introduction and the guiding question.

Read the introduction aloud. Introduce the term *properties*. When words are formally defined in an activity, they appear in bold type in the Key Vocabulary list. Encourage students to use these words when talking or writing about science. During discussions, listen for these words to see if students are using them correctly. Decide how you will support students' understanding of the vocabulary—perhaps by setting up a word wall in the classroom.

Science and Engineering Practices

Have the class suggest which properties of glass make it appropriate as a single-use drink container material. List the properties on the board for students to refer to later in the activity. Explain that students will work in groups to discuss the properties of aluminum and plastic. They will then examine data on the three materials to evaluate which would be the best choice for a single-use drink container. This is a good opportunity to introduce the science and engineering practice of *analyzing and interpreting data*, which will be used throughout this unit.

DO THE ACTIVITY

2. If you have not previously done so, introduce the SEPUP model for collaborative work.

a. Introduce SEPUP's 4–2–1 model for collaborative work.

4–2–1 Model

Explain that many activities in this book use the SEPUP 4–2–1 cooperative learning model. Students work in groups of four or in pairs to share, discuss, compare, and revise their ideas and to conduct investigations and activities. In all cases, each student is responsible for

contributing ideas, listening to others, recording and analyzing their results, and monitoring their own learning.

b. Clarify which situations are appropriate for collaboration and which are appropriate for working independently.

In science, collaboration is essential to the development of new ideas and to a better understanding of scientific concepts. However, scientists must publish only their own work and must give others credit when they build on others' ideas.

c. Introduce strategies for effective group interactions.

Facilitating Group Work

Explain or model what productive group interactions (both agreement and constructive disagreement) look like and sound like. It may be helpful to use Student Sheet 1.3, "Evaluating Group Interactions," and Visual Aid 1.1, "Group Interactions Classroom Rubric," provided at the end of this activity.

3. Introduce the use of a science notebook and the preparation of lab reports.

Science Notebook

Explain your expectations for the type and organization of students' notebooks. Keeping a science notebook helps students track data; record predictions, hypotheses, and questions as they investigate; process ideas; build scientific writing skills; and write lab reports. You may wish to use Visual Aid 1.2, "Keeping a Science Notebook," provided at the end of this activity and in Appendix E of the Student book, to guide them.

4. Students compare the properties of glass, aluminum, and plastic.

a. Assist students as needed in setting up their data tables.

Be sure that students add the properties of glass from the class discussion to their data tables. If appropriate, have groups briefly share responses with one another when they finish Procedure Step 2 and/or share the questions they list in Procedure Step 3.

PROCEDURE STEP 2 SAMPLE STUDENT RESPONSE

COMPARING MATERIALS

Type of material	Advantages	Disadvantages
Glass	*Reusable* *Can be recycled* *Easy to see through*	*Breaks easily* *Broken glass can be dangerous* *Heavy*
Aluminum	*Lightweight* *Can stack* *Can be recycled* *Lots of cans are recycled*	*One-time use only* *Cannot reclose an aluminum can after it's been opened*
Plastic	*Reusable* *Lightweight* *Doesn't break easily*	*Can't always be recycled*

b. Distribute Student Sheet 1.2, "Interpreting Graphs," and use it to support students' skills in analyzing the materials graphs and descriptions. (optional)

   If students are having trouble interpreting the graphs in Part B, you may wish to use the Student Sheet 1.2, "Interpreting Graphs," provided at the end of this activity and in Appendix C of the Student Book, to help them with their analysis.

c. Have students share their materials choices and the reasoning for their choices.

Science and Engineering Practices

   After students have completed their group discussions in Step 5, have one student in each group share the group's choice with the class for which material they believe to be the best for making a single-use drink container. Make sure that they also explain the reasoning behind their choice. This process supports the science and engineering practice of *obtaining, evaluating, and communicating information*, which will be expanded on in the Analysis section of this activity and in the activities that follow.

d. If you have not previously done so, introduce safety in the science classroom.

