Schoolyard Investigation

Toad Abodes

Second Grade

PEI PACIFIC EDUCATION INSTITUTE

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Toad Abodes

Overview

Many second-grade students leap at the opportunity to build playhouses or forts outdoors. The following lessons harness that enthusiasm and promote a greater sense of purpose for their construction. Students start in the first lesson by viewing a short video of a garden full of toads. Students will explore their own school campus and make a list of materials available on their school campus to build a rain proof toad abode. Next students test these materials to determine which are the most absorbent and which are the softest. Students will then make an origami frog. Students must design, using only the materials they tested, a dwelling large enough to fit their origami frog and keep it damp in dry conditions such as sun or wind. Students will draft plans, build, test, and optimize their solutions to the question, "how do you build a natural toad abode"?

Overview Statement

Test different materials to **determine which are best** for constructing an inviting space for a toad, then **evaluate others' designs**.

Next Generation Science Standards

2-PS1-2	Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose. [Clarification Statement: Examples of properties could include strength, flexibility, hardness, texture, and absorbency.] [Assessment Boundary: Assessment of quantitative measurements is limited to length.]
K-2 ETS1-3	Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Analyzing and Interpreting Data Analyzing data in K-2 builds on prior experiences and progresses to collecting, recording, and sharing observations. • Analyze data from tests of an object or tool to determine if it works as intended. (2-PS1-2, K-2-ETS1-3)	**PS1.A: Structure and Properties of Matter** • Different properties are suited to different purposes. (2-PS1-2) **ETS1.C: Optimizing the Design Solution** • Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3)	**Cause and Effect** • Simple tests can be designed to gather evidence to support or refute student ideas about causes. (2-PS1-2)

Common Core State Standards Connections:

ELA/Literacy –

RI.2.8	Describe how reasons support specific points the author makes in a text. (*2-PS1-2*)
W.2.6	With guidance and support from adults, use a variety of digital tools to produce and publish writing, including in collaboration with peers. (*K-2-ETS1-3*)
W.2.7	Participate in shared research and writing projects (e.g., read a number of books on a single topic to produce a report; record science observations). (*2-PS1-2*)
W.2.8	Recall information from experiences or gather information from provided sources to answer a question. (*2-PS1-2, K-2-ETS1-3*)

Mathematics –

MP.2	Reason abstractly and quantitatively. (*2-PS1-2, K-2-ETS1-3*)
MP.4	Model with mathematics. (*2-PS1-2, K-2-ETS1-3*)
MP.5	Use appropriate tools strategically. (*2-PS1-2, K-2-ETS1-3*)
2.MD.D.10	Draw a picture graph and a bar graph (with single-unit scale) to represent a data set with up to four categories. Solve simple put-together, take-apart, and compare problems using information presented in a bar graph. (*2-PS1-2, K-2-ETS1-3*)

English Language Proficiency Standard

ELP.2-3.2 Participate in grade appropriate oral and written exchanges of information, ideas, and analyses, responding to peer, audience, or reader comments and questions.

Background

> *Engineering design in the earliest grades introduces students to "problems" as situations that people want to change. They can use tools and materials to solve simple problems, use different representations to convey solutions, and compare different solutions to a problem and determine which is best. Students in all grade levels are not expected to come up with original solutions, although original solutions are always welcome. Emphasis is on thinking through the needs or goals of the engineering project that need to be met, and which solutions best meet those needs and goals.*
>
> Next Generation Science Standards Volume 2 Appendix I

When assessing students' final engineered projects, keep in mind that originality is not a criterion. Assessing if their projects could fit the origami toad and keep it damp are the benchmarks of success. Final assessment should be conducted only after multiple iterations of design. Optimization from first attempts is a crucial element of the engineering design standards, and an excellent opportunity to integrate into any growth mindset lessons teachers may do with students.

Students will need to be able to gather and use at least four different materials from the school grounds to build their toad abodes. Examples of these materials can be sand, soil, grass, leaves, twigs, bark, and rocks. Become familiar with your school campus and know where students will have safe access to these types of materials. Students should be able to dig in the ground as well as gather some material from the surface. Do not allow students to break branches from living trees, or pick leaves off plants. In the location where you plan to test the toad abodes resistance to drying out, make sure it is okay for students to dig small holes. Part of the learning experience is to make it okay for students to get their hands dirty!

Objectives

Students:

- Identify materials on the school campus that are natural and plentiful enough to build a toad abode that will fit an origami toad.

- Investigate the physical properties of different materials and assess their usefulness for their engineering design.

Materials: clipboards, paper, pencils, one (1) lined 3x5 index card for each student, water spray bottle, student pages or student notebook.

Timing: Minimum three 30-minute learning sessions.

Wonder Wall

A Wonder Wall is a great strategy to pair with inquiry lessons and promotes curiosity and wonder in student explorations. Simply, a Wonder Wall is a dedicated area of the classroom for student questions, which can be written on sticky notes. The point is, the educator is not to answer the questions through direct instruction, but that these questions invite students to investigate on their own. Some questions might be answered through the planned classroom investigations, while others might be learned during independent reading time or discussions around the dinner table. Students become the experts, answering questions of their peers!

