UNIT

Building for Birdie

Grade Levels: K-2

In this design challenge and ELA unit, student teams will apply knowledge of shapes to build a bird home that is structurally sound. Students will compare and contrast how their designs solve the problem. During the extension, they will iterate on their designs and improve them to withstand the wind. For the final assessment, students will do a team presentation.

Grade Levels: K-2

Duration: 150 min

Concepts/Skills

Compare and contrast, shapes, structure, engineering design, ornithology, habitats

Objectives

Students will:

- Design and build a home for a displaced bird.
- Identify and explain how shapes are used for stability in a structure.
- Compare and contrast bird home examples and models.

Unit Plan

This unit plan is designed to be adaptable to any situation or setting. The unit includes a detailed lesson plan, an extension activity, and supplementary resources for authentic assessment. Adjust the timing to suit your needs.

Building for Birdie Lesson

In this design challenge, students design a bird home which is stable enough to be moved around a "Wildlife Center." They will compare and contrast their solutions and use of shapes in their designs.

Frame the Challenge	**15 min total**
Activate Prior Knowledge	5 min
Introduce the Scenario	10 min
Design Challenge	**45 min total**
Introduce the Design Challenge	5 min
Prototype (Build and Test)	20 min
Share Solutions	15 min
Debrief	5 min

Wind Iteration Extension

Students will iterate and improve on their bird home designs. They will build and test a home with a new desired feature: They must make it stable against the wind.

Introduce the Extension	5 min
Prototype (Build and Test)	15 min
Sharing	10 min

Authentic Assessment

Students will act as wildlife veterinarians and present their designs to each other, explaining how the shapes in the design make it stable and how it compares to a real bird home.

This lesson is written to pair with **English Language Arts** standards around the concept of compare and contrast. To strengthen this connection, you might support students to build and practice these skills in the following ways.

Before this lesson students can practice their skills comparing and contrasting by looking at animal homes in books or their environment. Have students consider questions such as:

- *What kinds of houses do animals like squirrels, mice and birds have?*
- *How are animal homes like human homes? How are they different?*

Concurrently with this lesson, students can research and explore real bird homes to compare and contrast key features, including how they withstand wind. They can then apply this information to their iteration in the extension.

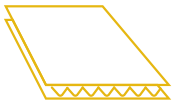
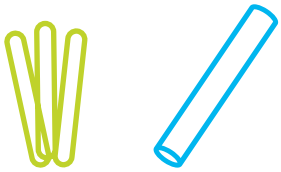
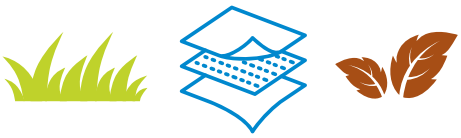
Materials and Preparation

Materials

Choose a couple items from each category. Don't limit yourself to the items on this list. Use whatever you have on hand.

Per class of 32

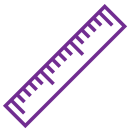
Structural Supplies *(~100 total)*	Cushion/Filler items *(~100 total)*	Connectors *(~100 total)*
☐ Cardboard pieces ☐ Coffee stirrers ☐ Craft sticks ☐ Paper towel/cardboard rolls ☐ Sticks	☐ Cotton balls ☐ Fabric (small scraps, socks etc) ☐ Foam pieces ☐ Grass, straw, leaves, feathers, etc.	☐ Twist ties ☐ Pipe cleaners (chenille stems) ☐ Rubber bands ☐ String ☐ Clothes pins ☐ Paper fasteners ☐ Hair ties ☐ Other natural materials (ex. mud, clay, grass)

Tip: Try to choose materials that challenge students to be creative (ex: avoid bowls or cups).

Test Area Supplies	Tools *(1 per group as age appropriate)*
☐ 1 table/desk ☐ Item to represent the bird: golf ball, tennis ball, small toy/figurine etc *(1 per team)*	☐ Scissors ☐ Hole punch ☐ Tape measure or ruler ☐ Tape (4-6 inches per team)



Tip: Beginning engineers may benefit from the fine motor practice of using tape. However, challenge advanced engineers to build without tape as it allows for faster iteration.

