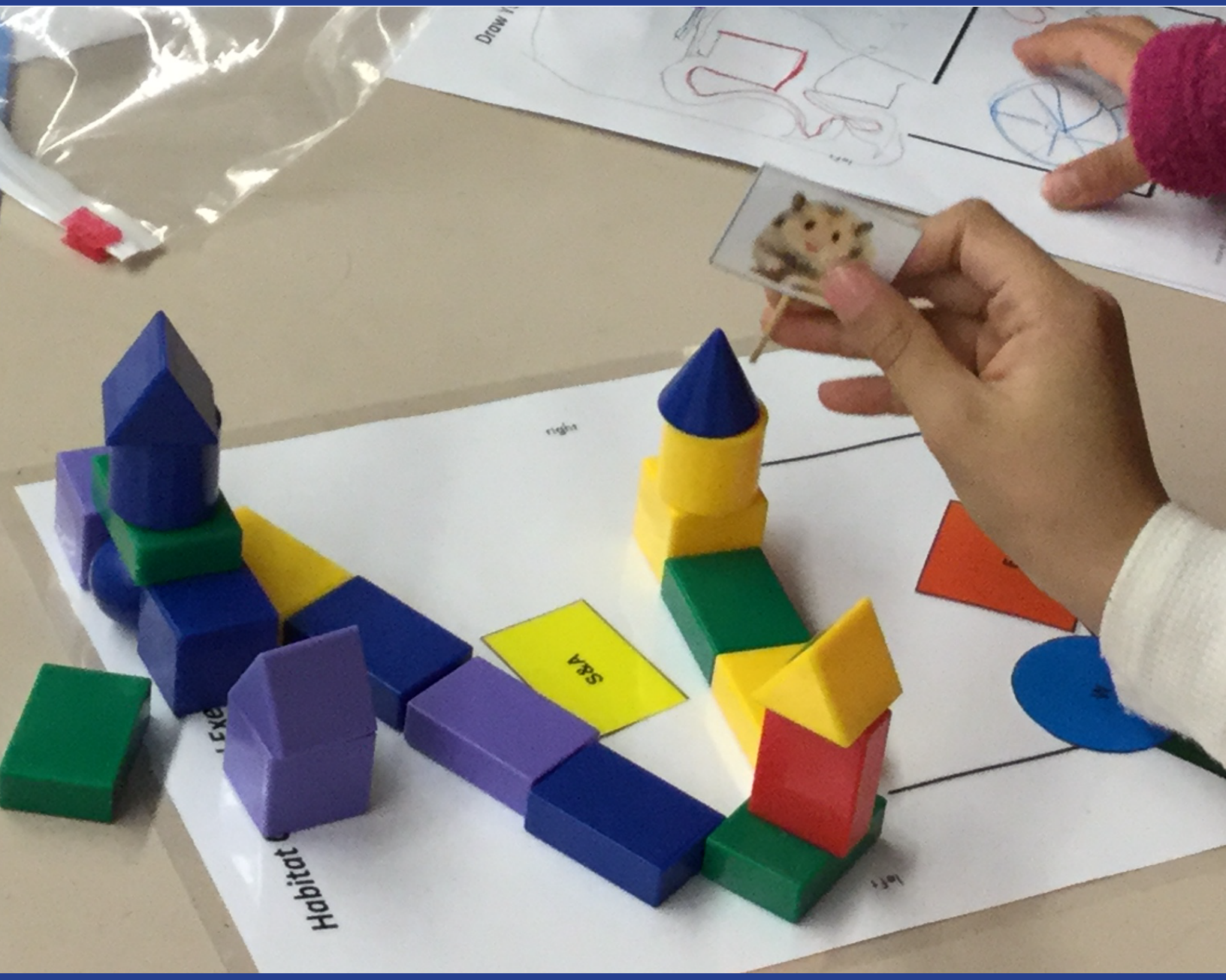
PictureSTEM

Designing Hamster Habitats



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INSPIRE
Research Institute for Pre-College Engineering

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About PictureSTEM
The PictureSTEM Project includes an instructional unit at each grade level, K-2, which employs engineering and literary contexts to integrate science, technology, mathematics, and computational thinking content instruction in meaningful and significant ways. These transformative new models for STEM+C (science, technology, engineering, mathematics, and computational thinking) learning use picture books and an engineering design challenge to provide students with authentic, contextual activities that engage learners in specific science, mathematics, and computational thinking content while integrating across traditional disciplinary boundaries. These units have been classroom tested and research has been published and is ongoing regarding student learning and teacher implementation in the classroom.

To learn more about the PictureSTEM Project and to view additional integrated STEM units, contact us:

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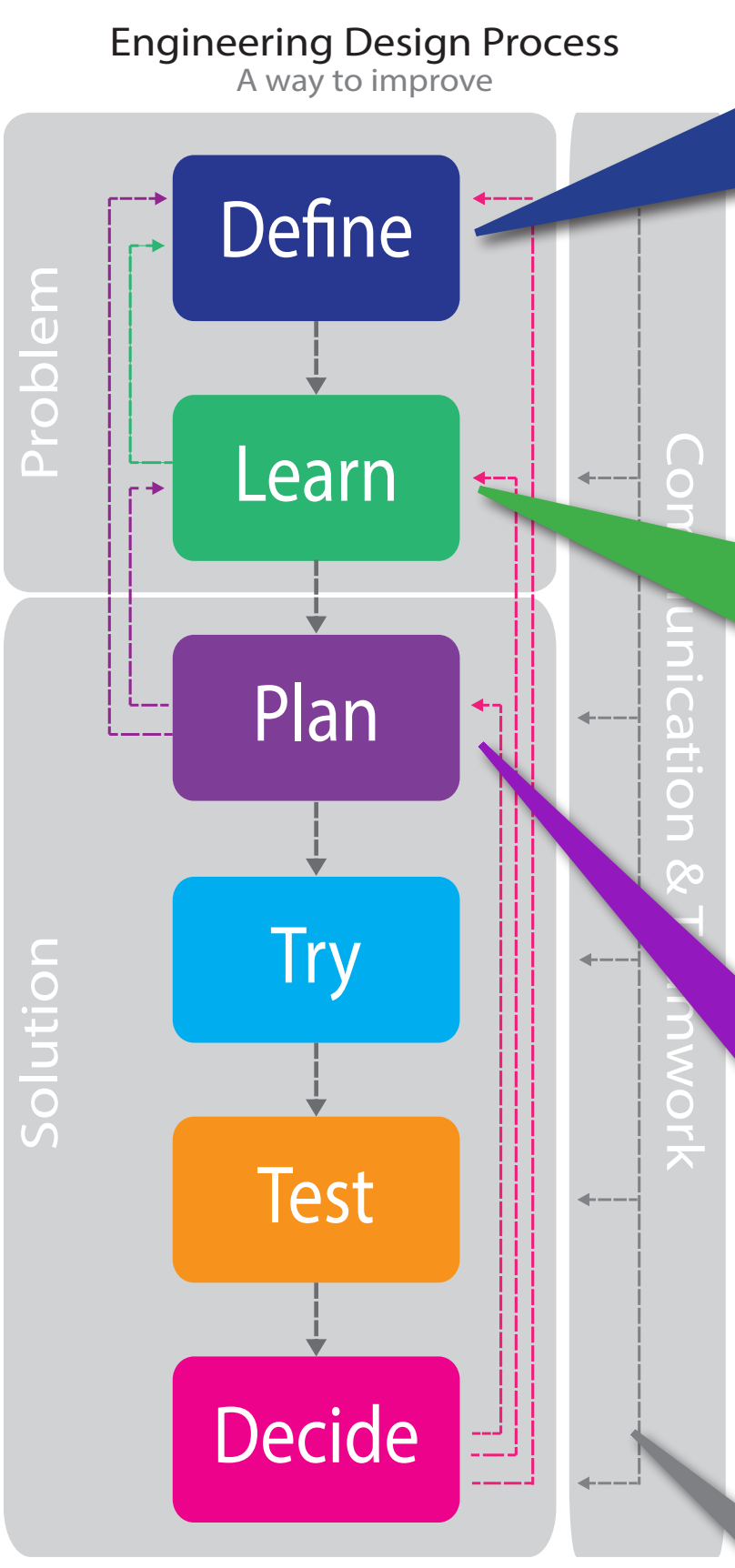
Overview: Engineering Design Process



DEFINE THE PROBLEM

- Who is the **client**?
- What does the client need?
- Why does the client need it?
- Who is the **end user**?
- Why might the end user want it?
- What are the **criteria** (requirements and limits) of the solution?

Problem Scoping:
WHO needs **WHAT** because **WHY**

LEARN ABOUT THE PROBLEM

- What kind of background knowledge is needed?
  - What science/math knowledge will be needed?
  - What materials will be needed?
- What has already been done to solve the problem?
- What products fill a similar need?
- How should we measure success and improvement?

PLAN A SOLUTION

- Continue to specify the criteria
- Generate ideas of possible solutions
- Develop multiple solution paths
- Consider **trade-offs** (criteria that compete with one another)
- Choose a solution to try
- Develop plans (blueprints, schematics, cost sheets, storyboards, notebook pages, etc.)

COMMUNICATION

- Communicate the solution clearly and make sure it is easily understandable
- Use **evidence** to support why the client should use your solution

Overview: Engineering Design Process

TRY A SOLUTION

- Put the plan into action
- Consider risks and how to optimize work
- Use criteria and consider trade-offs from the problem/plan to build a **prototype** (a testable representation of a solution), **model**, or **product**

TEST A SOLUTION

- Consider testable questions or hypotheses
- Develop experiments or rubrics to determine if the solution is meeting the stated criteria and needs
- Collect and analyze data

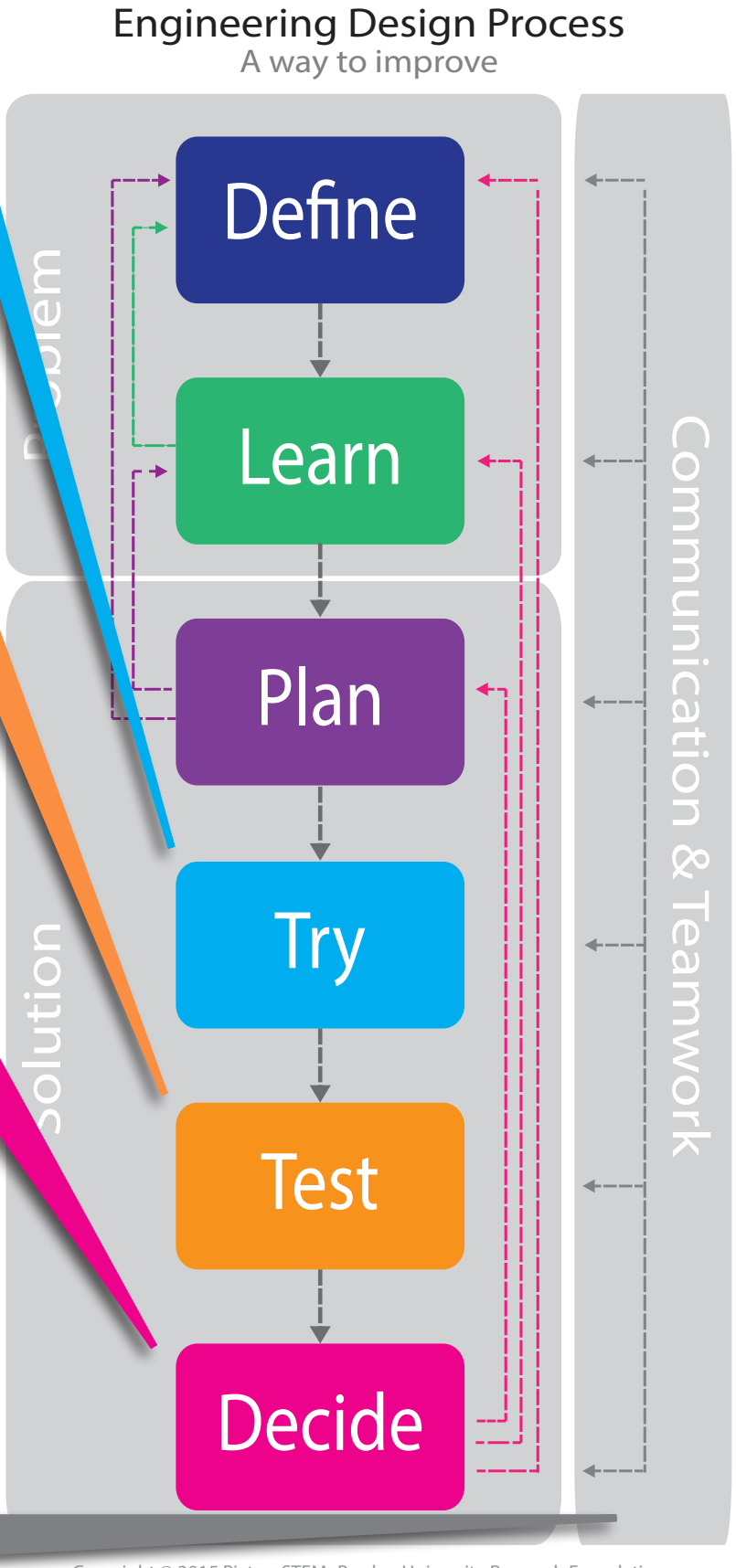
DECIDE IF THE SOLUTION IS GOOD ENOUGH

- Are users able to use the design to help with the problem?
- Does the design meet the criteria?
- How could the design be improved based on test results and feedback from the client/user?