For more ideas about the use of this strategy, check out Chapter 12 in Curriculum Essentials: A Journey (Linda J Button, Ed.D.)

Learning Experience

For this project students may work as individuals, in pairs or small teams. Each student should document their individual and group thinking throughout the design process, utilizing either the generated student pages or in a science notebook.

Engage

1. Begin this activity with a Notice and Wonder[1] routine. You can do this as a class on a shared Notice and Wonder chart or have each student record what they notice and are wondering in their journals. Share the video "Dozens And Dozens Of Toads In Our Yard and Toads Eating Flies."[2]
   a. Share at least the first two minutes of the video. The narrator does a great job of pointing out what he notices in his garden, modeling the use of the words, "I notice."
   b. You may want to watch the video more than once – there is so much to see!
   c. Ask students to share what they noticed in the video. Where did the toads like to hang out? What were they doing? What ***materials*** did the toads seem to visit most?
   d. Ask students what questions they have about what they saw in the video. Record these questions on a Wonder Wall[3] – a visible area of your classroom for student questions.
2. Next, ask students if they have ever seen toads in their school yard. Why or why not? If so, where have they seen them?
   a. Students should start wondering about the ***material properties*** the toads were attracted to in the video. Generally, amphibians like toads look for homes that are cool, clean, and damp.
3. Issue and Challenge: Habitat loss is one of the greatest threats to toads. The students will work to think about how spaces in the schoolyard might be re-engineered to be more inviting for amphibians.
   a. Challenge: Improve a little spot in the school yard so that toads might like to live or visit there.

[1] A "Notice and Wonder" routine is a simple way to engage students in new phenomenon. At the very basic level, you ask students to write down or share what they notice, and what they wonder. You can find out a lot more about "Notice and Wonder" by visiting https://sadlerscience.com/notice-and-wonder/.
[2] Shared with permission of the artist, for student/classroom use only. Retrieved from: https://youtu.be/XtCULbXcZVo
[3] Button, Linda J. (n.d.). *Curriculum essentials: A journey*. Pressbooks. Retrieved from: https://oer.pressbooks.pub/curriculumessentials/#main

4. Distribute the **Introducing the Challenge** student page.

5. Let students know they will be building shelters for toads using only the natural materials a toad would find on the school grounds. Review the difference between natural materials (rocks, dirt, leaves) and human-made materials (plastic, glass, paper, metal).

6. Tell students the class will be going outside to make a list of the materials that are available on the school grounds to build toad abodes. They must find at least four different materials they could possibly use.

7. Review your classroom rules and procedures for being outdoors. Ensure that each student knows the boundaries to explore and your signal to regroup as a class.

8. Lead students outside with clipboards, paper, and pencils, and direct them to an example of a type of material that is available on the school grounds they may consider using.

9. Gather students back together when each child has identified at least four suitable items to be used for building materials. It is appropriate that many of the students have identical lists. Some students may not think materials such as soil, sand, or "dirt" should be considered. Have some prepared probing questions such as, "where did you see the toads in the video?", "do you know where other animals live on the school grounds?" and "what do moles or ants make their homes out of?".

Literacy Extension

Read students the first chapter, "A List," from *Frog and Toad Together*. Ask students if they have ever made a list. Let students share their personal list experiences, such as shopping, chores, or gift lists. Explain that in this story Frog and Toad live in homes, or Toad Abodes. Toads, like most living creatures need shelter, a part of their habitat.

Students can write a list of natural and man-made material ideas. Students can write a list of natural materials that they might find on the playground before heading outdoors, and then check items they find off the list.

Explore

You may want to print the following instructions page for your students, but also go through the instructions with them. Model how to fold the origami toad.

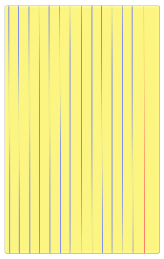
You can watch How To: Make a Jumping Frog from an Index Card[4] from the Harris County Public Library on YouTube.

Note: Origami (the Japanese art of folding paper) has been studied for the benefits the practice has on mindfulness, spatial reasoning, mathematics, hand-eye coordination, fine-motor skills, and improving concentration. Including the task of folding a paper toad might seem something that could be skipped for time, but it supports whole-child development and is a positive contribution to learning and growing.

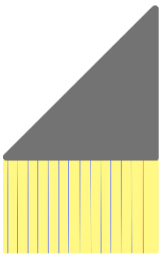
[4] Shared with permission from the Harris County Public Library, for educational use only. Retrieved from: https://youtu.be/Ncxp0fWvnsY

Create your Toad! Give each student a lined 3x5 card (you must use a notecard for these directions to work) to create their toad. The following steps provide a durable jumping origami toad.