Adaptations for Beginning Engineers

- Create and distribute kits of materials for each team.
- Create a visual check-list of the materials provided in each kit. This checklist can be used to practice vocabulary, counting, sorting and provide a tool for clean-up and recycling of materials at the end of the activity.
- Provide students with 2-3 minutes to just explore the materials before starting the build time.

Materials Check-List

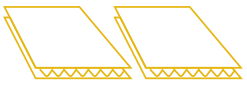

☐ 8 craft sticks


☐ 4 coffee stirrers


☐ 2 pipe cleaners


☐ 1 piece of fabric

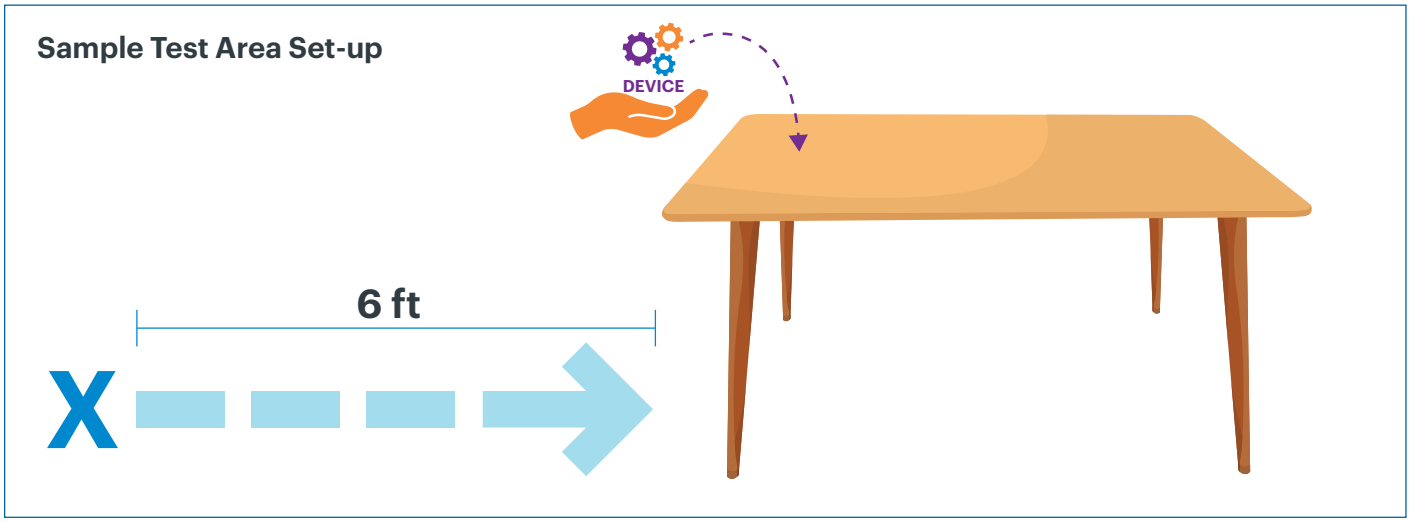

☐ 2 paper towel rolls


☐ 2 pieces of cardboard


☐ 2 rubber bands

Test Area Setup

1. Identify the area where students will need to transport their design during testing.
2. Choose a small surface (table/desk/chair) where teams will place their devices.
3. During testing, teams will carry their device approximately 6 ft to place it on this surface. Consider using tape to mark the starting point, and length of this path on the floor.
4. The testing site should be available throughout the build.
5. Each team will have their own "bird" to test with as they build.



Lesson Preparation

1. Try the challenge yourself and/or with other educators and students. This will give you practice with the materials and testing plan and help you to anticipate student questions.
2. Collect, organize and set up materials.
3. Set up the Test Area.

Adaptations for Distance Learning

When doing this lesson virtually, share the instructions with students and families ahead of time. Materials can be adapted to what students have around their home. For more tips on adapting Design Challenges to a virtual setting, see our Educator Tips for Remote STEM Learning.

Tech Tips

See our educator guides and videos for more design challenge facilitation techniques.
For this lesson check out:

- What is Engineering?
- Materials Strategies for Engineering Design

Frame the Activity

Activate Prior Knowledge *(5 min)*

- Lead a discussion to help students access prior knowledge about birds. For example:
  - *What kinds of homes do birds build? What are bird homes made out of?*
  - *How are bird homes like ours? How are they different?*
  - *What shapes do you notice in bird homes?*

Content Connections: Shapes

- If students are not familiar with 2D and 3D shapes, it may be useful to introduce these terms and definitions prior to this lesson.