   Explain that students are required to know and understand all classroom expectations for safety. Distribute the safety contract and guidelines you are using, and review your expectations for classroom safety. If you do not have a safety contract already, you may choose to use Student Sheet 1.4, "Guidelines for Safety in the Science Classroom." This can also be found in Appendix B in the Student Book. Point out the location of safety gear in the classroom, and review when and how to wear all basic safety gear, such as chemical splash goggles and gloves. Demonstrate how to use emergency safety equipment, including the eye-and-face wash. Provide plenty of time for students to ask questions, and then have them sign the safety agreement. Have them take it home for a parent's or guardian's signature, and tell them to return the signed agreement before the date you plan to conduct the next activity. Although the element samples in the upcoming "Investigating Elements" activity are generally considered safe to handle, this activity is an opportunity to familiarize students with wearing the protective equipment.

BUILD UNDERSTANDING

5. Introduce crosscutting concepts.

Crosscutting Concepts

   a. Explain that crosscutting concepts bridge disciplines.

      They can be a lens or touchstone through which students make sense of phenomena and deepen their understanding of disciplinary core ideas.

Refer students to the chart in Appendix G: Crosscutting Concepts in the Student Book, and point out the symbols and definitions provided.

b. Give an example that makes sense for students.

For example, one crosscutting concept is *patterns*. Students have almost certainly noticed patterns, such as the predictable pattern of the seasons every year. Earth scientists might study patterns in rock layers; physical scientists might study patterns in the behavior of chemicals; and life scientists might study patterns in the kinds of trees in different climates. Observing, questioning, and trying to explain patterns are things that all scientists do. This is why patterns are considered a crosscutting concept.

c. Introduce the crosscutting concept of *structure and function*.

This crosscutting concept relates to the close relationship between the structure of an object or system and what it does or how it behaves. Review the symbol used for *structure and function* in Appendix G. Scientists look at relationships between structure and function to figure out how things work. Structure and function applies from the atomic scale to the astronomical scale. For example, the functions of parts of the human body depend on their structures. An arm has a very different structure and function from the digestive system. Use this or other accessible examples to clarify this crosscutting concept for students.

d. Relate *structure and function* to this activity.

In this activity, and in many activities in this unit, students look at the structure and function of an object to determine what materials are best suited to making a particular object. In this activity, students looked at the properties of aluminum, glass, and plastic to determine which of these materials best fits the structure and function of a single-use drink container.

This is a good place to reintroduce the first driving question, "How do a material's properties affect its uses?," identified in the Phenomena, Driving Questions and SEPUP Storyline overview found in the NGSS and Common Core tab at the back of your Teacher Edition. Revisit the question, and add to or revise students' ideas as needed

6. Introduce the concept of *evidence and trade-offs*.

a. If you have not previously done so, introduce the meaning and use of evidence in science.

Evidence and Trade-Offs

Analysis item 2 provides an opportunity to introduce the definition of *evidence* provided in the Student Book. Explain that scientists collect information (data) with various tools and strategies, including observation

and experimentation. Like scientists, students will use evidence to develop explanations, construct scientific arguments, and recommend solutions to problems.

b. Distinguish evidence from opinion.

Explain that *evidence* is information that supports a claim. In contrast, an *opinion* is the view someone takes about a certain issue based on their own judgment. An opinion might not be based on evidence. An informed opinion might be based on evidence; however, another person may have a different opinion based on the same evidence. To distinguish evidence from opinion in science, it is helpful to determine if a statement describes information gathered through reliable and appropriate procedures and is likely to be reproducible. The question is: Could someone else gather similar information under similar circumstances? If the answer is yes, the statement is not opinion and is likely to be evidence.

c. Discuss the sources, quality, and quantity of evidence.

When evaluating evidence, scientists consider the source, quality, and quantity of the evidence available. Biased or insufficient evidence compromises the validity of scientific conclusions. Scientific conclusions should logically follow the evidence collected and should not be overly generalized beyond the context of the investigation.

The criteria for quality evidence may vary among the scientific disciplines. However, evidence is generally considered of higher quality if it is obtained through systematic investigation and is reproducible, meaning that another investigation under the same set of circumstances would obtain similar data.