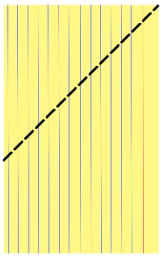
1. Position the card with the lines facing up and the shorter side positioned as the top and bottom.



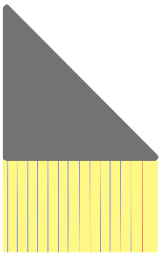
2. Fold the top left corner over to the right edge forming a triangle.



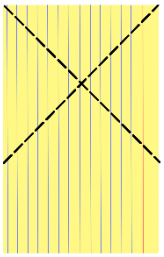
3. Unfold.



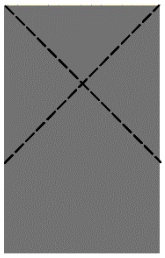
4. Repeat steps 2 & 3 for the top right corner.



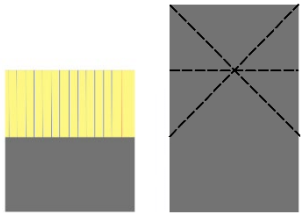
5. You should now have a folded "X" on the top of your card.



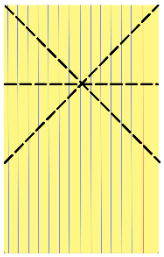
6. Turn the card over to the plain side.



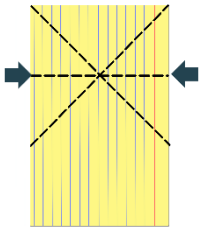
7. Fold the top edge of the "X" to the bottom of the "X" and unfold.



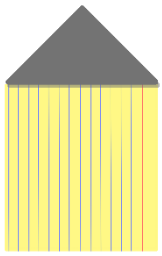
8. Flip the card back to the lined side



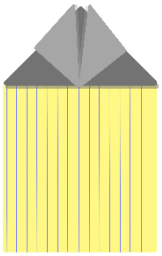
9. With your fingers, gently squeeze the center of the "X" and bring the edges of the scoop together.



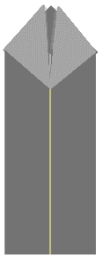
10. Continue to bring the edges together to form a triangle.



11. Fold the bottom tips of the triangle towards the top to form the toad's arms.

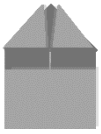


12. Fold the edges of the card in to meet at the center.



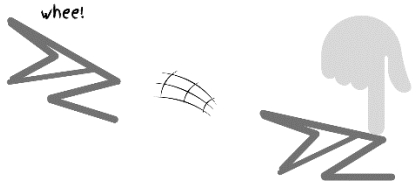
13. Fold the bottom of the card all the way to the top, folding the entire thing in half.

14. Fold the same edge back down to the new bottom. This forms the back legs of the toad.



15. Looking at the toad from the side and arrange the back legs to form a "Z" shape.

16. Place your toad on the table and give its back a gentle quick tap to make it jump!



Design Challenge. Once students have their toads made, they are ready for the design challenge. They must build a toad abode out of the materials found on the school grounds that are big enough for their toad to fit in and keep it damp in dry conditions.

1. Hand out student page **First Brainstorm**.

2. Have students *sketch their initial ideas* of how to build a toad abode with the *materials* they listed. Have students *label their drawings*. The test will be heat from an incandescent bulb or dry air such as from a heater. You should pick an amount of time that is safe for the materials/situation you have. (For example, don't leave a space heater on overnight without supervision or a heat lamp on through the weekend.)
    a. Suggestions: put student designs near the classroom or hallway heater or put student designs outdoors in warm/dry weather and tape off area to avoid tampering. Have a "control" toad that has no shelter. When you dampen the paper toad, make sure it is damp but not soaked.

3. Students should be able to *articulate the design challenge criteria and constraints*. Use the student pages **Describing Criteria and Constraints** or a science notebook to answer the following questions:
    a. What are the rules (criteria) you must follow to build the toad abode?
    b. What challenges (constraints) might you have as you build the toad abode?
    c. What are some possible solutions to the challenges you might face?

Explain

Test the materials

1. Explain to students that before they can begin building their toad abodes, they must first test their chosen materials on two characteristics: *texture* and *absorbance*.
    a. Suggestion: facilitate a class discussion about the *types of materials* a frog or toad *would want and why*. See if the students can come up with characteristics to test. You could even invite someone from a local pet store to come talk about what amphibians need to be happy and healthy in their habitat (cool, clean, and damp).

2. Hand out the student pages **Conduct Investigation of Texture and Absorbance**.

3. Demonstrate to students a sample *texture* test. Model how students can keep track of their results by *recording their tests and their results* on **Conduct Investigation of Texture and Absorbance** under "TEXTURE DESCRIPTION." Alternatively, students may use journal or science notebook for recording.
    a. Note that this and the following activity fit well to support Performance Expectation 2-PS1-1.
    b. Depending on your students, you can limit texture testing to "rough" and "smooth" or allow for many different adjectives/let students compile their own list.