Resources to Introduce and Frame the Challenge

- Picture books of birds and their homes:
  - "About Birds: A Guide for Children" by Cathryn Sill
  - "Mama Built a Little Nest" by Jennifer Ward (author) and Steve Jenkins (illustrator)
- Video example of building and iterating a bird home:
  - Peep and the Big Wide World, Chirp Builds a Nest
  - The first 4-5 minutes can introduce the problem of building a nest, while the remainder can be used to compare/contrast with their own designs later. In addition, have students look for examples of perseverance and collaboration.

Introduce the Scenario *(10 min)*

1. Read a book or show a video to engage students in the problem.
2. Next, explain that animals are sometimes **displaced**, or forced from their homes due to construction in growing communities. Ask:
   - *How else can animals be displaced?*
     - Responses may include: fire, flood, cutting down tree, another animal
   - *What could humans do to protect the animals living where humans want to build?*
3. Share the **design scenario/narrative** with students:

*Today we will be acting as **Wildlife Veterinarians**, people who take care of wild animals when they are sick or are displaced from their home. Wildlife centers take care of animals until they are ready to be released back to the wild. We will practice engineering by designing a temporary home for a recently displaced bird. It will stay there until it is ready to be released. The home will need to be **stable**, strong and able to stand on its own. It also has to stay together even if it needs to be moved to make room for more birds.*

Important!

Make sure students are aware that they should not move nests that they find on their own. In this challenge they are playing the role of professionals, but in their own lives, if they find a bird who has fallen out of a nest, or have a nest that is in an unsafe location, they should contact their local wildlife rescue group. See the Wildlife Education Rehabilitation Center (WERC) or Humane Society for more information.

Design Challenge

Introduce the Design Challenge *(5 min)*

1. Introduce the design problem, desired features and limitations.

Design Problem	Design and build a bird home that is strong enough to be moved.	
Criteria	• Your home must stay together when it is moved. • Protects the bird from falling out while being moved. • You should be able to name/identify the shapes in your design.	
Constraints	Time limit: 20 minutes	

2. Introduce students to the testing area. Have them consider: *The home needs to be moveable, so how will moving the home affect your design ideas?*
3. Explain the procedures students will follow for building, testing and sharing.
   - Encourage students to test throughout build time to help them iterate as they go.
4. If you have not already done so, group students into teams of 2-3.

Adaptations for Advanced Engineers

- Have them research a specific bird and build or modify their nest to meet its needs (ex: wingspan, size, weather, location, building materials). When testing, students should use a test "bird" that is appropriately sized. During share outs they should use evidence from their research to justify the features they included in their design.
- Students can research local birds or compare and contrast birds from around the world.
- If available, students can even monitor an existing bird nest and record their data using a tool like Nest Watch. Nest Watch is also an excellent resource for specifics on bird homes and habits and data collected by other citizen scientists.

Prototype (Build and Test) *(20 min)*

1. Before beginning prototyping, make sure students understand how to test their homes.
2. Distribute materials kits to students.
3. Set a timer to track the time limit.
   - Give students occasional reminders on time and desired features to help them monitor their own progress.
4. During the prototyping time, walk around and support teams.
   - Help students focus on the process, rather than on the success of their designs. If their design fails, ask them how many things they have tried, what they notice about what isn't working and what they might try next.
5. Ask open-ended questions to encourage students to reflect on their process.

   Prototype Questions:

   - *How does your design solve the problem?*
   - *What parts of your design help the home to be strong and stable?*
   - *What do you think will happen when you test?*
6. Encourage teams to test while they build.
7. Encourage them to collaborate with each other.
8. If teams feel like they are "done" use the **Challenge Cards** in the Appendix to keep them engaged.

Class Data Chart

Optional: Use a Data Chart like this example to track each team's test results. After teams share, compare and contrast the results, focusing on the shapes used, and their stability rather than the success of each team's solutions.