Criteria for quantity also vary but might include the sample size or number of trials in an experiment, the number of observations that support a conclusion, or the availability of multiple studies or multiple lines of evidence that lead to the same conclusion.

d. Introduce the idea that decisions about solutions to scientific and engineering problems often involve trade-offs.

This unit includes issues that relate to science and/or engineering and that may lead to decisions about the best solutions or designs for solving problems. One goal of this curriculum is to teach students that decisions about possible solutions often involve trade-offs and that identifying trade-offs involves analyzing evidence.

Explain to students that in this unit, they will make several decisions about choosing materials. In this activity, students look at the trade-offs of aluminum, glass, and plastic as materials for a drink container. In a decision involving trade-offs, something positive (or desirable) is given up to gain another positive (or desirable) outcome. Since many decisions involve trade-offs, students should understand that a perfect choice is often not possible. It is possible, however, to recognize and analyze the trade-offs associated with each decision.

e. Provide an example of trade-offs.

For example, when asked, "Paper or plastic?" at a store checkout counter, most shoppers make the choice quickly. But there are several trade-offs attached to choosing paper or plastic. A shopper who chooses paper over plastic may do so to avoid generating plastic waste. In requesting the paper bag, though, they are contributing to other environmental problems, such as increased water and energy use, and the higher amounts of solid waste and CO_2 emissions associated with making paper bags. Neither choice is ideal, and both choices have a downside. Identifying the trade-offs helps clarify the reasoning that is being applied to make a decision.

f. Develop some examples of trade-offs in students' lives.

To further explore this idea, brainstorm with the class a list of decisions they make every day that involve trade-offs. Choose one, and talk through the associated trade-offs of deciding one way or another. This practice will familiarize students with ways to identify and consider trade-offs in this and subsequent activities.

7. (QUICK CHECK; E&T ASSESSMENT) If you have not previously done so, introduce the SEPUP Assessment System.

a. Provide an overview of the Scoring Guides.

Explain that Analysis item 2 is the first assessment in this unit, and you will use it to introduce the SEPUP Assessment System to your students, rather than as a formal assessment.

SEPUP Assessment System

Before assigning the assessment, distribute the EVIDENCE AND TRADE-OFFS (E&T) Scoring Guide, and use it to model how the system works. Point out the levels in the first column of the Scoring Guide. Tell students that these levels are the same for all Scoring Guides and range from 0 to 4. Review the descriptions of each level. For example, a Level 4 response is "complete and correct" in all Scoring Guides. Point out that the scores (0–4) are based on

Quick Checks

the quality of their responses and do not correspond to letter grades. Allow students to refer to the Scoring Guide as they prepare their answers. Be sure they understand that the Scoring Guides do not include the specific content that students must provide in their responses; rather, the guides explain the overall expectations for responses at various levels of performance on the task. Note that Analysis item 2 can also be used as a Quick Check for students' use of the science and engineering practice of *obtaining, evaluating, and communicating information*, which is being used in the context of a question about evidence and trade-offs.

b. Explain the expectations for student growth over time.

Explain to students that they aren't expected to always produce complete and correct work on their first attempts. Instead, they should work toward developing consistent Level 3 and Level 4 answers as they become more proficient with the concepts (both disciplinary core ideas and crosscutting concepts) and the science and engineering practices being assessed. It is not necessary (or even expected) that an "A" student will always write Level 4 responses, especially at the beginning of the course or when they are introduced to a new Scoring Guide.

c. (LITERACY) Support students' writing with Student Sheet 1.1, "Writing Frame: Evidence and Trade-Offs." (optional)

Writing Frame

To help students complete Analysis item 2, you may wish to pass out Student Sheet 1.1, "Writing Frame: Evidence and Trade-Offs." This literacy strategy gives students a structure for organizing their ideas and communicating them in coherent written responses. A sample Level 4 response can be found in the Sample Responses to Analysis, below.