4. Once students complete the texture observations, help them understand what it means for something to be "absorbent." Demonstrate to students a sample *absorbance* test. You can use the Absorbency Test[5] animation from the American Chemical Society, or model using a few of the natural materials students have selected.
    a. For a natural materials absorption test, you can set up sticks, grass, dry vegetation, etc., similarly to the Absorbency Test animation, or in the diagram "**Absorbency Test, Set-up Option 1**". For soils, sand, and gravel, you will need to set up a cup with fine mesh covering the opening for each

[5] The Absorbency Test from American Chemical Society can be found at https://www.acs.org/education/resources/k-8/inquiryinaction/second-grade/absorbency-test.html

sample, as in the diagram "**Absorbency Test, Set-up Option 2**". Place the sample on the mesh and spray with water. Students can count how many sprays until water flows through the mesh.

b. Definition of absorbent: Material which can soak up a liquid.

5. Students will *reflect on their results* and determine if their tests make them change any of their initial design ideas. The results may be slightly ambiguous. The goal is to have students understand that *materials will have different characteristics*, and that those *properties may be better suited to one use over another*.

Elaborate

1. Hand out the student page **Optimizing Scientific Tests.**

2. Have students return to their first design sketches and update them after conducting the investigations.

3. Ask students to work in small groups and discuss why they think they should update their designs or change some of their first ideas.

4. Students should complete a new sketch that will be used to build their toad abodes.

5. Once students have their toad abodes built, have them put their damp origami toads inside. If they cannot fit their toad inside, they have not met the design criteria.

6. If the toad can fit, set the toad abodes in a dry area for your predetermined amount of time (i.e., one full day, one week).

7. Have the students remove the toads, if the paper shows sign of drying out, they have not met the design criteria.

8. Have students reflect upon their results and record in their student pages or journals using **Testing Built Toad Abodes 1st Trial.**

Evaluate

1. It may be tempting to end the design challenge here; however, this does not complete the full process. It is imperative that students have another opportunity to *optimize their designs* and test a new iteration using the student page **Optimizing after Scientific Test: Third Sketch of Toad Abode.**

2. It is appropriate that if students imitate other classmates' successful designs, they should give credit in their reflections, a technique often used by scientists.

3. Students who may have met the design criteria in the first iteration, should now be required to *improve their design* by either making it larger so the toad can host his friend frog, or survive a rainstorm, or survive more extreme dry conditions.

4. Make sure students reflect upon their results and sketch a new updated plan before building their second toad abode to test.

5. Have students record their final test results on a student page **Testing Built Toad Abode 2nd Trial.**

6. Hand out reflection and assessment page **I used to think...But now I know page**. This page is designed to be cut into three.

7. Tell students they are going to reflect on their learning from Toad Abode about *materials* used for engineering.

8. Using the sentence starters, have students draw or write about their previous understanding and new learning. If students have never done a reflection like this before, you might want to model it for students or have students work in small groups. Scaffold this activity as needed dependent on student needs and time of year.

9. Hand out the reflection and assessment page **Toad Abode: Claim and Evidence**.

10. Have students complete the **Toad Abode: Claim and Evidence** using their Toad Abode and the tests they completed to provide evidence to *support their claim*. It is appropriate for students to access their work from previous parts of the investigation.

11. Evaluate students' claim and evidence of the best building materials to engineer their toad abodes. Make sure it is accurate and contains many details. Collect this for evidence of progress towards Performance Expectation K-2-ETS1-3. See the rubric for scoring.

Extensions

- Additional NGSS opportunities - Read *Frog and Toad Together*. After reading the second chapter, test why seeds grow just as Toad does.
- Art - Have students paint terracotta pots to take home and put outdoors to encourage frogs and toads to have additional habitats.
- Math - Conduct an origami hopping competition where students must measure and graph which toads jump the farthest. Create a competition for different origami toad designs using different paper material.
- Career Connections - Invite presentations from field biologists that work on amphibian health monitoring or zoologists who might work on breeding endangered frog species.
- Social Studies - Explore frogs' importance to local Tribal communities. Or compare to how people build homes for themselves. What materials do we use?

Suggested Additional Reading

- *How a House is Built* by Gail Gibbons 1990
- *Frogs* by Gail Gibbons 1993
- *Frog or Toad, how do you know?* by Melissa Stewart 2011
- *The Girl who Never Made Mistakes* by Mark Pett and Gary Rubinstein 2011
- *Those Darn Squirrels* by Adam Rubin and Daniel Salmieri 2012