Iterative nature of design: Always consider which step should be next!

TEAMWORK

- Discuss in teams how the solution meets the criteria and needs of the client
- Consider different viewpoints from each teammate



Overview: Unit Description

Grade Levels

K-2

Approximate Time Needed to Complete Unit (see unit overview for breakdown)

Introduction: one 45 minute class period
Literacy: six 40-45 minute class periods
STEM+C: six 45-90 minute class periods

Unit Summary

Perri's Pet Palace wants to offer its customers a new pet habitat that meets all of the basic needs of a hamster. In this unit, students learn about animals' basic needs and explore characteristics of two- and three- dimensional shapes before applying them to design an artificial hamster habitat.

Science Connections	Technology & Engineering Connections	Mathematics Connections
Learn about animals, habitats and basic needs, compare designed and natural systems, conduct fair tests	Create a habitat design plan, follow the engineering design process	Identify characteristics of basic shapes, compose and decompose objects

Standards Alignment

Next Generation Science Standard

- **K-2-ETS1-1:** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
- **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.
- **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.
- **K-ESS2-2**: Construct an argument supported by evidence for how plants and animals (including humans) can change the environment to meet their needs.
- **K-ESS3-1**: Use a model to represent the relationship between the needs of different plants or animals (including humans) and the places they live.
- **4-LS1-1 (LS1.A)**: Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
- **2-LS4-1**: Make observations of plants and animals to compare the diversity of life in different habitats.

Common Core State Standards - Mathematics

- **1.G.A.1**: Distinguish between defining attributes (e.g., triangles are closed and three-sided) versus non-defining attributes (e.g., color, orientation, overall size); build and draw shapes to possess defining attributes.
- **1.G.A.2**: Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape.

Standards Alignment

Common Core State Standards - Mathematics

- **1.OA.A.1**: Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.
- **MP2**: Reason abstractly and quantitatively.

Common Core State Standards - English/Language Arts

- **SL.K.1**: Participate in collaborative conversations with diverse partners about first grade topics and texts with peers and adults in small and larger groups.
- **SL.K.6:** Speak audibly and express thoughts, feelings, and ideas clearly.
- **RL.1.2**: Retell stories, including key details, and demonstrate understanding of their central message or lesson.
- **RL.1.3**: Describe characters, settings, and major events in a story, using key details.
- **RL.1.4:** Ask and answer questions to help determine or clarify the meaning of words and phrases in text.
- **RL.1.5:** Explain major differences between books that tell stories and books that give information, drawing on a wide reading of a range of text types.
- **RL.1.7:** Use illustrations and details in a story to describe its characters, setting, or events.
- **RL.1.9:** Compare and contrast the adventures and experiences of characters in stories.
- **L.1.1.I:** Use frequently occurring prepositions (e.g., during, beyond, toward).
- **RI.1.1:** Ask and answer questions about key details in a text.
- **RI.1.2:** Identify the main topic and retell key details of a text.
- **RI.1.3:** Describe the connection between two individuals, events, ideas, or pieces of information in a text.

CSTA Standards

- **1A-A-5-3**: Plan and create a design document to illustrate thoughts, ideas, and stories in a sequential (step-by-step) manner (e.g., story map, storyboard, sequential graphic organizer).
- **1A-A-3-7**: Construct and execute algorithms (sets of step-by-step instructions) that include sequencing and simple loops to accomplish a task, both independently and collaboratively, with or without a computing device.

Overview: Unit Description

Standards Alignment - Indiana State Standards

Science Standards

- **SEPS.1:** Posing questions (for science) and defining problems (for engineering).
- **SEPS.2:** Developing and using models and tools.
- **SEPS.8:** Obtaining, evaluating, and communicating information.
- **1.LS.2:** Develop a model mimicking how plants and/or animals use their external parts to help them survive, grow, and meet their needs. Explore how those external parts could solve a human problem.
- **1.LS.4:** Use a model to represent the relationship between the needs of different plants and animals (including humans) and the places they live.
- **K-2-ETS1-1:** Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.
- **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.
- **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.

Mathematics Standards

- **PS.2:** Reason abstractly and quantitatively.
- **1.CA.2:** Solve real-world problems involving addition and subtraction within 20 in situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all parts of the addition or subtraction problem (e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem).
- **1.G.2:** Distinguish between defining attributes (e.g., triangles are closed and three-sided) versus non-defining attributes (e.g., color, orientation, overall size); build and draw shapes to possess defining attributes.
- **1.G.3:** Use two-dimensional shapes (rectangles, squares, trapezoids, triangles, half circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape.

English/Language Arts Standards

- **1.RL.2.2:** Retell stories, fables, and fairy tales in sequence, including key details, and demonstrate understanding of their central message or lesson.
- **1.RL.2.3:** Using key details, identify and describe the elements of plot, character, and setting.
- **1.RL.4.1:** Use illustrations and details in a story to describe its characters, setting, or events.
- **1.RL.4.2:** Compare and contrast the adventures and experiences of characters in stories.
- **1.SL.1:** Participate in collaborative conversations with diverse partners about grade-appropriate topics and texts with peers and adults in small and larger groups.
- **1.RN.2.1:** Ask and answer questions about key details to clarify and confirm understanding of a text.
- **1.RN.2.2:** Retell main ideas and key details of a text.
- **1.RN.2.3:** Describe the connection between two individuals, events, ideas, or pieces of information in a text.
- **1.RV.2.1:** Demonstrate understanding that context clues (e.g. words and sentence clues) and text features (e.g. glossaries, illustrations) may be used to help understand unknown words.

Standards Alignment - Indiana State Standards

Computer Science Standards

- **K-2.PA.3:** Arrange information using concept mapping tools and a set of statements that accomplish a simple task.

Overview: Lesson Summaries

Introduction Lesson - Defining the Problem: In this introductory lesson, students are introduced to the problem through email interactions with their client, Perri. They have the opportunity to explore the engineering design process, ask questions of their client, help their client define the problem to be solved and identify the criteria of the problem to be solved.

Lesson 1A - Nibble's Guide to Caring for Your Hamster: In this literacy lesson, students are introduced to hamsters as they build background knowledge about how hamsters live by reading *Nibble's Guide to Caring for Your Hamster* by Anita Ganeri - an informational text told from the perspective of a hamster. The focus of this lesson is on the basic needs of animals. Students learn about the things that animals need to survive – food, water, shelter and space/air. This lesson sets the context for the engineering design challenge in which they have to design a habitat for their hamsters which provides for their hamsters' basic needs. Reading strategy: main ideas from informational text.

Lesson 1B - Animals and Their Basic Needs: In this STEM+C lesson, students learn that animals have different physical characteristics such as fur, wings, scaly skin and fins which help to categorize them into specific groups. This lesson builds upon Lesson 1A, by first introducing students to a sorting activity in which they identify animals based on their physical characteristics, with the goal of distinguishing specific animal groups. The students then sort animals based on their basic needs of food and shelter, which helps build background knowledge for the engineering design challenge in which students have to design a habitat that provides for their hamsters' basic needs.

Lesson 2A - I See a Kookaburra!: In this literacy lesson, students explore animals in their natural habitats through reading *I See a Kookaburra!: Discovering Animal Habitats Around the World* by Steve Jenkins & Robin Page. In the previous lesson, students learned that animals have different physical characteristics such as those with fur, wings, scaly skin and fins, as well as that the habitat of an animal provides it with food and other basic needs. This activity builds on this knowledge by helping students identify where animals get their food, water, shelter, space and air in their natural habitat. Reading strategy: making connections.

Lesson 2B - Help Me Find My Home: In this STEM+C activity, students learn that every hamster has basic needs which can be found in suitable habitats. In order to place a hamster in its habitat, therefore, it is important for students to identify the basic needs an animal should expect to find in its habitat. This will ensure that the animal is safe and healthy in the habitat it is placed. This activity helps to build students' understanding of previous lessons on animals' physical characteristics, basic needs and how these relate to their habitats. This will prepare students for the final engineering challenge where they design a hamster habitat that ensures the basic needs of the hamster are met.

Lesson 3A - The Greedy Triangle: Through this literacy lesson, students will learn about the basic shapes: 3-sided (triangle), 4-sided (quadrilateral), and 5-sided (pentagon) by reading *The Greedy Triangle* by Marilyn Burns. This story is about an unhappy triangle who visits a shape shifter to add sides and angles to become a new shape. This lesson builds background knowledge and sets the stage for the related STEM activity (Lesson 3B). Reading strategy: comprehension monitoring - questioning.

Lesson 3B - Exploring Animals and Tangrams: In this STEM+ C lesson, students build upon their knowledge and understanding of concepts about 2D shapes (triangle, square and parallelogram) in order to sort objects in a set of tangrams based upon the characteristics that they learned in the related literacy activity (number of sides, picture and name). Students work to exhibit fluency in naming these shapes appropriately and translating and rotating these shapes as they create different tangram animals with the shapes. This background knowledge is needed to both develop the algorithm in Lesson 4B and to set up the use of 3D shapes in Lesson 5B.

Lesson 4A - Joey and Jet: In this literacy lesson, students work on prepositions and sequencing in a story using the book *Joey and Jet* by James Yang. This book takes students through a game of fetch from the perspective of the dog, Jet. Students sequence the actions from the story, reverse the sequence, and learn preposition words to use when giving directions to Perri on how the hamster will move through the exercise trail. Reading strategy: sequencing to help retell events of the story.

Lesson 4B - Algorithms with Tangrams: This STEM+C lesson ties into the work with tangrams and sequencing in the previous lessons as students are introduced to the concept of algorithms. Students use their knowledge of both sequencing and tangrams to develop algorithms to make basic tangram shapes. As part of the design requirements for Perri, students will develop an algorithm to give to Perri that helps Perri and her customers understand how a hamster will use the habitat they designed.

Lesson 5A - Pop! The Invention of Bubble Gum: This literacy lesson transitions from science and mathematics learning of earlier lessons into engineering, with a focus on testing in engineering and that engineers often fail and learn from that failure, by reading the narrative nonfiction book *Pop! The Invention of Bubble Gum* by Meghan McCarthy. Students learn about the invention of bubble gum and how the inventor tested his different mixtures and learned from each of the failures before he got it right. This lesson helps set the context for why it is important to test materials before designing, which leads into the Lesson 5B activity titled "The Importance of Testing," where students test their shapes with the "stackability" and "flickability" tests. Reading strategy: finding "juicy" words (identifying new words).