Class Testing Data	
Group name	Puffin Rockstars
Shapes in design	
Did the home stay together?	
Did the bird fall out?	

Share Solutions *(15 min)*

1. At the end of the time limit, learners stop building even if they haven't been able to complete a design.
2. Make sure all of the teams can see the testing area, taking turns testing/demonstrating their device before sharing their process.
3. Keep sharing simple and focused on what they did and why.

   Sharing Questions/Prompts:

   - *Tell us about your design.*
   - *Explain how the shapes in your design make it successful.*
   - *What changes would you make to your design based on your testing? What would you change if you had more time?*
   - *What inspired your design?*
4. Encourage students to give each other positive feedback on their designs.
   - Select an observing team to tell the presenting team one thing they liked or noticed about the design.
   - They can use a simple sentence frame:
     - *I liked that the design_____.*
     - *I wonder what would happen if_____.*

Content Connections: Compare and contrast with real bird homes

After students have built their designs, have them compare what they have built with real bird homes. Use some of the following resources to support this reflection.

- Refer back to any images, videos and books used to introduce the challenge.
- Use the **Bird Homes Student Handout**: See this resource in the Appendix for some examples of bird homes.

The Language of Compare and Contrast

Use sentence frames to help students compare and contrast their bird homes throughout the lesson. For example:

- **Compare**:
  - Both _____ and _____ have _____.
  - _____ are similar/alike because they both _____.
- **Contrast**
  - _____ has/is _____, but _____/is _____.
  - _____ and _____ are different because _____.

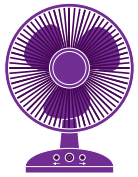
Debrief *(5 min)*

1. After students share their solutions, bring the conversation back to the engineering concepts and what they learned.
2. Lead a short discussion with some of these **Debrief Questions**:
   - *How were our designs similar? How were they different from each other?*
   - *What shapes are the same in many designs? Are there any shapes that no one used in their design?*
   - *How would our designs help keep real birds safe?*
   - *How do our designs compare to/contrast from real bird homes?*

Extension Materials

In addition to the building and testing materials from the initial design challenge, you will also need:

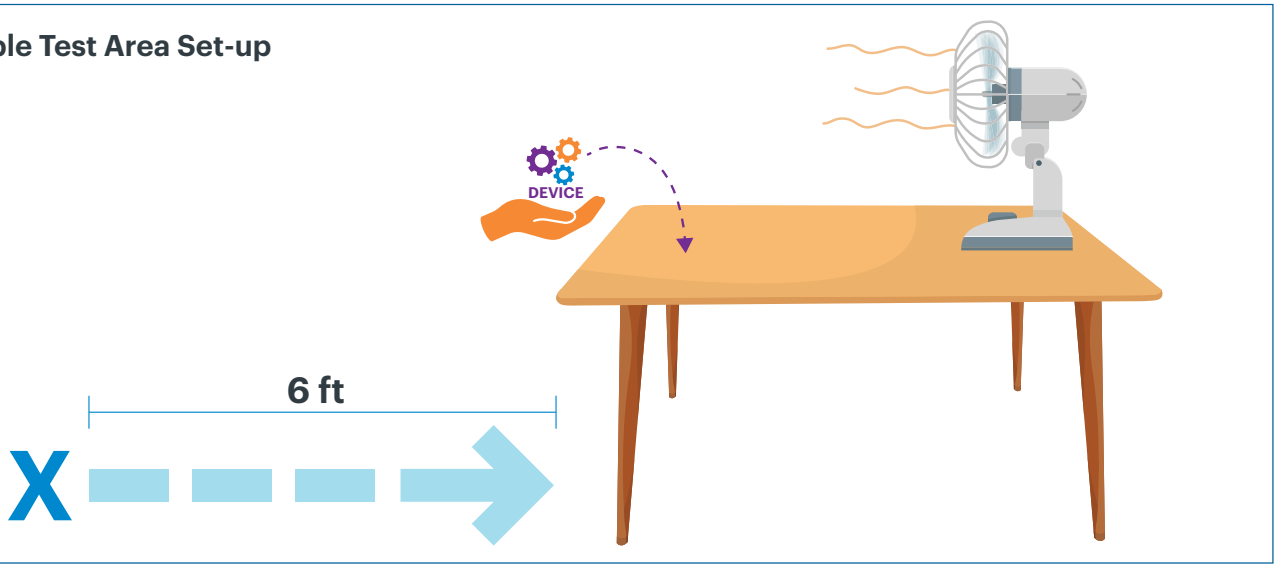
- ☐ Wind source (fan, hairdryer or folder)
- ☐ *Optional*: Timer



Extension Test Area Setup

1. Place a wind source at one end of the testing area.
2. Use a fan, hairdryer or folder to create wind to blow at the design for 20 seconds.
3. During testing, students can count or use a timer.