STRATEGIES FOR TEACHING DIVERSE LEARNERS

Below are suggestions for differentiating instruction and assessment in this activity for diverse learners in your classroom:

Differentiated Instruction

- Students with learning disabilities: Have students work with a partner to write their responses to the Student Sheets, or allow them to show their understanding by drawing diagrams or pictures rather than constructing verbal answers.
- English learners: Introduce a class word wall for the Chemistry of Materials unit as a visual reminder of the new key scientific terms and to make words easily accessible. Begin constructing it for this activity, and continue to add terms throughout the unit. Consider adding an explanatory picture or diagram for some (or all) of the terms.

- Academically gifted students: Assign students one of the materials investigated in this activity (glass, aluminum, or plastic), and have them research—and, if appropriate, present to the class—more data and information about the production of these materials.

These icons, ● ● ●, indicate opportunities to formatively assess students' proficiency with the three dimensions: ● = SEP, ● = DCI, ● = CCC.

SAMPLE RESPONSES TO ANALYSIS

1. Did the graphs of the data help you make a decision about the advantages and disadvantages of each material? Explain.

   Students' responses will likely vary. A sample response is shown here:

   The graphs helped me make a decision about the advantages and disadvantages of glass, metal, and aluminum because I did not know which was recycled the most, which was the most expensive to produce, which one caused the most pollution and waste, and how many containers could be made from each ton of material. That data helped me to choose aluminum as the best material instead of plastic, which I had originally chosen, because the graphs showed that you can make a lot more containers out of one ton of aluminum than you can out of glass or plastic. It is a lot cheaper to make a container out of aluminum, and aluminum is recycled more than glass or plastic. I think this makes aluminum the best choice, even though creating a ton of aluminum creates more waste and pollutants.

2. (QUICK CHECK; E&T ASSESSMENT) **Revisit the issue:** Imagine that you are an environmentalist who is concerned with pollution, litter, and problems with a bottle's impact on the environment. Based on the information from this activity, which material would you claim is the best for making a single-use drink container?

   Write a letter from an environmentalist's viewpoint to the president of the drink company describing your recommendation at this time. Support your reasoning with evidence, and identify the trade-offs of your decision.

   Hint: To write a complete answer, first state your opinion. Provide two or more pieces of evidence that support your opinion. **Evidence** is factual information or data that support or refute a claim. Consider all sides of the issue, and identify the trade-offs of your decision. A **trade-off** is a desirable outcome given up to gain another desirable outcome.

   Students' responses will likely vary, based on the material they choose.

SAMPLE LEVEL 4 RESPONSE

There is a lot of discussion about the issue of which material is best for single-use drink containers—glass, aluminum, or plastic. My decision is that the best material is aluminum. My decision is based on the following evidence: First, you can make a lot more aluminum containers from a ton of aluminum than you can glass or plastic; second, aluminum is recycled a lot more than glass or plastic; and third, aluminum containers are less expensive to make than glass or plastic containers. People who disagree with my decision might say that glass is better because making a ton of glass does not produce as many pollutants and waste as making a ton of plastic, but this does not argue against aluminum, just against plastic.

3. In this unit, you will investigate phenomena related to the properties of different materials. What questions do you have about the properties of the three materials you considered in this activity: glass, aluminum, and plastic?

   Students' responses will likely vary. A sample response is shown here:

   I would like to know the differences between different types of plastics, especially ones that can and cannot be recycled. I would also like to know why glass seems heavier than aluminum.

REVISIT THE GUIDING QUESTION

What information would help you decide which material is best for making a single-use drink container?

Have students discuss their responses to Analysis item 2 and what information from the activity was helpful in making their decision. Let students know that they will continue to gather information about the three materials—glass, aluminum, and plastic—in the following activities. Over the course of the unit, they will have several opportunities to evaluate which material might be best for different uses, and they will evaluate other materials, their uses, and their impact on society and the environment.