Lesson 5B - The Importance of Testing and Planning: This STEM+C lesson draws on the bubble gum story and the idea of why it is important to test designs before they are sold or sent for production in order to have students test the shapes that they will use in their final hamster habitat prototype designs. In this lesson, students will perform the "stackability" and "flickability" tests to build background knowledge about three-dimensional shapes that they will use in their designs for their hamster exercise trails. Students will also start working on their engineering design challenge of making a hamster exercise trail by completing the individual brainstorming and group planning steps of an engineering design process.

Lesson 6A - The Perfect Pet: This literacy lesson sets the context for the engineering design process by introducing a fictional story, *The Perfect Pet* by Margie Palatini, an amusing story about a girl trying very hard to persuade her parents to let her have a pet, whose needs are her parents' reasons for not getting the pet. This sets up a discussion with the children about a pet hamster's needs, allowing them to use what they learned earlier in the unit while at the same time setting up the engineering design challenge of creating a habitat trail that would meet the hamster's needs. Reading strategy: identifying important details.

Lesson 6B - Designing a Hamster Habitat and Exercise Trail: This STEM+C lesson ties to the *Perfect Pet* story by giving students the opportunity to build and test a hamster habitat and exercise trail. In this lesson, students will apply the science, mathematics, and computational thinking knowledge that they have learned in previous lessons to help them build a habitat for their imaginary pet hamster. They build this hamster habitat and exercise trail using 3D shapes and will need to identify where the habitat provides for their hamster's basic needs using the 2D markers. They will describe how the hamster moves through the trail by making an algorithm. After designing the habitat, they will have the opportunity to share their designs with the class followed by a redesign of their habitats.

Overview: Unit Overview

Lesson	Activity Type	Time Needed	Materials
Introduction: Defining the Problem	STEM	45 min	• **Per student:** Engineering Design Process Slider & jumbo paperclip • **Per class:** chart paper (3), markers, Perri's first email, Perri's second email, Engineering Design Process Slider Poster & paper clip, Velcro
1A: *Nibble's Guide to Caring for Your Hamster*	Literacy	45 min	• **Per student:** Animal Topic Map graphic organizer • **Per class:** *Nibble's Guide to Caring for Your Hamster*, large copy of Animal Topic Map
1B: Animals and Their Basic Needs	STEM	45 min	• **Per pair:** set of animal cards, set of Animals and their Basic Needs sorting placemats (3) • **Per class:** Hamsters' Basic Needs list
2A: *I See a Kookaburra!*	Literacy	45 min	• **Per student:** Making Connections graphic organizer • **Per class:** *I See a Kookaburra!: Discovering Animal Habitats Around the World,* Hamsters' Basic Needs list
2B: Help Me Find My Home	STEM	50 min	• **Per student:** Help Me Find My Home Assessment • **Per pair:** deck of animal cards, 2D basic needs shapes, set of "Can You Help Me Find My Home?" habitat placemats (4)
3A: *The Greedy Triangle*	Literacy	45 min	• **Per student:** Thinking about *The Greedy Triangle* worksheet • **Per class:** *The Greedy Triangle*, Shapes in *The Greedy Triangle* Chart
3B: Exploring Animals and Tangrams	STEM	60 mins	• **Per student:** Tangrams, Magic Shapes tangram placemats (4 different levels, 4 animals) • **Per class:** Shapes in *The Greedy Triangle* Chart, *Three Pigs, One Wolf, and 7 Magic Shapes*, large version of duck tangram, Tangram Oral Checklist Educator Resource
4A: *Joey and Jet*	Literacy + CT	45 min	• **Per student:** Flowchart-Jet Chase and Flowchart-Jet Returns placemats, set of preposition cards, dry erase marker • **Per class:** *Joey and Jet*, Flowchart-Jet Chases
4B: Algorithms with Tangrams	STEM + CT	60 min	• **Per student:** Tangram Mat, Develop Your Own Algorithm worksheet, tangrams • **Per class:** Shapes in *The Greedy Triangle* Chart, Algorithm List Educator Resource
5A: *Pop! The Invention of Bubble Gum*	Literacy	45 min	• **Per student:** My Juicy Words graphic organizer • **Per class:** *Pop! The Invention of Bubble Gum,* chart paper
5B: The Importance of Testing and Planning	STEM	90 min	• **Per pair:** set of 3D shapes, Plan Your Design-Shape Store planning sheet, "Stackability", and "Flickability" data sheets • **Per student:** Draw Your Habitat Cage and Exercise Trail planning sheet • **Per class:** large-sized "Stackability" and "Flickability" data sheets
6A: *The Perfect Pet*	Literacy	40 min	• **Per student:** Important Details graphic organizer • **Per class:** large copy of Important Details, *The Perfect Pet*
6B: Designing Hamster Habitat and Exercise Trail	STEM	90 min	• **Per pair:** Habitat Cage and Exercise Trail building mat, assorted 3D shapes, 2D basic needs shapes, paper hamsters on sticks • **Per student:** Final Letter to Perri, Extra Algorithm Lines • **Per class:** Engineering Design Checklist Educator Resource, Perri's Thank You Email

Objectives The student will be able to:
• **Engineering:** ask questions and gather information to define a problem about a situation people want to change through developing a new tool.
• **Literacy:** identify, organize, and record important facts or information from the text. • **Science:** identify hamsters by their physical characteristics and mention their basic needs drawing from information in the literacy books.
• **Science:** sort animals based on their characteristics and basic needs. • **Engineering:** ask questions, make observations, and gather information to define a problem about a situation people want to change through developing a new tool.
• **Literacy:** make connections from one part of the text to another. • **Science:** use knowledge about how the physical characteristics of animals influence their choice of habitat.
• **Science:** sort diverse living things by many different observable characteristics. • **Science:** identify where animals get their basic needs in their habitat, which is a natural system that has many components that interact to maintain the system.
• **Literacy:** answer questions about what they are reading to promote understanding. • **Mathematics:** describe basic shapes, 3-sided (triangle), 4-sided (quadrilateral), and 5-sided (pentagon). • **Mathematics:** identify differences among various shapes and associate them with the correct names.
• **Mathematics - Spatial reasoning:** rotate, flip, and slide 2D shapes in order to combine them to create new shapes.
• **Literacy:** use prepositions to describe actions. Use flowcharts to organize the sequence of events in a story. • **Computational Thinking - Algorithms & Procedures:** sequence the events of the story using a flowchart.
• **Mathematics:** compose 2-D shapes to create composite shapes. • **Computational Thinking - Algorithms & Procedures:** follow and create algorithms.
• **Literacy:** identify new vocabulary words ("juicy" words) and use strategies for determining the meaning of those words. • **Engineering:** discuss the importance of testing materials before building a prototype.
• **Engineering:** test materials, determine the best materials to use and plan the designs before building and testing them.
• **Literacy:** identify important details that will help to summarize the story.
• **Science:** describe how an animal's habitat provides for the basic needs of that animal. • **Engineering:** test prototypes to be sure their designs meet the hamsters' needs. • **Engineering:** redesign the prototype when designs could be made better or fails; redesign is an important part of engineering.

Master Materials List

KEY
#S: number of students
#P: number of pairs
L: laminate

- 7 Books:
  - *Nibble's Guide to Caring for Your Hamster*
  - *I See a Kookaburra! Discovering Animal Habitats Around the World*
  - *The Greedy Triangle*
  - *Three Pigs, One Wolf, and Seven Magic Shapes*
  - *Joey and Jet*
  - *Pop! The Invention of Bubble Gum*
  - *The Perfect Pet*
- white Velcro sticky back strips (5'x ¾" works well)
- jumbo paper clips (#S)
- chart paper markers (1)
- chart paper pack (1)
- tangrams (#S)
- dry erase markers (#S)
- tubs of 3D shapes (#P) [The curriculum uses the Geometric Shapes Tubs from Lakeshore Learning.]
- small craft sticks or small straws (for Hamster cards) (#P)

Master Printing List

KEY
#S: number of students
#P: number of pairs
L: laminate

Printable Manipulatives

- 1 large Engineering Design Process Poster & large paper clip
- Engineering Design Process Sliders (#S, L)
- 1 Email #1 (L)
- 1 Email #2 (L)
- 1 large copy of Animal Topic Map
- Animal Cards (#P, L)
- 3 Animals and Their Basic Needs sorting placemats (#P, L)
- 2D Basic Needs Shapes - Triangle, Rectangle, Square, and Circle (#P, L)
- 4 Can You Help Me Find My Home? habitat placemats (#P, L)
- Magic Shapes tangram placemats- 4 different animals with 4 back-to-back different levels (#S, L)
- 1 large copy of duck tangram
- Flowchart - Jet Chases placemat(#S, L)
- Flowchart - Jet Returns placemat (#S, L)
- Preposition Cards (#S, L)
- Tangram Mat (#S, L)
- 1 large copy of "Stackability" data sheet
- 1 large copy of "Flickability" data sheet
- 1 large copy of Important Details sheet
- Habitat Cage and Exercise Trail building mat (#P, L)
- Hamster cards (#P, L)
- 1 Thank You Email from Perri (L)

Student Handouts and Educator Resources

- Animal Topic Map graphic organizer (#S)
- Making Connections graphic organizer (#S)
- Help Me Find My Home Assessment (#S)
- Thinking about *The Greedy Triangle* worksheet
- 1 Tangram Oral Checklist Educator Resource
- Develop Your Own Algorithm worksheet (#S)
- 1 Algorithm List Educator Resource
- My Juicy Words graphic organizer (#S)
- "Stackability" and "Flickability" data sheets (#P)
- Draw Your Own Habitat Cage and Exercise Trail planning sheet(#S)
- Plan Your Design - Shape Store planning sheet (#P)
- Important Details graphic organizer (#S)
- 1 Engineering Design Oral Checklist Educator Resource
- Final Letter to Perri (#S)
- Extra Algorithm Lines (#S)

Lesson Intro

FOCUS/KEY CONCEPTS

Students will be able to:

- **Engineering:** ask questions and gather information to define a problem about a situation people want to change through developing a new tool.

STANDARDS

National

- NGSS: K-2-ETS1-1
- CCSS-ELA: SL.1.1, SL.K.6

MATERIALS

- See Unit Overview

TEACHER PREPARATION

- Prepare a large copy of the **Engineering Design Process Slider poster**
- Prepare individual **Engineering Design Process Sliders**
- Write each heading on its own sheet of chart paper: Problem, Goals/Criteria

VOCABULARY

- **Habitat** The natural home or environment of an animal, plant, or other organism
- **Engineer** Use mathematics, science, and creativity to solve problems to help people
- **Criteria** Goals of the design problem
- **Engineering Design Process** A series of phases engineers go through in designing products such as background of problem, designing and implementing a prototype, and evaluating and refining designed product
- **Prototype** A testable model of a design

Defining the Problem

SUMMARY OF THE LESSON

In this introductory lesson, students are introduced to the problem through email interactions with their client, Perri. They have the opportunity to explore the engineering design process, ask questions of their client, help their client define the problem to be solved, and identify the criteria of the problem to be solved.

INTRODUCTION

1. **Introduce engineering.** **Say:** *We are going to be working as engineers over the next few days.* **Ask:** *Does anyone know what an engineer does?* Take student answers. **Say:** *Engineers are people who use science, mathematics, and creativity to solve problems to help people. Typically their solution is a new or improved technology or a process.* **Ask:** *What problems do engineers solve?* Take student answers.

2. **Make a personal connection to engineering.** Give an example of a problem that you have had and ask students to help you think of a solution. Then ask students to share a problem they might have or have had in the past. **Say:** *Those are some good problems, and, just like that, you are starting to think like engineers.*

3. **Make a personal connection to the challenge.** **Say:** *Out on the playground, you have a chance to climb up, on, over, through the playground equipment. Why do you think they put that on our playground? What does that feel like? Have you ever been somewhere else where you have been able to do that?* Allow students to share their experiences.