Toad Abode

Student Pages

Name: _____

Engineering Design Challenge: Toad Abodes

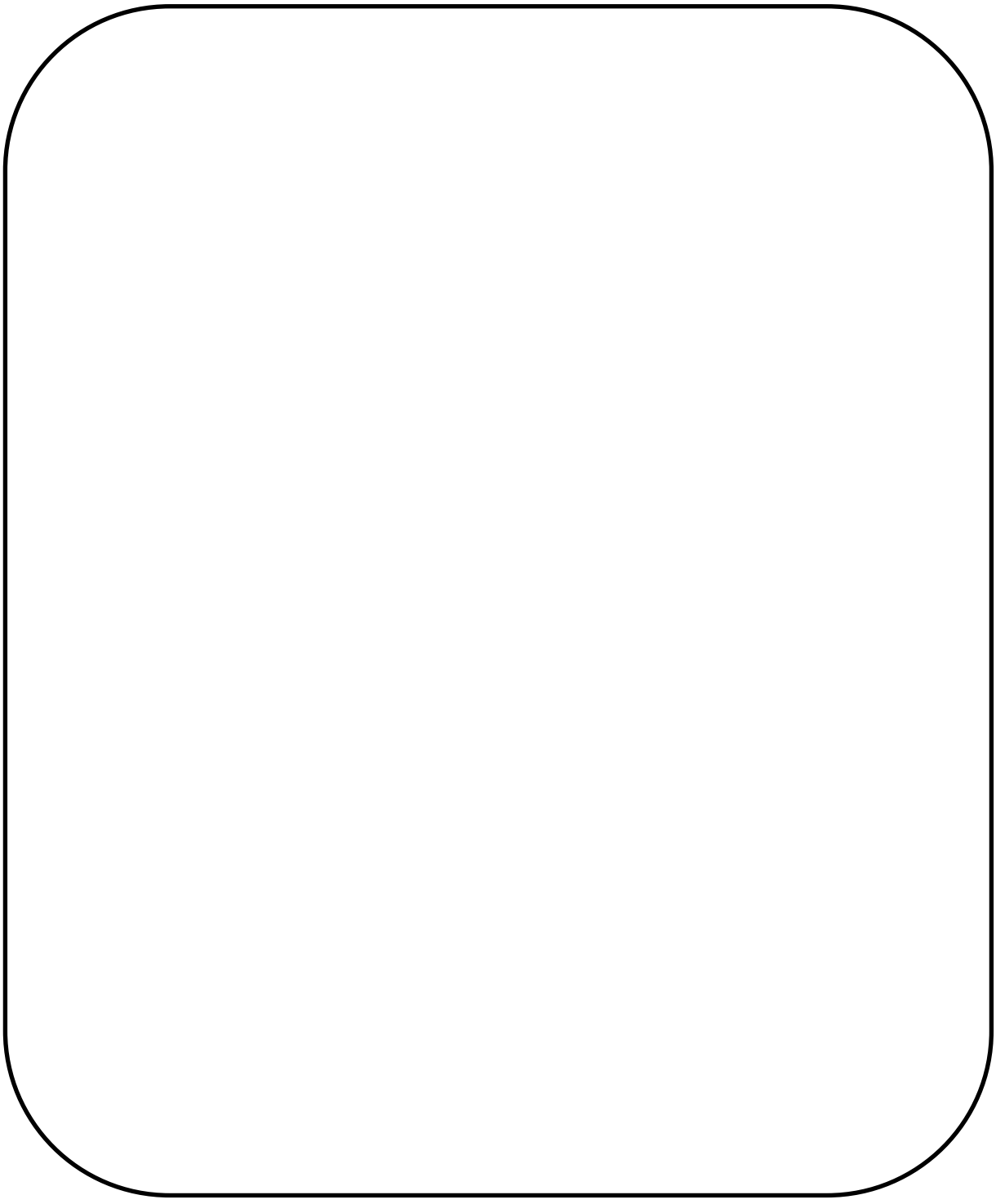
Introducing the Challenge

What different materials can you find on the school grounds?

Name of material	Where did you find it outside?	Is there enough to build with?
1.		
2.		
3.		
4.		

First Brainstorm

You made your toad! Sketch your first draft of a toad abode. Label the materials you are using in your possible solution. Will it be comfortable for a toad? Will it help their skin stay damp?



Describing Criteria and Constraints

1. What are the rules that you must follow in building this toad abode?

2. What are the most challenging parts to building this toad abode?

3. Describe the constraints of the challenge and possible solutions to problems.

Conduct Investigation of Texture and Absorbance

TEXTURE DESCRIPTION

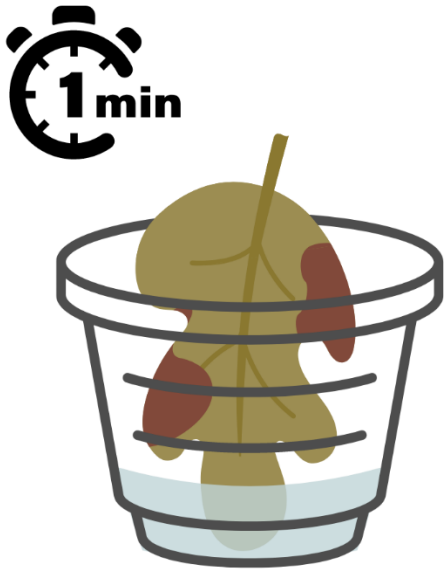
1. Start with Material 1. Write the name of it on the line under “Material 1”.
2. Next, pet the material with your finger. Does it feel smooth or rough? Put a checkmark in the box that best describes Material 1.
3. Now gently squish the material between your finger and thumb. Does it feel soft or hard? Put a checkmark in the box that best describes Material 1.
4. Rub the material between your first finger and thumb. Does it feel gritty (or like sand)? Put a checkmark in the box that best describes Material 1.
5. Finally, Touch the material to the back of your hand. Does it feel damp or dry? Dampness can feel cooler than dryness. Put a checkmark in the box that best describes Material 1.
6. Repeat steps 1-5 for Materials 2, 3, and 4.