ACTIVITY RESOURCES

KEY VOCABULARY

evidence

material

property

trade-off

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Name_____ Date_____

STUDENT SHEET 1.1

WRITING FRAME: EVIDENCE AND TRADE-OFFS

There is a lot of discussion about the issue of _____

_____

My decision is that _____

_____

My decision is based on the following evidence:

First, _____

_____

_____

Second, _____

_____

_____

Third, _____

_____

_____

The trade-off is _____

_____

_____

People who disagree with my decision might say that _____

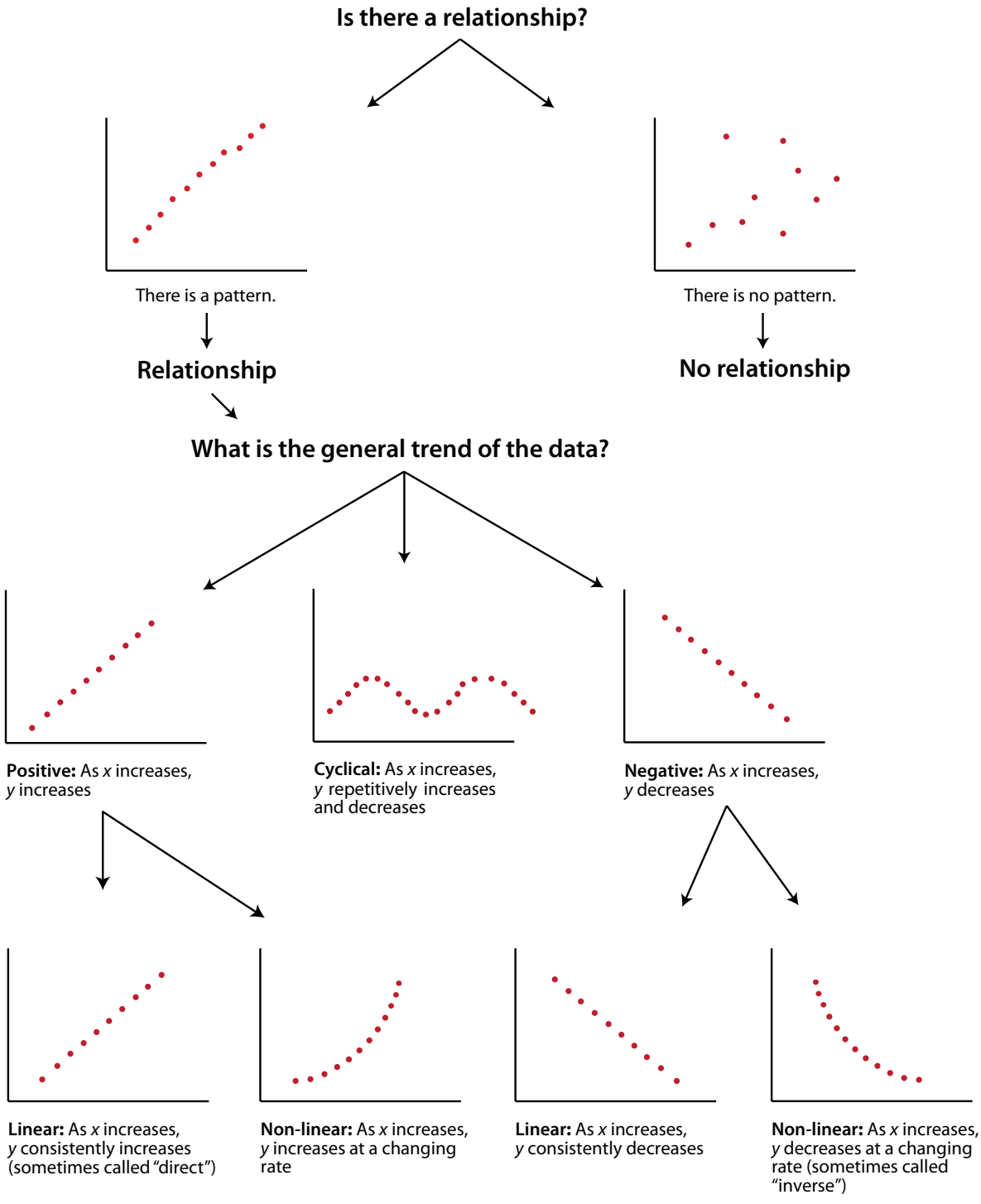
_____

_____

STUDENT SHEET 1.2

INTERPRETING GRAPHS

Determine the path that describes the data.