4. **Introduce the engineering design process.** Display the engineering design process and have students place their engineering design cycle cards in front of them. NOTE: If this is a distraction, only use the poster. Explain that engineers use this process along with science, mathematics, and creativity to understand a problem and create a solution.
   - **DEFINE:** Engineers must define the problem and criteria (goals and limits).
   - **LEARN:** To better understand the problem engineers must learn about the science and other factors that impact how the problem can be solved. As they learn they must keep the problem and its goals and limits in mind.
   - **PLAN:** Engineers brainstorm many ideas before deciding which one to try. They must make plans that clearly communicate their idea. Plans may include some of the following information in word and/or picture form: measurements, materials, colors, how things fit together and the order in which things should be done. Engineers must make sure that their plan meets the goals and limits presented in the problem as best as possible. While creating their plan engineers may find they need to go back and learn something before their plan can be finalized.
   - **TRY:** Engineers use their plan to try to create a prototype of their planned solution. A prototype is a testable model used to test a design plan. Although a prototype allows the engineer to test parts of their design it is not the final solution or product. In fact, it may not even be the same size as the final design.
   - **TEST:** Engineers test their plan to see if it is a good solution for the problem. Engineers must conduct fair tests and use mathematics to make sense of the data they collect.
   - **DECIDE:** Engineers use the test results to make decisions about the solution. Does it solve the problem and meet the criteria (goals and limits)? Are there new things that need to be learned in order to better solve the problem? Should they try other ideas that were previously brainstormed or brainstorm new ideas to achieve a better solution?

Defining the Problem

Lesson Intro

TEACHER NOTES

5. **Introduce the engineering challenge.** Read **Perri's First Letter.**

6. **Identify where we are in the engineering design process. (Define)**
   Engineers need to define the problem they will solve before they can learn about the problem, plan a design, try the design, test the design, and decide if their design works.

ACTIVITY - Defining the problem

7. **Discuss the client and the client's needs. Say:** *Let's think back to the letter/email we received.* **Ask:** *Who is the client? What does the client need? Why does she need it?* Record responses on the chart paper labeled "Problem".

8. **Provide feedback to Perri. Ask:** *Do you have any questions for Perri about her hamster habitats?* Record questions from students where they can see them. **Ask:** *What are some of your ideas about how to help Perri expand the hamster habitat she sells?* Record responses from students where they can see them. You may need to develop answers to the students' questions that help them focus in on the problem and not be distracted by other ideas. Pretend to send this information to Perri via email and receive the following letter back.
   NOTE: This would be a good time to take a break (give time for Perri to 'respond'). This will also help break up the introduction.

9. **More information about the engineering challenge.** Read the **Second Letter from Perri's Pet Palace.**

10. **Define what an engineer is and what they do. Say:** *We are going to think like engineers while we work to design an exercise trail for Perri that can be added to her current habitat cage.* Talk with students about what an engineer is and what they do. **Say:** *Engineers use mathematics, science, and creativity to solve problems to help people.*

11. **Identify the criteria and define "criteria". Say:** *In her letter, Perri said there are several things that she would like to be true about the hamster habitat. I'm going to read her letter again, raise your hand when you hear something that Perri wants to be true about the hamster habitat and exercise trail.* Read Perri's letter aloud again. The students should identify the 6 numbered items as things that should be true about the hamster habitat and exercise trail. **Say:** *Here is Perri's list of things that need to be true about the habitat cages and exercise trails.* Put up the list of 6 numbered items from the second letter. **Say:** *These 6 things that you have said need to be true about the hamster habitat and exercise trail are called "criteria".* Define criteria as the goals of the design problem. Describe criteria as things that we use to decide how good a solution is to the problem.

CLOSURE

12. **Check in with students.** Encourage students to share any questions they may have about the problem and criteria. Record their questions on a sheet of chart paper. Share that engineers also ask questions about the problems they are trying to solve to help them know what they need to learn more about and what kind of tests they must do before brainstorming a solution.
    NOTE: If students have not seen a hamster cage before, you may want to find images or videos of hamsters in the exercise trail tubes. The Target 2011 Back to School commercial on YouTube has a good example.

Delete

Reply

Reply All

Forward

Move

Related

Follow Up

From: perrispetpalace@gmail.com
To: StudentEngineers@gmail.com
CC:
Subject: Perri's Pet Palace Problem

Dear Students,

Hi! My name is Perri. I am the owner of a pet store called Perri's Pet Palace. Perri's Pet Palace sells a lot of different pet supplies to help you care for pets. My store sells things like pet food, leashes, cages, and habitats for dogs, cats, fish, birds, hamsters, and guinea pigs. My customers like our hamster habitat cages that are currently in my store, but they have been asking for a way to expand the habitat cages so their hamsters can have more room to run and explore to be happy and healthy.

Can you please send me some ideas about how to expand the hamster habitats?

Thank you for all of your help!

Perri Martinez
Owner, Perri's Pet Palace


Delete


Reply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Follow Up

From: perrispetpalace@gmail.com
To: StudentsEngineers@gmail.com
CC:
Subject: Re: Perri's Pet Palace Problem

Dear Students,

Thank you for your ideas about expanding the hamsters habitat. I really liked your ideas. I have decided to expand the hamster habitat by adding an exercise trail. Will you please help me design my new hamster habitat cages with exercise trails?

As you create your design, you need to make sure the following are true for the habitat cage and exercise trail:

1. The exercise trail must connect to the two openings in the back of the habitat cage.
2. The exercise trail should be fun and exciting for the hamster.
3. The exercise trail and habitat cage cannot take up too much space.
4. The exercise trail and habitat cage should keep the hamster happy.
5. The exercise trail and habitat cage should keep the hamster healthy.
6. The hamster must not be able to escape.

Please send me a set of directions for how your hamster will travel through your exercise trail as well as a picture of the habitat cage with your exercise trail prototype. I will use this information to make sure that my customers know how to set up your design.

Thank you for all of your help!

Perri Martinez
Owner, Perri's Pet Palace

Lesson Intro

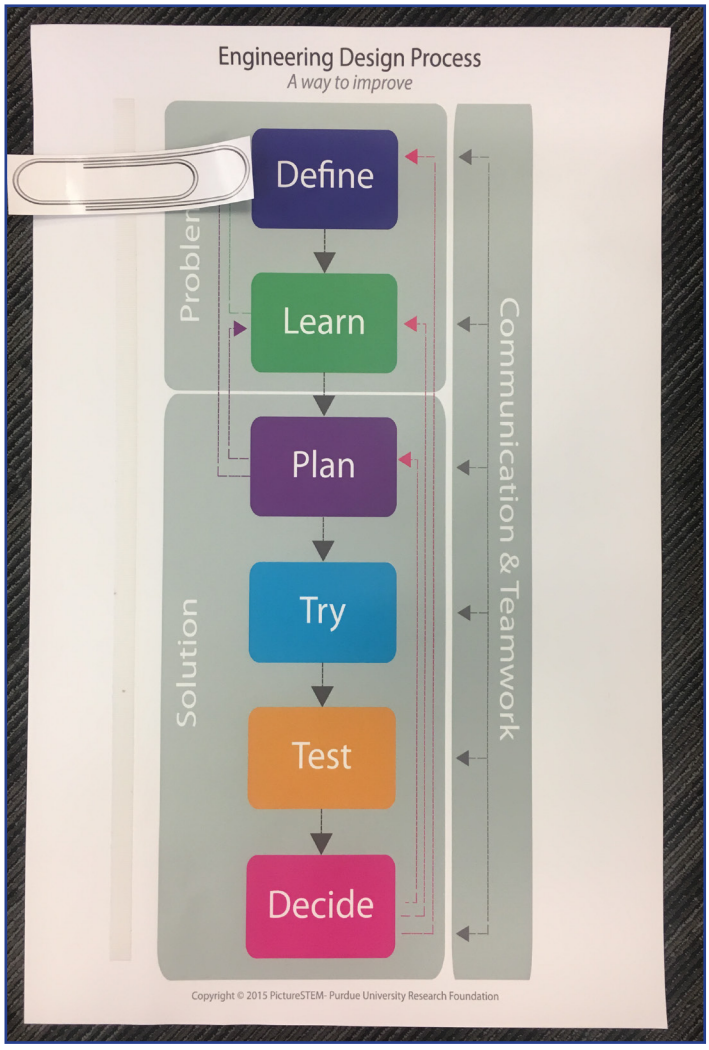
How to make Engineering Design Process sliders

HOW TO CREATE THE POSTER

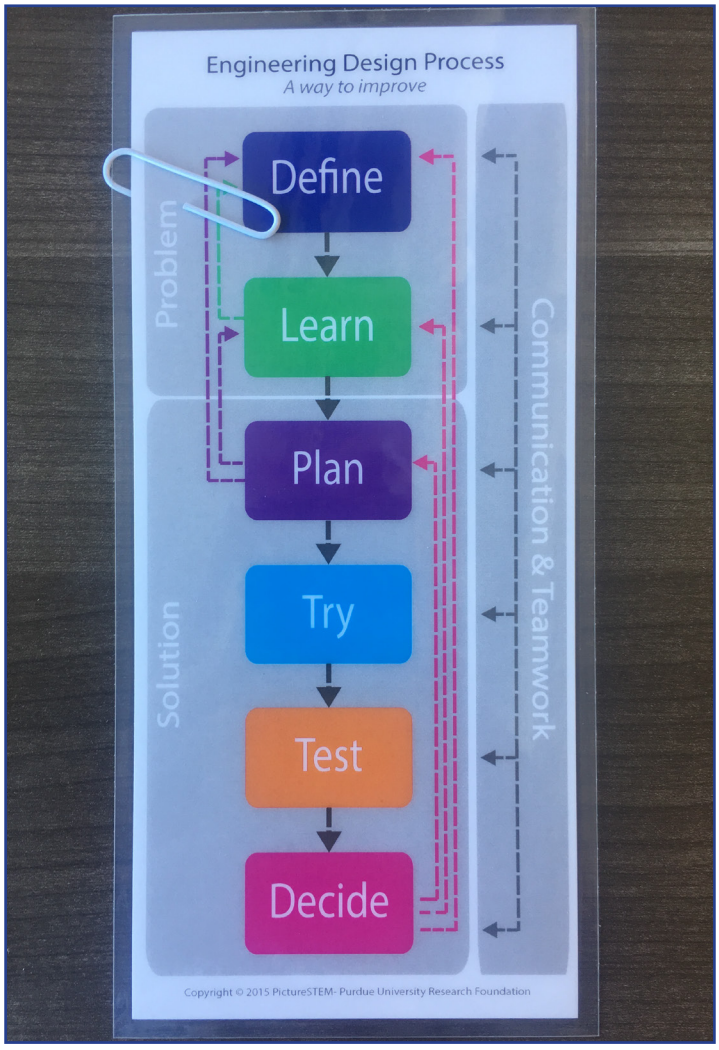
1. Download the high-quality PictureSTEM Slider Poster and the paper clip images from PictureSTEM.org.
2. Print the poster and the paper clip on poster-sized paper and cut to size. High-gloss or semi-gloss paper is the best choice.
3. Use self-sticking Velcro on the back of the paper clip and down the side of the poster so that the paper clip can be placed to point at all 6 sections of the slider.

HOW TO CREATE INDIVIDUAL SLIDERS

1. Print the sliders on the opposite page - enough for one slider per student in your class.
2. Cut the sliders apart.
3. Laminate the sliders individually.
4. Use a jumbo paper clip as the pointer for each slider.