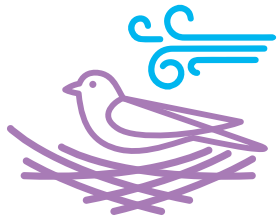
Sample Test Area Set-up



Introduce the Extension *(5 min)*

1. Iteration is an important part of the design process. With additional time, challenge students with a new desired feature.
2. First, have students draw from knowledge they have about the difficulties bird homes face in natural settings, like wind, rain, etc.
3. Next, have students use their Compare and Contrast skills to look at the homes of birds in windy places. For example: Puffins, albatrosses, cliff swallows.
   - *How are they different from other bird homes? How are they similar?*
   - *What shapes do they use?*
4. Introduce the new design scenario, problem and desired feature.

Design Scenario: *Another wildlife center wants to use your design but their location gets a lot of wind. Can you improve your design to protect the bird from the wind?*

New Design Problem	Improve your design to protect the bird from the wind.	
New Desired Features *(criteria)*	• The bird home must be stable against the wind. • Your home must stay together when it is moved. • Protects the bird from falling out while being moved. • You should be able to name/identify the shapes in your design.	
New Design Limitations *(constraints)*	Time limit: 15 minutes	

Prototype (Build and Test) *(15 min)*

1. Before beginning prototyping, make sure students understand how to test their homes by holding them in the wind for 20 seconds.
2. Use open ended **Prototyping Questions**:

Before testing
- *What new shapes did you use in your design to help the home be stable in the wind and protect your bird?*
- *Was your design inspired by something you have seen? How is your design similar? How is it different?*
- *What do you think will happen when you test?*

After testing
- *What will you change to make your design more stable/protective?* (unsuccessful test)
- *What other features can you add?* (successful test)

Share Solutions *(10 min)*

1. After students iterate on their designs, have them share and debrief again. In addition to the previous **Sharing Questions**, they can consider:
   - *What did you change? Why did you change _____?*
   - *What parts of your design help keep it stable and protect your bird in the wind?*
   - *How is your new design the same as your first design? How is it different?*

Debrief:
- *What do you notice is the same in all the models that withstood the wind?*
- *Was this feature different in the models that didn't withstand the wind?*

Next Generation Science Standards

Grades	Standard		Description
K-2	Performance Expectation	ETS1-2	**Engineering Design:** Develop a simple sketch drawing, or physical design to illustrate how the shape of an object helps it function as needed to solve a given problem.
K-2	Disciplinary Core Idea	DCI: ETS1.B	**Developing Possible Solutions:** Designs can be conveyed through sketches, drawings, or physical designs. These representations are useful in communicating ideas for a problem's solutions to other people.
K-2	Science and Engineering Practice	SEP	**Developing and Using Models:** Develop a simple design based on evidence to represent a proposed object or tool.
K-2	Cross Cutting Concept	CCC6	**Structure and Function:** The shape and stability of structures of natural and designed objects are related to their function(s).

Common Core State Standards

Grade	Standard	Description
1	RL1.9	Compare and contrast the experiences and adventures of characters.

Vocabulary

For more tips on vocabulary and common engineering terms, see our Tech Tip: The Language of Engineering.

- **Displace:** To force out of a home territory or particular place.
- **Iteration:** Remaking the object many times in different ways or remaking with a new part.
- **Rehabilitation:** To restore to good health.
- **Stable:** An object is stable when it can stand on its own and not be easily pushed over or fall apart.
- **Wildlife Center:** A place where sick, injured or orphaned wild animals are cared for before they are released back into the wild.
- **Wildlife veterinarian:** Someone who takes care of sick or injured wild animals.