Define the components of the graph.

Things you can say:

"The title of the graph is ..."

"The independent variable in this graph is ..."

"The dependent variable in this graph is ..."

"_____ is measured in _____"

Create a description of what the graph reveals.

Things you can say:

"This graph shows ..."

"As the _____ increases, the ..."

"The _____ has the highest ..."

" _____ is different from _____ because ..."

"The _____ peaked at ..."

"The rate of _____ increased from ..."

Describe how the graph relates to the topic.

Things you can say:

"This graph is important to understanding _____ because ..."

"This graph supports the claim that _____ because ..."

"This graph refutes the claim that _____ because ..."

Name_____ Date_____

STUDENT SHEET 1.3

EVALUATING GROUP INTERACTIONS

Procedure

Use the table below to rate your group's performance.
Give evidence for your scores by answering questions 1 and 2.

GROUP INTERACTIONS	SCORE
Group stays on task and mananges time efficiently	
Group shares opportunities	

1. Give some examples of how your group stayed on task and managed the time efficiently.

2. Give some examples of how your group shared opportunities to contribute to the activity. Your examples might include times when you or your group members respected and treated others with courtesy, helped one another do the work, shared the work (not having one person do all the work alone), or stayed open-minded and willing to compromise.

Name_____ Date_____

STUDENT SHEET 1.4

GUIDELINES FOR SAFETY IN THE SCIENCE CLASSROOM

Before the Investigation

- Listen carefully to your teacher's instructions, and follow any steps recommended when preparing for the activity.
- Use only those materials or chemicals needed for the investigation.
- Know the location of emergency equipment, such as a fire extinguisher, fire blanket, and eyewash station.
- Tie back or remove dangling or bulky items, such as long hair, jewelry, sleeves, jackets, and bags. Do not wear open-toed shoes in the science lab.
- Tell your teacher if you wear contact lenses, or have allergies, injuries, or any medical conditions that may affect your ability to perform the lab safely.
- Make sure both the work surface and floor in your work area are clear of books, backpacks, purses, or any other unnecessary materials.

During the Investigation

- Follow all written and spoken instructions.
- Read the activity procedure carefully.
- Don't eat, drink, chew gum, or apply cosmetics in the lab area.
- Wear chemical splash goggles when using chemicals.
- Do not wear contact lenses when using chemicals. If your doctor says you must wear them, notify your teacher before conducting any activity that involves chemicals.
- Read all labels on chemical bottles, and be sure you are using the correct chemical.
- Keep all chemical containers closed when not in use.
- Do not touch, taste, or smell any chemical unless you are instructed to do so by your teacher.
- Mix chemicals only as directed.
- Use caution when working with hot plates, hot liquids, and electrical equipment.
- Follow all directions when working with live organisms or microbial cultures.
- Be mature and cautious, and don't engage in horseplay.
- Report any accidents to your teacher immediately.
- Not sure what to do? Ask!

After the Investigation

- Dispose of all materials as instructed by your teacher.
- Clean up your work area, wash out trays, replace bottle caps securely, and follow any special instructions.
- Return equipment to its proper place.

I, _____, have read the Guidelines for Safety and have discussed them in my classroom. I agree to follow all these rules during science investigations.

_____ _____
Student Signature Date

_____ _____
Parent/Guardian Signature Date

In case of accident or emergency, contact:

_____ (_____)_____
Name Phone Number

_____ (_____)_____
Name Phone Number

Please list any known allergies or health problems: _____

_____

Name *Sample student response* Date

STUDENT SHEET 1.1

WRITING FRAME: EVIDENCE AND TRADE-OFFS

There is a lot of discussion about the issue of *which material is best for single-use drink containers—glass, aluminum, or plastic.*

My decision is that *the best material is aluminum.*

My decision is based on the following evidence:

First, *you can make a lot more aluminum containers from a ton of aluminum than you can glass or plastic.*

Second, *aluminum is recycled a lot more than glass or plastic.*

Third, *aluminum containers are less expensive to make than glass or plastic containers.*

The trade-off is *some people taste a metallic aftertaste in the water from aluminum bottles. Also, aluminum bottles can be heavier than some plastic bottles.*

People who disagree with my decision might say that

glass is better because making a ton of glass does not produce as many pollutants and waste as making a ton of plastic, but this does not argue against aluminum, just against plastic.