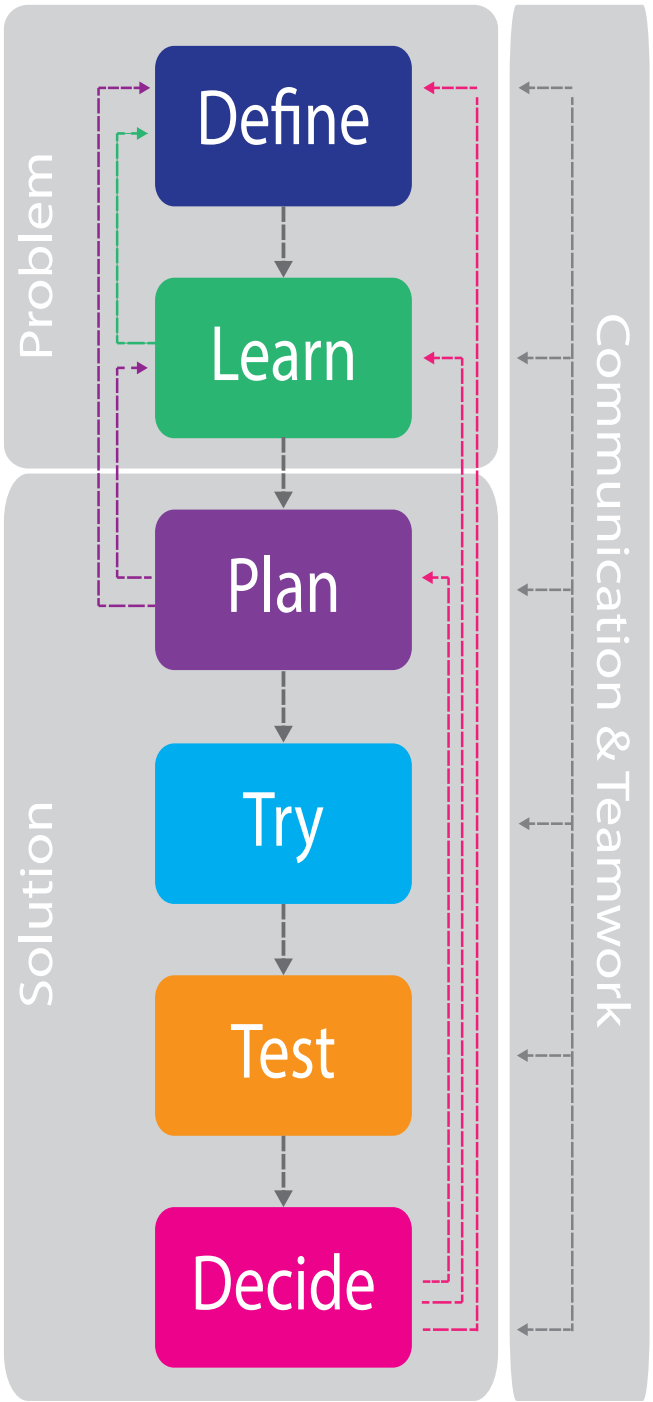
Poster



Individual slider

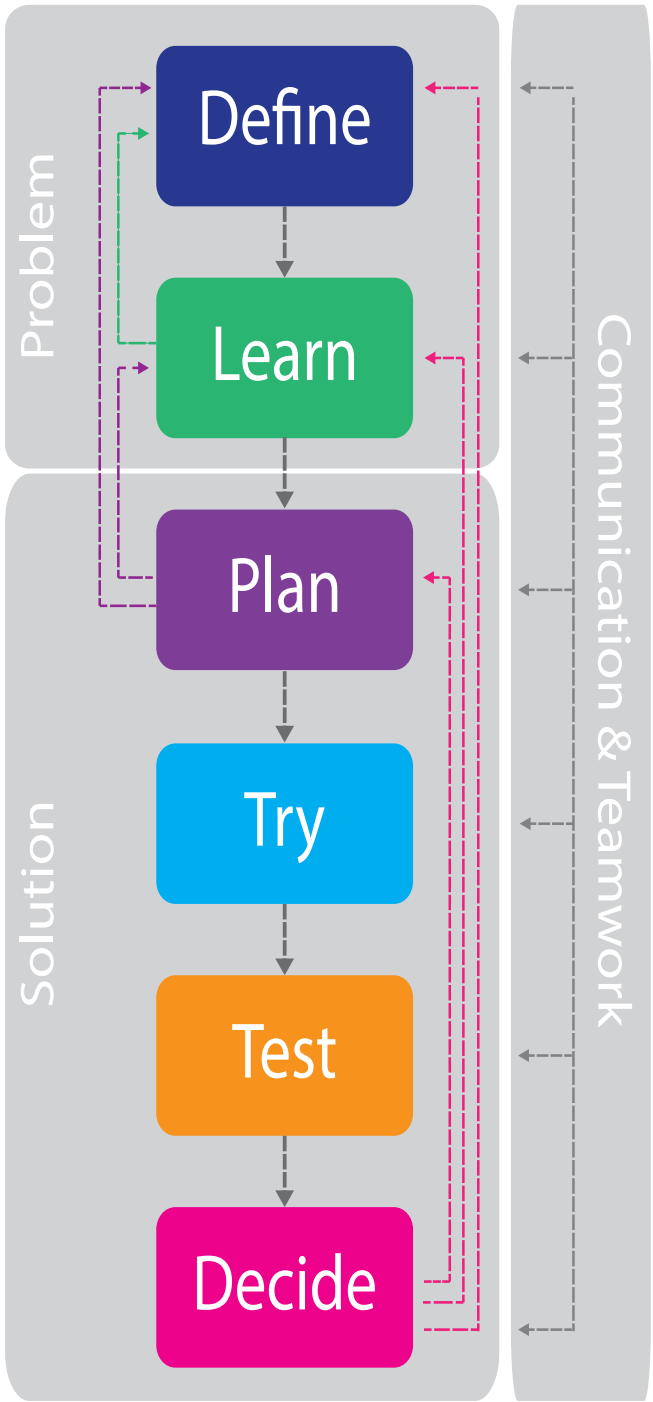
Engineering Design Process

A way to improve



Engineering Design Process

A way to improve



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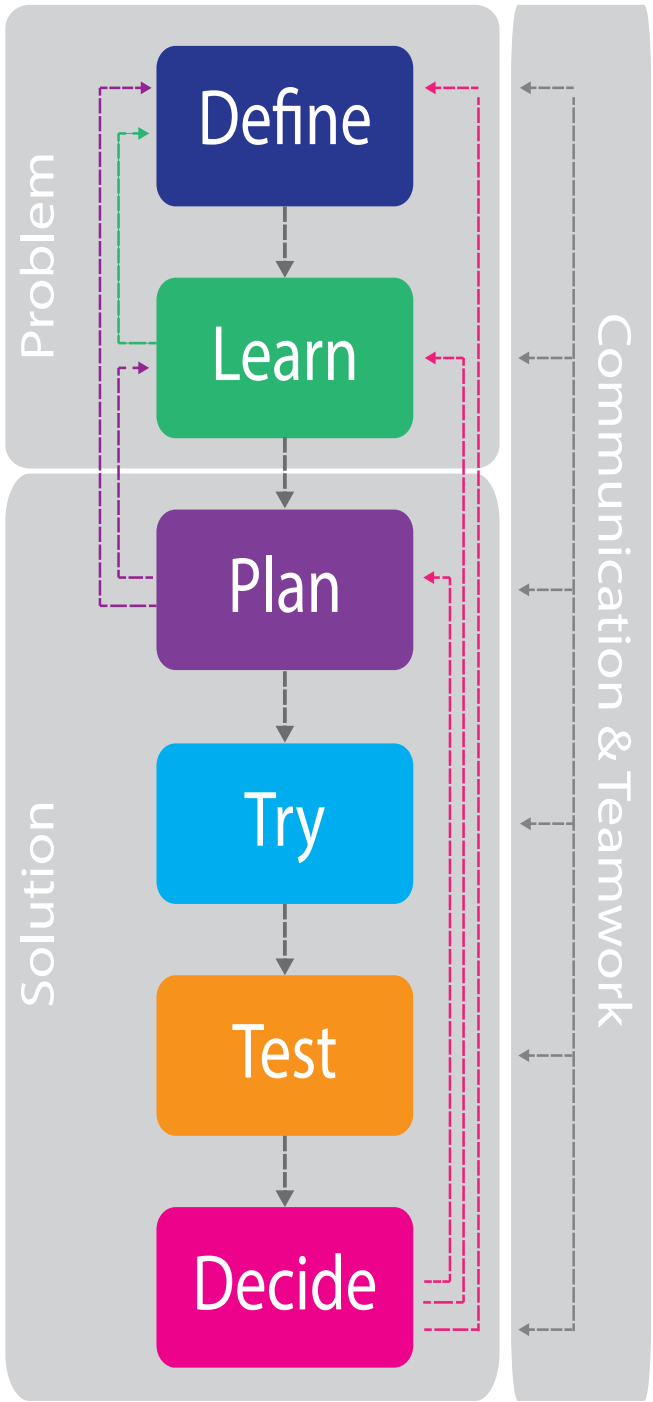
Engineering Design Process

A way to improve



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Lesson 1A

FOCUS/KEY CONCEPTS

Students will be able to:

- **Literacy:** identify, organize, and record important facts or information from the text.
- **Science:** identify hamsters by their physical characteristics and mention their basic needs drawing from information in the literacy books.

STANDARDS

National

- NGSS: K-2-ETS1-1, K-ESS2-2, K-ESS3-1
- CCSS-ELA: SL.1.1, SL.K.6, RL.1.5, RI.1.1, RI.1.2

MATERIALS

- Book: *Nibble's Guide to Caring for Your Hamster* by Anita Ganeri
- Large Copy of the Animal Topic Map graphic organizer
- **Animal Topic Map** graphic organizer

TEACHER PREPARATION

- Make a large copy of Perri's Pet Store Letter (on chart paper, overheard, SMART board, etc.)
- Make a large copy of the **Animal Topic Map** (on chart paper, overheard, SMART board, etc.)

VOCABULARY

- **Habitat** The natural home or environment of an animal, plant, or other organism
- **Basic needs** What a plant or animal needs *to survive* **- food, water, shelter, and space/air**

Nibble's Guide to Caring for Your Hamster

SUMMARY OF THE LESSON

In this literacy lesson, students are introduced to hamsters as they build background knowledge about how hamsters live by reading *Nibble's Guide to Caring for Your Hamster* by Anita Ganeri - an informational text told from the perspective of a hamster. The focus of this lesson is on the basic needs of animals. Students learn about the things that animals need to survive – food, water, shelter and space/air. This lesson sets the context for the engineering design challenge in which they have to design a habitat for their hamsters which provides for their hamsters' basic needs. Reading strategy: main ideas from informational text.

INTRODUCTION

1. **Prior knowledge.** Students will need to have a basic understanding of animals and some familiarity with a variety of common animals, like a polar bear, owl, camel, frog, fish, or monkey. It will also be helpful for students to be able to identify animals based on their characteristics to help them sort by their fur, skin, wings, and fins in the second activity.

2. **Discuss characteristics of animals.** Have students gather for a "Read Aloud." **Ask:** *What is your favorite animal?* To probe student understanding about animals, **Ask:** *How do you know __(repeat the animal they named)__ is an animal?* They might say it breathes, eats, is alive, can bark, etc., getting at some of the characteristics of animals.

3. **Introduce the unit.** After taking some initial student ideas about animals, introduce the unit. **Say:** *In this unit we are going to learn all about animals' habitats.*

4. **Introduce the engineering challenge.** **Say:** *I am going to read the letter from the Perri's Pet Palace again.* Read the letter to the class. Post class copy of the letter to refer to during the unit. **Ask:** *Do you think we can help Perri's Pet Palace by designing good habitats for hamsters?* **Say:** *Our letter from Perri's Pet Palace said the hamster habitat we design will need to meet certain criteria/rules. One criterion is it must meet the basic needs of a hamster.* **Ask:** *What do we need to know in order to do this?* We need to know more about the basic needs of hamsters. **Say:** *We need to learn more about the basic needs of animals before so we can plan, test, and design our habitat.*

5. **Identify where they are in the engineering design process. (Learn)** **Say:** *To prepare for our engineering design challenge we will be learning more information about our mystery animal and its basic needs, so we will design the best habitat for our animal.* **Ask:** *Where do you think we are in the engineering design process?* Point to the classroom Engineering Design Process chart. **Ask:** *Where should we move our paper clip?* Move paper clip to LEARN.

ACTIVITY - Summarizing informational text

6. **Introduce the book.** *Nibble's Guide to Caring for Your Hamster* by Anita Ganeri. **Say:** *This is a non-fiction or informational text told by a*

Nibble's Guide to Caring for Your Hamster

hamster. Informational text can tell us about lots of true information about a lot of things. We will be looking for new vocabulary words and learning new information about animals.