Material 1:	**Material 2:**	**Material 3:**	**Material 4:**
_____	_____	_____	_____
Smooth ☐ Rough ☐	Smooth ☐ Rough ☐	Smooth ☐ Rough ☐	Smooth ☐ Rough ☐
Soft ☐ Hard ☐	Soft ☐ Hard ☐	Soft ☐ Hard ☐	Soft ☐ Hard ☐
Fine ☐ Gritty ☐	Fine ☐ Gritty ☐	Fine ☐ Gritty ☐	Fine ☐ Gritty ☐
Damp ☐ Dry ☐	Damp ☐ Dry ☐	Damp ☐ Dry ☐	Damp ☐ Dry ☐

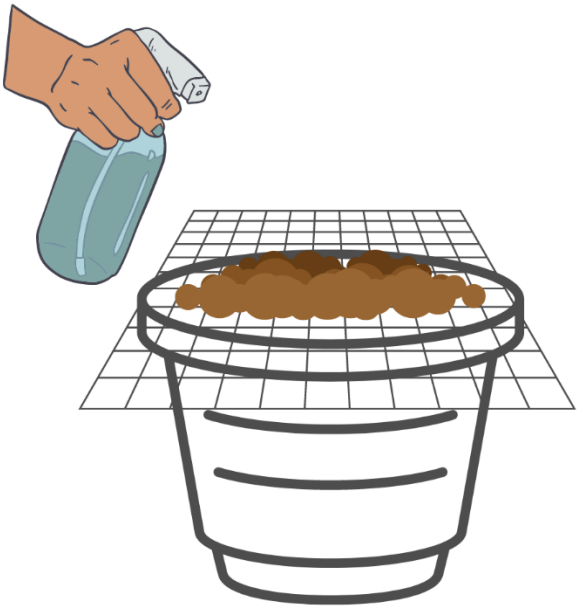
How will you use your soft materials when building your toad abode? Why?

How will you use your other material? Why?

ABSORBANCE TEST



Absorbency Test, Set-Up Option 1



Absorbency Test, Set-Up Option 2

Absorbency test, set-up option 1:

1. Place water in a small plastic cup, filling the bottom inch of the glass with water.
2. Attach your material to the side of the cup and set the timer for one minute.
3. After one minute, take the material out of the water and see if the material **absorbed** (soaked up) any water.
4. Record your observations.

Absorbency test, set-up option 2:

1. Place a fine mesh screen over a small plastic cup.
2. Place a small amount of your loose material on top of the mesh screen.
3. Using a spray bottle, spray the material with water.
4. Go slowly! Count the number of sprays it takes for water to go through the material and into the cup.
5. Record your observations.