Resources and References

1. Educator Tips for Remote STEM Learning, The Tech Interactive
2. "About Birds: A Guide for Children" by Cathryn Sill (author) and John Sills (illustrator), 2013
3. "Mama Built a Little Nest" by Jennifer Ward (author) and Steve Jenkins (illustrator), 2014
4. Video: Peep and the Big Wide World ep.17: chirp-builds-a-nest/
5. Wildlife Education Rehabilitation Center (WERC)
6. Humane Society
7. Nest Watch: https://nestwatch.org/
8. Cornell Lab of Ornithology: https://www.birds.cornell.edu/home

Handouts

Gila Woodpecker Nest

Bowerbird Home

Cliff Swallow Home

Bald Eagle Home

Baya Weaver Home

Sociable Weaver Home

Asian Paradise-flycatcher Home

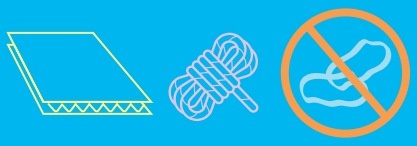
Puffin Home

Baya Weaver Home

Building for Birdie
Challenge Cards

Fewer Materials

Can you build your bird home with fewer materials?



Many Moves

Your bird home needs to move at least 5 times! Will it stay together?

Big Bird

Your bird has grown! Change your design for a bird that is larger.

Clean Up

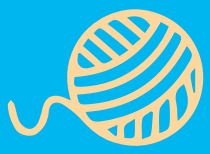
Sometimes baby birds make a mess. Change your design to be easily cleaned.

Peek-a-Boo

Make sure that the bird can be seen inside from across the room.

Bored Bird

Add something fun to your nest that the bird might play with or enjoy.

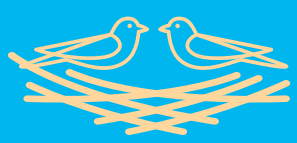


Rainy Day

Your bird home is being moved outside. Protect it from getting wet in the rain.

Two Birds

The wildlife veterinarian has more birds. Change your design to hold two birds.



Teacher's Choice

Authentic assessment opportunities help students to make connections between what they are learning and how those skills may be useful in a future situation or even in a career.

Use this assessment scenario to have students role-play what might happen after a design is finished and share their design process and knowledge of real bird homes and shapes.

Assessment Scenario:

You are a wildlife veterinarian working with the Wildlife Center of your community. You were asked to design a bird home that can be used for displaced birds that come to the center. You will present and explain your design to other wildlife experts at the facility.

The presentation must include the following:

- A **physical bird home model** and description of their bird's home
- An explanation of what **shapes** were used and how those shapes make it stable
- At least 2 ways that the design is **similar** to other class designs or bird homes
- At least 2 ways that the design is **different** from other class designs or bird homes

Tools Included for Assessment:

- ☐ Team Presentation Plan
- ☐ Performance Assessment Checklist
- ☐ Rubrics

Team Name: _____

1. Introduce your team.

_____, _____, _____

Name *Name* *Name*

2. Describe your design.

Our design is a good home for a bird, because

_____

_____

3. We used _____

Draw/write the shapes you used.

4. Tell how these shapes helped your design be stable and protect your bird.

_____

_____

5. Tell how your design is the same as bird homes you saw in pictures, books or videos. Give 2 ways:

• Both my design and the other bird homes have

• My design and the other bird homes are also alike because they both

6. Tell how your design is different from bird homes you saw in pictures, books or videos. Give 2 ways:

• My design and the other bird home are different because

• My design has/is

but the other bird home has/is

Team: _____ **Date:** _____

Student names: _____

As students present their design as wildlife veterinarians for the Wildlife Center of your community, use the following checklist to assess student engineering learning. These items align directly to the rubric.

Assessment Presentation

☐ Describes **model** of a bird's home they built
- *How is your design a good home for a bird?*

☐ References **shape** accurately
- *What is one shape you used in your design?*

☐ Explains how shape affects **stability** and reason makes sense.
- How do the shapes in your design make it stable?

☐ Comparison: Gives at least 2 accurate **similarities** to other designs.
- How is your design the same as other designs?

☐ Comparison: Gives at least 2 accurate **differences** from other designs.
- How is your design different from other designs?