7. **Introduce the literacy skill.** Informational text contains a lot of good information, which we want the students to be able to pull from the text. In this lesson, you will be using a topic map to help students identify and record important facts about the animal during the whole group lesson. The goal is to have students help you fill in the **Animal Topic Map** graphic organizer as you read about that animal.

8. **Start reading.** Read the book, using interesting words from the text to fill in the **Animal Topic Map**. Sample interesting words:
   - p. 9 scurrying
   - p. 11 drip-feeder
   - p. 13 escaping
   - p. 16 pouches
   - p. 22 gnawing
   - p. 28 burrow

   NOTE: Make sure to read the hamster facts on page 28.

9. **Individual practice.** Leave enough time at the end of the whole group lesson to review the **Animal Topic Map** that your students have created about the hamster with all of the great facts and information they have learned from this book.

CLOSURE

10. **Whole group summary.** At the end of the activity, give students the following questions to test their understanding of the readings and their recall what they filled out as part of the **Animal Topic Map**:
    - Who can tell me what the mystery animal is we learned about today was?
    - What did you learn about what hamster eat?
    - Where do hamsters live?
    - What do hamsters look like?
    - Is there anything else that we learned about hamsters?

    NOTE: This information will be useful to refer back to throughout the unit, especially during the engineering design challenge as students create their habitat.

11. **Tie back to engineering challenge.** Remind students of the engineering challenge. **Say:** *All the things you learned about hamsters will help you identify their basic needs. Giving a hamster its basic needs will keep the hamster happy and healthy.* Remind students of the criteria of the problem.

TEACHER NOTES

Lesson 1A

ASSESSMENT

Pre-Activity Assessment
Before the activity, ask students to identify their favorite animals by asking the question, "What is your favorite animal?" To probe student understanding about animals, you can ask students "how they know the thing they named is an animal"

Activity Embedded Assessment
Completion of the **Animal Topic Map** graphic organizer while reading the story with students.

Post-Activity Assessment
Post reading questions.

Lesson 1A

Name_____

Animal Topic Map

Directions: Use words or draw pictures with words.

My animal is:	
food:	**habitat:**
physical characteristics: (what it looks like)	**interesting facts:**

Lesson 1B

Animals and Their Basic Needs

FOCUS/KEY CONCEPTS

Students will be able to:

- **Science:** sort animals based on their characteristics and basic needs.
- **Engineering:** ask questions, make observations, and gather information to define a problem about a situation people want to change through developing a new tool.

STANDARDS

National

- NGSS: K-2-ETS1-1, 4-LS1-1 (LS1.A)
- CCSS-ELA: SL.1.1, SL.K.6

MATERIALS

- Set of animal cards (for each pair of students)
- Sorting placemats (for each pair of students)
- Hamsters' Basic Needs chart

TEACHER PREPARATION

- Make a copy of the Hamsters' Basic Needs chart (on chart paper. SMART board, etc.)

VOCABULARY

- **Habitat** The natural home or environment of an animal, plant, or other organism
- **Basic needs** What a plant or animal needs to survive – food, water, shelter, and space/air
- **Characteristics** A feature or quality belonging to a person, place or thing
- **Shelter** A place providing protection

SUMMARY OF THE LESSON

In this STEM+C lesson, students learn that animals have different physical characteristics such as fur, wings, scaly skin and fins which help to categorize them into specific groups. This lesson builds upon Lesson 1A, by first introducing students to a sorting activity in which they identify animals based on their physical characteristics, with the goal of distinguishing specific animal groups. The students then sort animals based on their basic needs of food and shelter, which helps build background knowledge for the engineering design challenge in which students have to design a habitat that provides for their hamsters' basic needs.

INTRODUCTION

1. **Connect to literacy lesson.** Connect back to what students learned by listening to the story about hamsters and what they need to survive (e.g., Where they live? What they eat?).

2. **Tie to engineering challenge.** **Ask:** *Why are we learning about what a hamster needs to survive?* **Say:** *We need to learn about the needs of our hamster to help us complete our engineering design challenge to design a habitat that provides for a hamster's basic needs.* Refer back to the topic map that the students created during the literacy lesson.

3. **Identify where they are in the engineering design process. (Learn)** As a class, move the clip on the engineering design process to LEARN. **Say:** *It's important for engineers to learn about the needs of the final design before we start to plan the design so we can meet the criteria.*

ACTIVITY - Sorting animal characteristics and needs

4. **Review the basic needs of hamsters.** **Ask:** *We just talked about the things that hamster need to survive. What things do other animals need to survive? Do you think that it is the same as what a hamster needs to survive?* **Say:** *Things that an animal needs to survive are called **basic needs**. We are going to make a list of basic needs that hamster need to survive.* Make a list of hamster's basic needs with the students – food, water, shelter, space and air (example below). Place this list next to the topic map as a reference for the students in later lessons.

Hamsters' Basic Needs
Basic needs are things that hamsters need to survive (stay alive)
food water shelter air space

5. **Part 1: Sort by characteristics.** **Say:** *To help us answer the question of if animals need the same things to survive, we will do a fun sorting activity with these animal cards.* Hold up an example of a few of

the different animal cards. **Ask:** *Who can tell me what this animal is?* Hold up one animal card and call on a student to answer the question. **Say:** *You and your partner will get a deck of cards. Using the* **Animals and Their Basic Needs** *characteristic sorting placemats, place the animal card where you think they fit. For example, if your animal has fur, place the animal card under fur.* **Ask:** *How did you decide to sort your animals into each box?* Help students with the idea that the different groups have larger names (mammals, birds, reptiles, fish) with a few outliers (that tend to be the ones they have a hard time placing).

6. **Part 2: Sort by basic needs.** **Say:** *We just sorted the animals into groups, we are going to use the* **Animals and Their Basic Needs** *basic needs sorting placemats and look at what these animals need to survive.* Refer back to the basic needs chart and initial question about if hamster's needs are the same as other animals. **Say:** *Now, you are going to look for where animals find food, water and shelter.* This will lay the foundation for Lesson 2, when students learn that animals' habitats provide for their basic needs.

CLOSURE

7. **Summarize the activity as a group.** **Ask:** *What did you notice about the needs for similar animals?* They are similar. *Are these needs the same as the needs for a hamster? Why do you think that the things needed by animals or organisms are referred to as basic needs?* They are things which an animal or organism require if they are to survive for a long time.

8. **Tie back to the engineering challenge.** **Say:** *We are going to be helping Perri to design an exercise trail for hamsters. One of the criteria is that it keeps the hamster healthy and happy.* **Ask:** *What are some things that we might need to consider in our designs to help keep the hamsters happy and healthy?* Basic needs.

9. **Connect to the next lesson.** **Say:** *In the next lesson, we will be learning more about how animals get what they need (these basic needs) from the places they live.*

10. **Introduce the word habitat.** **Say:** *We have been talking a lot about where animals live. We call this their "habitat"* (a habitat is the natural home or environment of an animal, plant, or other organism). Write the word on a piece of chart paper and during lesson 2A, the class will work towards a student-friendly class definition of the word habitat to post in the room for use during this unit.

TEACHER NOTES

Lesson 1B

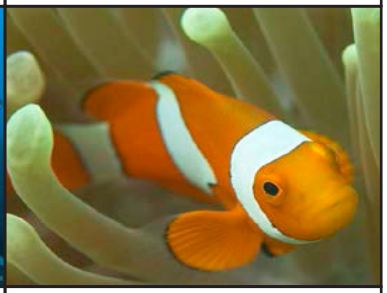
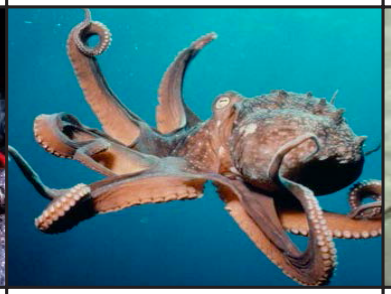
ASSESSMENT

Pre-Activity Assessment
Review the basic needs of a hamster that was identified in the first activity. Ask students which of these things are needed for a hamster to survive.

Activity Embedded Assessment
Both of the sorting activities can be used to assess students' ability to describe and sort animals by physical characteristics (part 1) as well as their ability to recognize that animals need food, water, shelter, space and air (part 2).

Post-Activity Assessment
Listen to students' answers from questions in the closure activity for understanding of the sorting activity.

EXTEND THE LESSON
Once students have sorted the animals on the mats, you can use this as an opportunity to talk about how the characteristics of the animals fit (with exceptions) with the five animal groups: mammals, fish, reptiles, amphibians, and birds.

			
SNAKE	TIGER	MONKEY	GORILLA
			
PARROT	TREE FROG	SHARK	FISH
			
DOLPHIN	LOBSTER	OCTOPUS	STARFISH

			
SEAL	FOX	PENGUIN	SNOWY OWL
			
REINDEER	POLAR BEAR	CAMEL	IGUANA
			
COYOTE	VULTURE	DESERT TORTOISE	JACK RABBIT

Lesson 1B

Animals and Their Basic Needs

What characteristics do I have?

fur
scaly or slimy skin

Lesson 1B

Animals and Their Basic Needs

What characteristics do I have?

wings
fins or lives underwater

Lesson 1B

Animals and Their Basic Needs

Basic Needs

Part 1 : I get my food from...

eating plants
eating other animals

Lesson 1B

Animals and Their Basic Needs

Basic Needs

Part 2 : I find shelter in...

trees or bushes
shells

Lesson 1B

Animals and Their Basic Needs

Basic Needs

Part 2 : I find shelter in...

caves, rocks, or dens
ocean or coral reef

Lesson 1B

Answer Sheet

Animal	Characteristics	Food Source	Finds Shelter in...
Camel	fur	plants	trees or bushes (may sleep under a tree
Coyote	fur	plants	caves, rocks, or dens
Dolphin	fins or lives underwater	other animals (mostly shellfish)	ocean or coral reef
Desert Tortoise	scaly or slimy skin	other animals	caves, rocks, or dens; under trees or bushes
Fish	fins or lives underwater	plants or other animals	ocean or coral reef
Fox	fur	other animals, sometimes plants	caves, rocks, or dens
Gorilla	fur	plants and other animals (bugs)	trees or bushes (builds nests to sleep on)
Iguana	scaly or slimy skin	plants	caves, rocks, or dens
Jack Rabbit	fur	plants	trees or bushes (nests in grass or bushes)
Lobster	fins or lives underwater	other animals	ocean or coral reef
Monkey	fur	plants and other animals (bugs)	trees or bushes
Octopus	fins or lives underwater	other animals	ocean or coral reef
Parrot	wings	plants, sometimes other animals	trees or bushes
Penguin	wings (that are used as fins, they cannot fly)	other animals	caves, rocks, or dens (make nests or burrows out of sticks and grass). Some use each other as shelter
Polar Bear	fur	other animals	caves, rocks, or dens (Arctic ice)
Reindeer	fur	plants	trees or bushes
Seal	fur	other animals	caves, rocks, or dens
Snake	scaly or slimy skin	other animals	caves, rocks, or dens, under trees or bushes
Snowy Owl	wings	other animals	trees or bushes
Starfish	fins or lives underwater	other animals (shellfish), sometimes plants	ocean or coral reef
Tiger	fur	other animals	caves, rocks, or dens
Tree Frog	scaly or slimy skin	other animals (bugs)	trees or bushes
Vulture	wings	other animals	trees or bushes

Lesson 1B

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Dolphin - NOAA, www.noaa.gov
Lobster - NOAA photo library, www.photolib.noaa.gov
Octopus - NOAA photo library, www.photolib.noaa.gov
Starfish - NOAA photo library, www.photolib.noaa.gov

Lesson 2A

I See a Kookaburra!

SUMMARY OF THE LESSON

In this literacy lesson, students explore animals in their natural habitats through reading *I See a Kookaburra!: Discovering Animal Habitats Around the World* by Steve Jenkins & Robin Page. In the previous lesson, students learned that animals have different physical characteristics such as those with fur, wings, scaly skin and fins, as well as that the habitat of an animal provides it with food and other basic needs. This activity builds on this knowledge by helping students identify where animals get their food, water, shelter, space and air in their natural habitat. Reading strategy: making connections.