1. Which materials have the best texture for your toad abode? Why?

2. Which materials might not be great for your toad abode? Why?

3. List your materials from most absorbent to least absorbent.

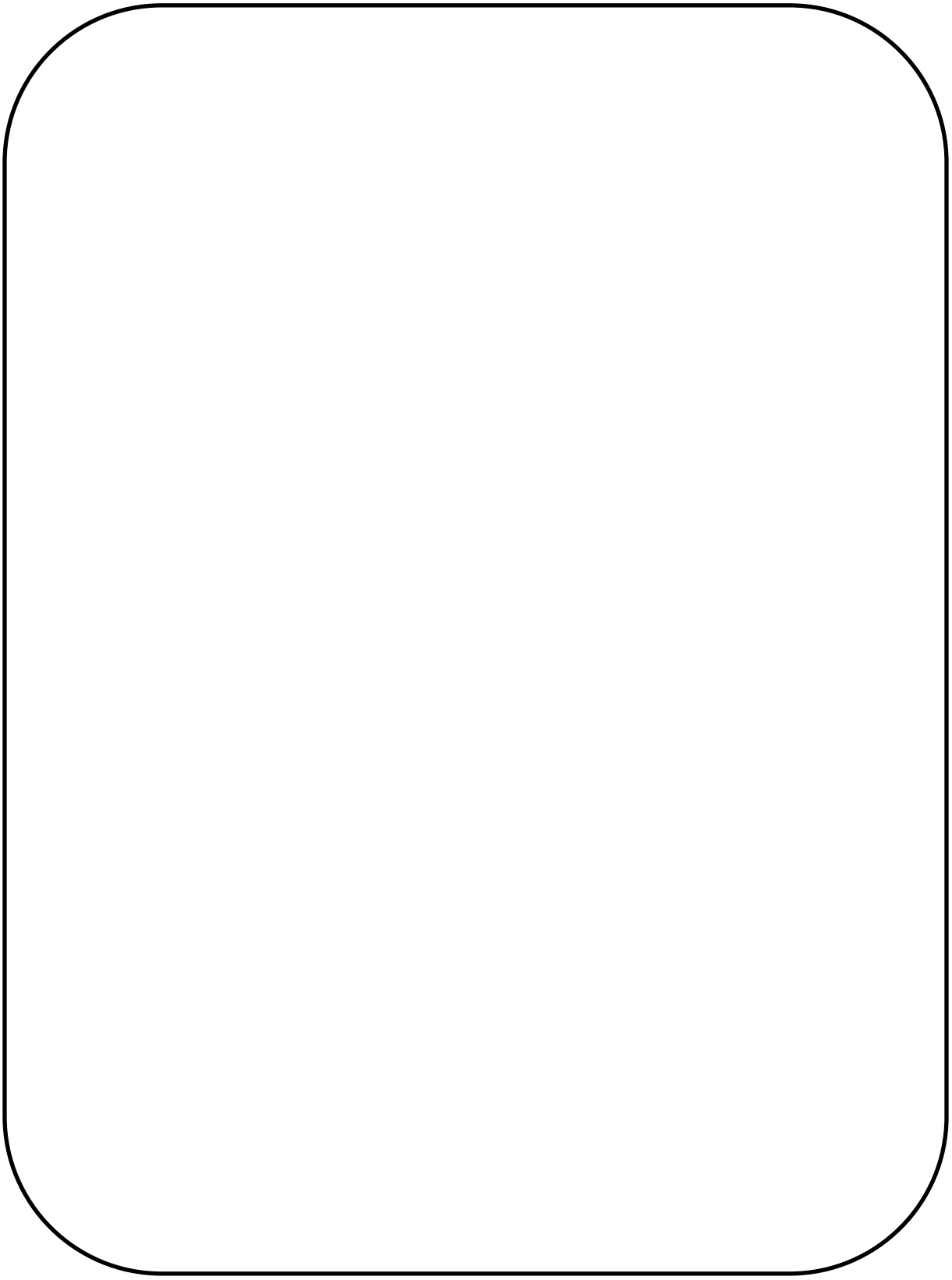
4. How do you know which is the most absorbent and which are the least absorbent?

5. How will you use the material with the best texture when building your toad abode? Why?

6. How will you use your most absorbent material when building your toad abode? Why?

7. How will you use your other material? Why?

Optimizing after Scientific Tests: Second sketch of toad abodes



Testing Built Toad Abodes 1st Trial

1. Did my toad fit into the toad abode?

2. Did my toad stay damp?

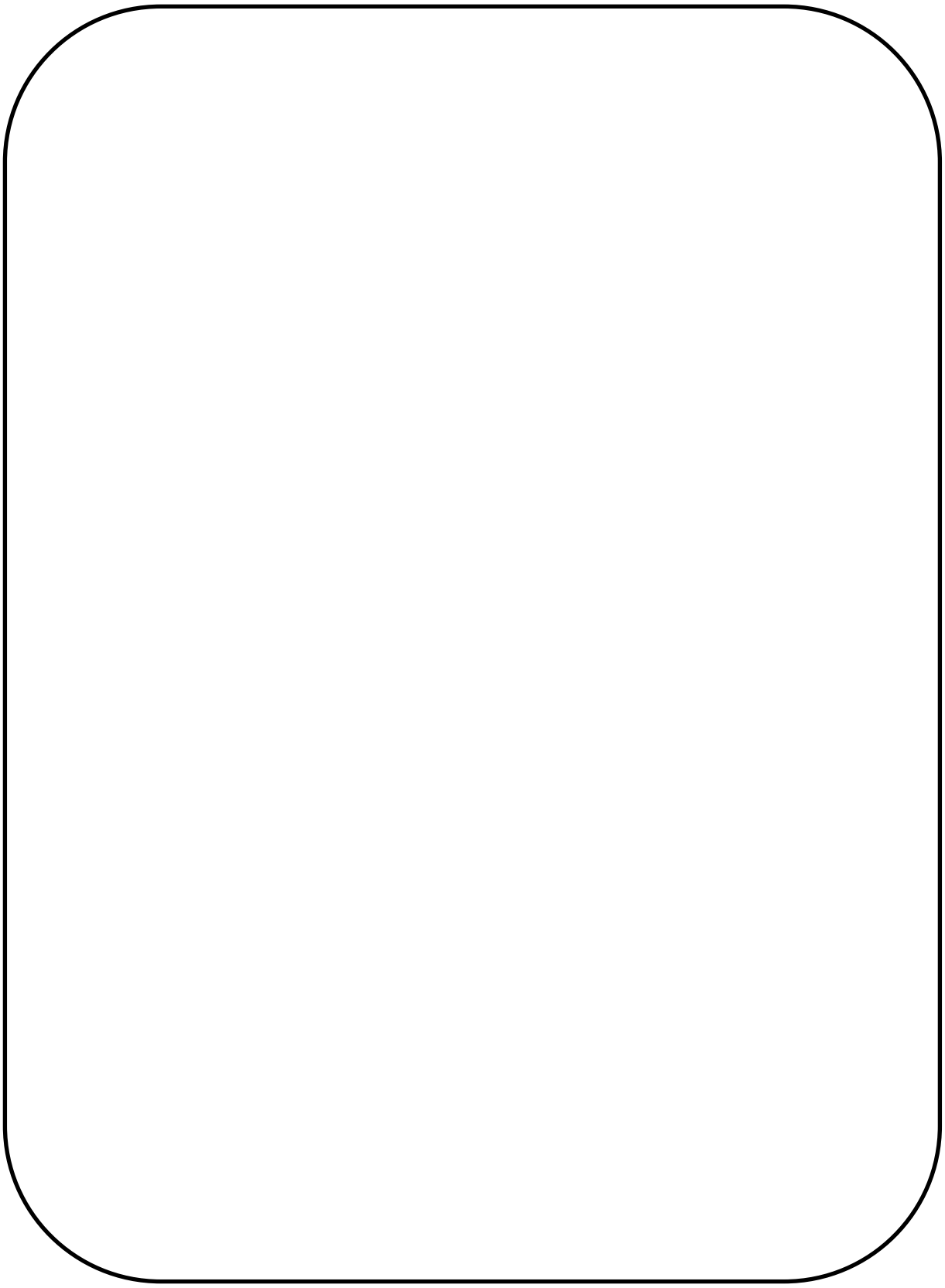
3. Which of my materials worked best?