Wind Iteration

☐ Explains how the design withstood wind (or could be changed to withstand wind) and reason makes sense:
- *How does the shape of your design help keep it stable in the wind?*

Next Generation Science Standards Performance Expectation

- **K-2-ETS1-2:** Develop a simple sketch drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

	Below Standard	Approaching Standard	Meeting Standard	Above Standard
NGSS DCI **ETS1.B: Developing Possible Solutions:** Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.	*Areas that a student may need one-on-one support with:* • Clearly describing how their design functions. • Identifying the cause of design's failure/difficulty. • Persevering. Not giving up/ quitting too soon. • Making improvement decisions based on the cause of failure.	• Physical model and student description of a bird's home does not clearly convey the ideas behind the design. *Areas to strengthen might include:* • Identifying which desired features a design is not meeting based on failure points. • Identifying failure points as a decision point for what to try next (rather than starting all over from scratch).	• Physical model and student description of a bird's home clearly convey the ideas behind the design even if the physical model is not quite complete.	*Areas where a student may exceed:* • Uses adjectives or many details to describe their design to someone else. *Ideas for next steps for growth:* • Draw and label a diagram of the design that was built.
NGSS SEP **Developing and Using Models:** Compare models to identify common features and differences.	*Areas a student may need one-on-one support with:* • Understanding how to make comparisons. • Language development for making comparisons.	• Gives at least 1 similarity to another design and 1 difference to another design or gives multiple similarities and differences that are not accurate. *Areas to strengthen might include:* • Noticing what characteristics might be similar or different.	• Gives at least 2 accurate similarities to other designs and 2 accurate differences from other designs.	*Areas where a student may exceed:* • Gives many similarities and differences between models. • Draws patterns of similarities that lead to success or failure. *Ideas for next steps for growth:* • Challenge students to come up with categories for different models particularly as they relate to bird protection/ shapes and stability.
NGSS CCC **Structure and Function:** The shape and stability of structures of natural and designed objects are related to their function(s).	*Areas that a student may need one-on-one support with:* • Reviewing 2-D and 3-D shape names • Practice identifying shapes in the natural world • Language development/ sentence frames for explaining how shapes relate to function.	• Accurately identifies at least 1 shape used in their model. • Explanation of how the shape of the structure is related to its function is unclear or is unrealistic. *Areas to strengthen might include:* • Experimenting with different shapes and comparing how well each stands on its own/ withstands wind. • Discussing the advantages of different shapes for different uses.	• Accurately identifies at least 1 shape used in their model. • Gives a reasonable explanation of how the shape of the structure is related to its function (how shape allows it to be stable while moved or to withstand wind).	*Areas where a student may exceed:* • Accurately identifies multiple shapes in their model and shows deep understanding for how multiple shapes relate to multiple functions of their model. *Ideas for next steps for growth:* • Challenge students to add a new feature that uses a shape. How does this new shape make the design better?

Building for Birdie
Assessment Rubric and Self-Reflection

Review your student's progress on the following tasks and ask them to reflect on their work and their mindsets.

Next Generation Science Standards Performance Expectation

- **K-2-ETS1-2:** Develop a simple sketch drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

	Task *Highlight or circle what was completed or observed*	Score		
		?	✓	★
Sharing ideas	The student described their design of a bird's home clearly so that others could understand their ideas, even if the model was not finished.			
Comparing Designs	The student shared at least 2 ways that their design is the same as other designs and 2 ways it is different from other designs.			
Using Shapes	The student named at least 1 shape used in their design.			
	The student explained how the shape of the design made it stable or not, even in the wind.			
	Overall Score			

Notes from the student:	**Notes from the educator:**

Student Self-Reflection

Ask the student to circle the face that shows how they feel about each question.

BOLD: Did you try new things?	? ✓ ★	PERSEVERANT: Did you keep trying even when it was not easy?	? ✓ ★	COLLABORATIVE: Did you work as a team?	? ✓ ★
CURIOUS: Did you ask questions today?	? ✓ ★	EMPATHETIC: Did you listen to others?	? ✓ ★	Did you enjoy this activity?	? ✓ ★
Which one of the mindsets above do you want to practice more? How will you practice it?					