INTRODUCTION

1. **Introduction to literacy lesson.** To help students to start thinking about integrating knowledge and ideas within informational text, they will be making connections between two pieces of information in a text. **Ask:** *Who can tell me one thing about where you live that will help me to visualize it in my head?* It has a green roof, it is made from bricks, it has a big fireplace, etc. Gather a few answers and help students start to make connections to the things that we have in our homes and why we have those things. For example, you could ask, Why does your home have a roof? **Say:** *These are* ***characteristics*** *that describe where we live. Today we will read about a few different places to help us understand why plants and animals live where they live.*
2. **Tie to engineering challenge.** **Say:** *As we think about our engineering design challenge of helping Perri to design a new hamster habitat, we need to learn more about why animals live in the different places they live. In this book, you will explore six different parts of the world and the animals that live there as we learn more about why and how they live in these different habitats.* This activity builds on previous knowledge about basic needs and habitats and will help students in designing a habitat for their engineering design challenge.

3. **Identify where they are in the engineering design process. (Learn)** **Ask:** *Where do you think we are in the engineering design process?* Point to the classroom Engineering Design Process chart. *Where should we move our paper clip and why should we move it there?* Remind students they need lots of information to design a good habitat for the pet store and move paper clip to LEARN.

ACTIVITY - Making connections

4. **Introduce the book.** **Say:** *Today, we will read* I See a Kookaburra! Discovering Animal Habitats Around the World. *This book is an informational book, so it is written in order to provide content information about the social or natural world.* NOTE: Some science trade books include a section at the end that gives the facts or "true" parts of the story. **Say:** *In the book, you will see many animals in their natural habitats. We will work together to identify how the basic needs of the animals are being met in each habitat.*

5. **Explain the reading strategy.** **Say:** *Today we are going to continue to work on becoming better readers by making connections between two different ideas in the same book. Good readers take time to*

FOCUS/KEY CONCEPTS

Students will be able to:

- **Literacy:** make connections from one part of the text to another.
- **Science:** use knowledge about how the physical characteristics of animals influence their choice of habitat.

STANDARDS

National

- NGSS: K-2-ETS1-1
- CCSS-ELA: RI.1.3

MATERIALS

- Book: *I See a Kookaburra!: Discovering Animal Habitats Around the World* by Steve Jenkins & Robin Page
- Large copy of the Basic Needs chart
- **Making Connections** graphic organizer

TEACHER PREPARATION

- Make a large copy of the Basic Needs chart (on chart paper, overheard, SMART board, etc.)

VOCABULARY

- **Identify** To know and say who someone is or what something is
- **Connection** Causal or logical relation or sequence (e.g., the connection between two ideas)
- **Characteristics** A special quality or feature that makes something different from other things

think about what they read and start to make connections between some of the different facts and ideas that are presented within the same book and even on the same page. This helps us to understand what we have read. Today, while we are reading, I want you to be thinking about connections between the animals that are hiding in this book and how the places where they are living help meet their basic needs. To encourage active participation through non-verbal response have students interlock their thumb and forefinger of each hand to make a link when they find a connection between the animals and the places they live.

6. **Start reading.** Show the class the cover. **Say:** *Today we are reading* I See a Kookaburra! Discovering Animal Habitats Around the World. As you read, stop at each habitat introductory habitat page (e.g., In the desert I see…) and talk about the picture. **Ask:** *How will the basic needs of the animals in this habitat be met?* For example, where can they get food? Where is their shelter? NOTE: The book text does not clearly address how animals get the water they need. The animal guide at the back will help you. Once you have discussed the habitat page, read the pages out loud about the animals that live in that habitat. Remember to use some of the strategies that help with reading and comprehension development:
   - Teach new vocabulary at the point of contact.
   - Target the reading skill – making connections.
   - Encourage higher-level thinking and comprehension monitoring by pausing for "teacher think alouds" and asking questions about or discussing the text.

7. **Re-read and practice.** Hand out the **Making Connections** graphic organizer. **Say:** *Good readers make connections when they read. We are going to practice by filling in a sheet that will help with making connections between animals from different habitats in the book and how their basic needs are being met.* Work through the worksheet together. Students should select an animal from the book whose need is being met by their habitat.
   NOTE: There is only one specific reference to air in the text. However, your discussion of each habitat page should have addressed where the animals get their air.

CLOSURE

8. **Tie back to the engineering challenge.** Remind students about the engineering challenge and what they are helping Perri to do with the hamster habitats. **Ask:** *What connections can you make to the story we just read and the problem that we are helping Perri to solve?* Each of the habitats provided for the basic needs of the animals that lived in these habitats and had characteristics that helped them to live there. So we need to make sure that our habitats are a place where hamsters are happy and want to live.

TEACHER NOTES

ASSESSMENT

Pre-Activity Assessment
Students will answer the question, "Who can tell me one thing about where they live that will help me to visualize it in my head?", which will provide information about human homes in order to gain a better understanding about what additional teaching might be necessary for them to complete the **Making Connections** graphic organizer.

Activity Embedded Assessment
Making Connections handout, which asks students to make connections between animals from different habitats in the book.

Post-Activity Assessment
Listen to students' answers from questions in the closure activity for understanding of making connections.

EXTEND THE LESSON
Ask students to draw a plan of their house and identify places in it where their basic needs are met.

Lesson 2A

Name_____

Making Connections

Directions: Use words or draw pictures with words.

Presented in the book	Connection to another idea in the book
food and water: In the tide pool, a poisonous weever fish waits for its next meal.	
shelter: In the desert, the tiny elf owl makes its nest in a giant cactus.	
space: In the jungle, a spider monkey escapes danger by swinging from branch to branch.	
air: In the pond, a water spider has a bubble of air trapped in its web.	

Lesson 2B

Help Me Find My Home

SUMMARY OF THE LESSON

In this STEM+C activity, students learn that every hamster has basic needs which can be found in suitable habitats. In order to place a hamster in its habitat, therefore, it is important for students to identify the basic needs an animal should expect to find in its habitat. This will ensure that the animal is safe and healthy in the habitat it is placed. This activity helps to build students' understanding of previous lessons on animals' physical characteristics, basic needs and how these relate to their habitats. This will prepare students for the final engineering challenge where they design a hamster habitat that ensures the basic needs of the hamster are met.

INTRODUCTION

1. **Connect to prior knowledge.** **Say:** *I want you to think of your favorite animal in your head, don't say the name of the animal out loud or you will ruin the surprise.* Give students a minute to brainstorm their favorite animal. **Say:** *I want you to think about how you could describe the animal to me without telling me the name of the animal. For example, I am thinking of an animal that has fins and scaly skin that lives in the ocean. This animal breathes air through its gills. What animal is that?* Fish. Take a few student guesses. **Say:** *I will give you a second to think in your head how you might describe your favorite animal.* **Ask:** *Do I have a volunteer who wants to describe their favorite animal?* Take a few student answers before moving on.

2. **Tie to engineering challenge.** **Say:** *We are going to learn that every animal has basic needs that can be found in suitable habitats. We need to learn about the physical characteristics of animals to help us with our engineering design challenge to build a habitat for our animal.*

3. **Identify where they are in the engineering design process. (Learn)** **Ask:** *Where do you think we are in the engineering design process? Where should we move our paper clip and why should we move it there?* Remind students they need lots of information to design a good habitat for the pet store and move paper clip to LEARN.

ACTIVITY - Help me find my home

4. **Part 1: Can You Help Me Find My Home?** Give each pair of students one deck of animal cards and one of the 4 different **Can You Help Me Find My Home?** animal habitat placemats. Have students use their animal cards to place the different animals in the correct habitat by identifying characteristics that match with the habitat. For example, the fish needs water to breathe, so it would be found in a habitat with water. Have students use their animal cards to sort animals into a second habitat. Have students share their sorting results with a partner that has a different habitat and have each group share one animal and why they chose to put it in their habitat. **Say:** *We are going to go through all of the habitats together as a class, and learn why certain animals belong in that habitat and how their characteristics can help you to identify which habitat they belong in.*

FOCUS/KEY CONCEPTS

Students will be able to:

- **Science:** sort diverse living things by many different observable characteristics.
- **Science:** identify where animals get their basic needs in their habitat, which is a natural system that has many components that interact to maintain the system.

STANDARDS

National

- NGSS: K-2-ETS1-1, K-ESS3-1, 4-LS1-1 (LS1.A), 2-LS4-1
- CCSS-ELA: SL.1.1, SL.K.6

MATERIALS

- "Can You Help Me Find My Home?" habitat placemats (1 per pair)
- Deck of animal cards (1 per pair)
- 2D basic needs shapes (1 per pair)
- **Help Me Find My Home Assessment**

TEACHER PREPARATION

- Have students cut out the basic shapes before the activity.

VOCABULARY

- **Ocean** A region, biome or habitat that consists of a large body of salt water
- **Desert** A region, biome or habitat that has little to no vegetation due to the very small amount of rainfall in this area
- **Arctic** An extremely cold region, biome or habitat located at either end of the Earth that is ice-covered and consists of no trees and little vegetation

Help Me Find My Home

5. **Part 2: How does my habitat help me with my basic needs?** Earlier in the unit (Lesson 1), students were introduced to the idea of basic needs as things that animals need to survive (food, water, shelter, space and air). Once they have placed their animals correctly into their habitat, have them use the 2D basic needs shape markers to identify sources of food, water, shelter, space and air. Model an example animal in one habitat and show where that animal finds its basic needs by placing the basic needs shapes on the habitat. NOTE: You can work on beginning word sounds with the markers. **Say:** *Animals find their basic needs in the habitats where they live, that is why these animals can survive there.* After modeling the basic needs activity, have students choose one animal in their habitat and identify where that animal finds its basic needs in the habitat. Have each groups share the basic needs of the animal in their habitat so that all students have the chance to see the similarities and difference of how animals find their basic needs in their habitats.

CLOSURE

6. **Whole group summary.** To close the lesson, lead a discussion about the connection of the two parts of this lesson using the following questions as a guide:
   - How could the (physical) characteristics of the animals help with the placement of animals in the different habitats?
   - What do many of the arctic animals have in common?
   - What do many of the ocean animals have in common?
   - What did they notice about the basic needs of their animals in the habitats? (They were met through the habitat!)

7. **Individual practice.** To assess what students have learned about animals and habitats, have students individually complete the **Help Me Find My Home Assessment.**

8. **Tie back to the engineering challenge.** **Say:** *Today, we found where an animal can find its basic needs in its natural habitat.* **Ask:** *How can we use this when we are designing our hamster habitats and exercise trails?* We need to identify where the hamster can find its basic needs in the habitat and exercise trail.

TEACHER NOTES

Lesson 2B

ASSESSMENT

Pre-Activity Assessment
This pre-assessment activity will look at what students learned in the previous activity through these questions. Who can remember what we mean when we say the word, **habitat**? (A habitat is the natural home or environment of an animal, plant, or other organism.) We also made connections between habitats and basic needs. Who can remember what we said about the basic needs for humans? For frogs?

Activity Embedded Assessment
Student explanation of the **Can You Help me Find My Home?** sorting activity and placement of their basic needs shapes.

Post-Activity Assessment
Have students fill out the **Help Me Find My Home Assessment**

Lesson 2B

Can You Help Me Find My Home?

Place all of the animals that live in the **arctic** here.

Lesson 2B

Can You Help Me Find My Home?

Place all of the animals that live in the **desert** here.

Lesson 2B

Can You Help Me Find My Home?

Place all of the animals that live in the **rainforest** here.

Lesson 2B

Can You Help Me Find My Home?

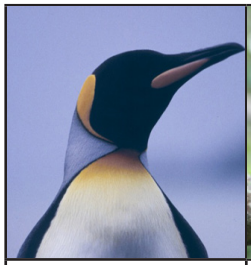
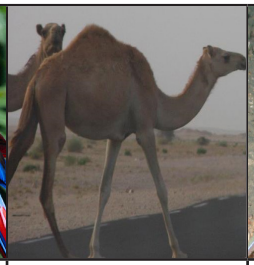
Place all of the animals that live in the **ocean** here.