4. How can I improve my toad abode?

5. How could I make it bigger to fit a friend in with my toad?

6. How could I make it more resistant to drying out?

Optimizing after Scientific Tests: Third sketch of toad abodes



Testing Built Toad Abodes 2nd Trial

1. Did my toad fit into the toad abode?

2. Did my toad stay damp?

3. Which of my materials worked best? How do I know?

4. How can I improve my toad abode?
   Example: Could I make it bigger to fit a friend in with my toad? Could I make it more resistant to drying out to keep my toad damp if it was hotter and drier for longer?

Reflection and Assessment

I used to think:

But now I know:

Reflection and Assessment

I used to think:

But now I know:

Reflection and Assessment

I used to think:

But now I know:

Name: _____

What is the best material to build a Toad Abode from? Use evidence from your Toad Abode investigations.

Write the claim to answer the question:

_____

_____

_____

Evidence: Write or draw evidence to support your claim.

Rubric: Claim and Evidence for Toad Abode

K-2-ETS1-3 Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

	Score of 4	Score of 3	Score of 2	Score of 1
Organizing Data	The student uses graphical displays (e.g., tables, pictographs, line plots) to organize the data from tests of materials, including data about the features and relative performance.	With guidance, the student uses graphical displays to organize data from tests of materials, including data about the features and relative performance.	With significant guidance, the student attempts to use graphical displays to organize data from tests of materials, including data about the features and relative performance.	The student needs substantial support and guidance to use graphical displays to organize data from tests of materials, including data about the features and relative performance.
Identifying Relationships	The student effectively uses their organization of the data to find patterns, accurately identifying how each of the objects performed relative to the other object and the intended performance. They also demonstrate a clear understanding of how various features of the objects relate to their performance.	With guidance, the student mostly uses their organization of the data to find patterns, identifying how each of the objects performed relative to the other object and the intended performance. They also demonstrate some understanding of how various features of the objects relate to their performance.	With significant guidance, the student attempts to use their organization of the data to find patterns, but may struggle to accurately identify how each of the objects performed relative to the other object and the intended performance. They also demonstrate limited understanding of how various features of the objects relate to their performance.	The student needs substantial support and guidance to identify patterns in the data, struggling to understand how each of the objects performed relative to the other object and the intended performance. They also struggle to identify how various features of the objects relate to their performance.
Interpreting Data	The student effectively uses the patterns found in object performance to describe the way each object will solve the problem, the strengths and weaknesses of each design, and determine which object is better suited to the desired function when both solve the problem.	With guidance, the student mostly uses the patterns found in object performance to describe the way each object will solve the problem, the strengths and weaknesses of each design, and determine which object is better suited to the desired function when both solve the problem.	With significant guidance, the student attempts to use the patterns found in object performance to describe the way each object will solve the problem, the strengths and weaknesses of each design, and determine which object is better suited to the desired function when both solve the problem.	The student needs substantial support and guidance to describe the way each object will solve the problem, the strengths and weaknesses of each design, and determine which object is better suited to the desired function when both solve the problem.

***This assessment shows student progress towards achieving the full standard**