VISUAL AID 1.1

GROUP INTERACTIONS CLASSROOM RUBRIC

When to use this rubric:
This classroom rubric is used when students work together as a group toward a common goal.

What to look for:

- Group members work together as a team.
- The ideas of all members are valued and considered by the whole team in working toward the common goal.

Level	Description
Level 4 Accomplished	Group members accomplish Level 3 and actively collaborate by doing the following: • Asking questions about one another's ideas • Helping one another accomplish the task • Building on one another's ideas
Level 3 Almost there	All group members participate equally, and respectfully consider one another's ideas.
Level 2 On the way	Unequal group participation OR group respectfully considers some, but not all, ideas.
Level 1 Getting started	Significantly unequal group participation OR group totally disregards some members' comments and ideas.
Level 0	Members do not work together OR single individual does entire task.
x	Student had no opportunity to work as part of a group.

VISUAL AID 1.2

KEEPING A SCIENCE NOTEBOOK

- Write in blue or black ink.
- Cross out mistakes or changes with a single line. Do not erase or use correction fluid.
- Write neatly.
- Record the date of each entry.
- For each new investigation, record the following:

  Title:

  Purpose:

  Rewrite the guiding question in your own words.
  Hint: What are you going to do? Why are you going to do it?

  Materials:

  Note: Place a "√" here after you have collected the necessary materials.

  Procedure:

  Write down whether you understand the procedure.

  Data:

  Record your observations, measurements, and other lab work.
  Include relevant data tables, charts, diagrams, and/or graphs.
  Be sure to label your work clearly.

- Sometimes, you may want to:

  Make inferences or draw conclusions based on the data:

  I think my results mean…
  I think that this happened because…

  Reflect on how the activity worked in your group:

  This is what went well… This is what did not go well…
  If I could do this activity again, I would…

  Think about what questions you still have:

  I wonder if…
  I'm not sure about…

  Keep track of new vocabulary and ideas:

  A key word I learned is…
  I would like to find out what happens when…
  One interesting thing to do would be to…

VISUAL AID 1.2 *(continued)*

KEEPING A SCIENCE NOTEBOOK

The following is a guide to help you conduct investigations. However, depending on the investigation, you may not always use all of steps below or use them in the same order each time.

Title: Choose a title that describes the investigation.

Purpose: What am I looking for? Write what you are trying to find out in the form of a question.

Background: What do I know about the topic? Write a summary of background information you have on the topic that led to the purpose for the investigation.

Hypothesis: Write a statement about what you predict you will see as data in the experiment to answer the question in the "Purpose" and why you are making that prediction.

Experimental Design: How will you answer the question?

Describe the methods you will use (what you will do) to answer the question.
Use short numbered steps that are easy to follow in the lab.
Make a list of the materials you will use to answer the question.
Outline the variables:

- Independent variable (what is being changed)
- Dependent variable (what is being measured)
- Control (what will be used as baseline comparison)

Data: What did you find?

Record observations and measurements.
Use a data table where appropriate to organize the data.
Don't forget to include proper units and clear labels.

At the end of your investigation:

Make inferences or draw conclusions about the data:

I think my results mean…
I think this happened because…

Think about any errors that occurred during the investigation:

What did not go as planned?
What steps were hard to follow while doing the investigation and why?

Think about questions you still have that could lead to new investigations:

I wonder if…
I'm not sure about…

Keep track of new vocabulary and new ideas that could lead to new investigations:

I would like to find out what happens when…
One interesting thing to do would be to…

Reflect on how the activity worked in your group:

This is what went well…This is what did not go well…
If I could do this investigation again, I would…