Lesson 2B

Name_____

Help Me Find My Home Assessment

Directions: Draw a line from each animal to the correct habitat.

							
Penguin	Monkey	Dolphin	Parrot	Camel	Octopus	Tree Frog	Polar Bear

			
Desert	Ocean	Rainforest	Arctic

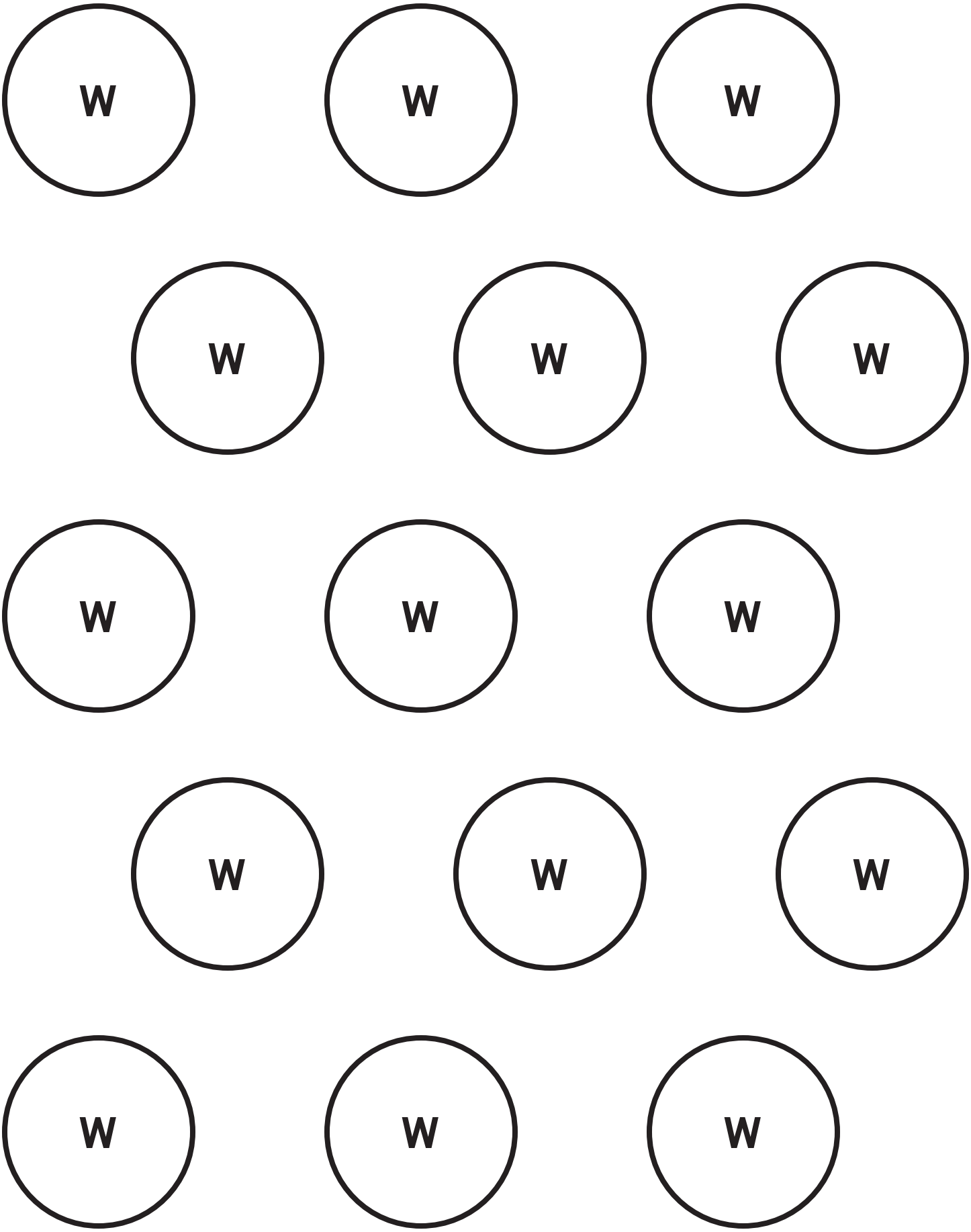
BASIC NEEDS 2D SHAPES

print on colored paper

or

print with colored ink

Print on **blue** paper.



Print on **yellow** paper.

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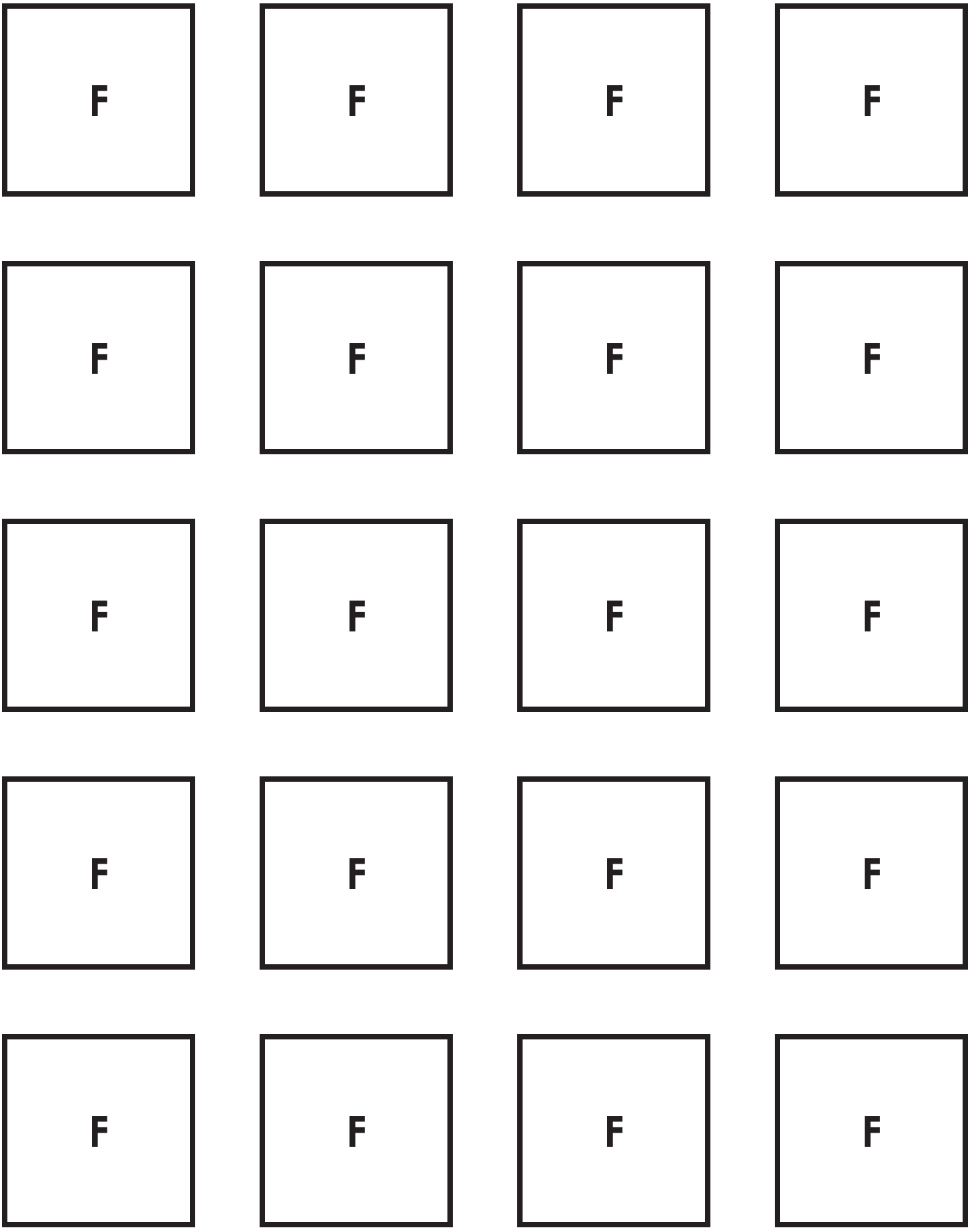
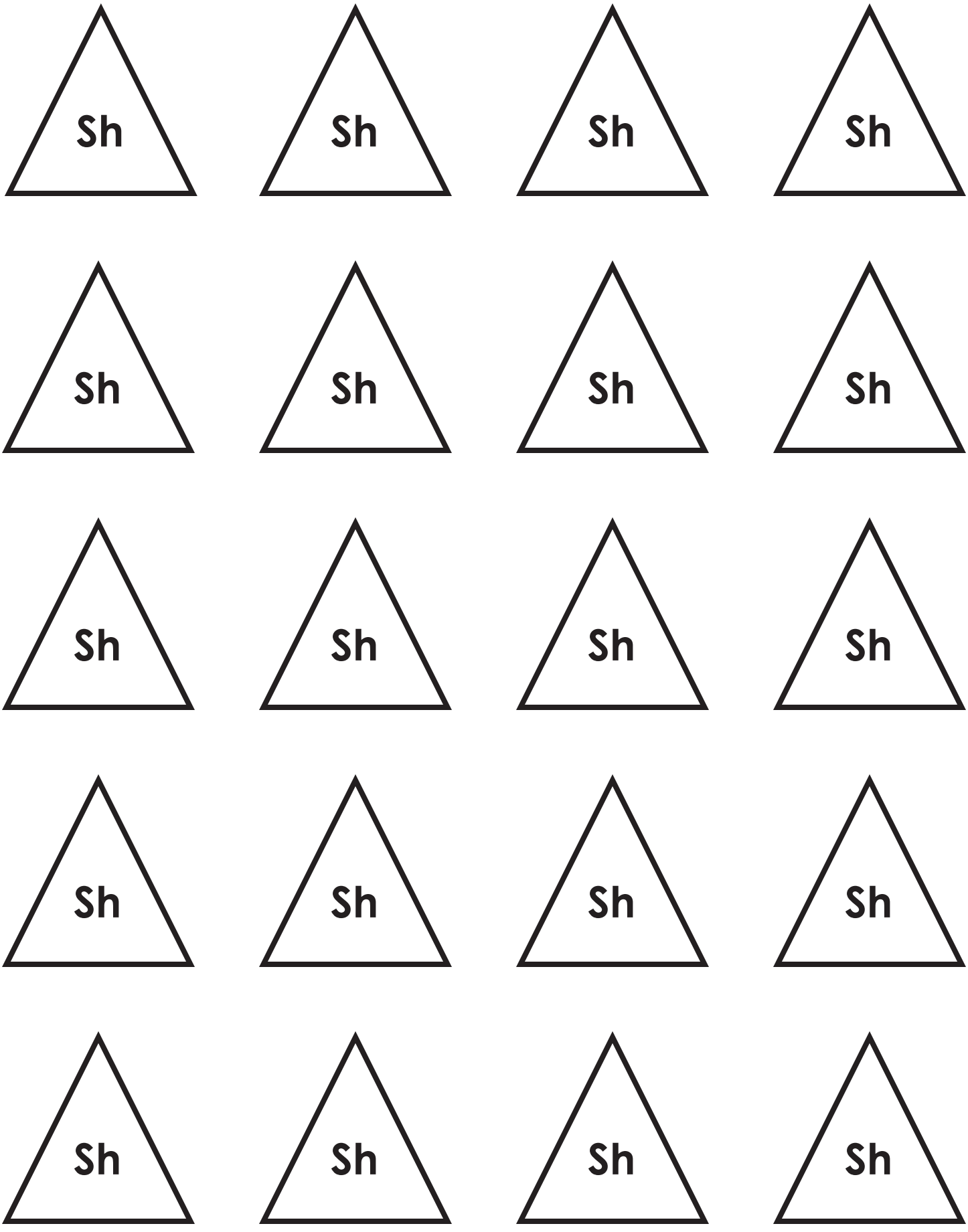
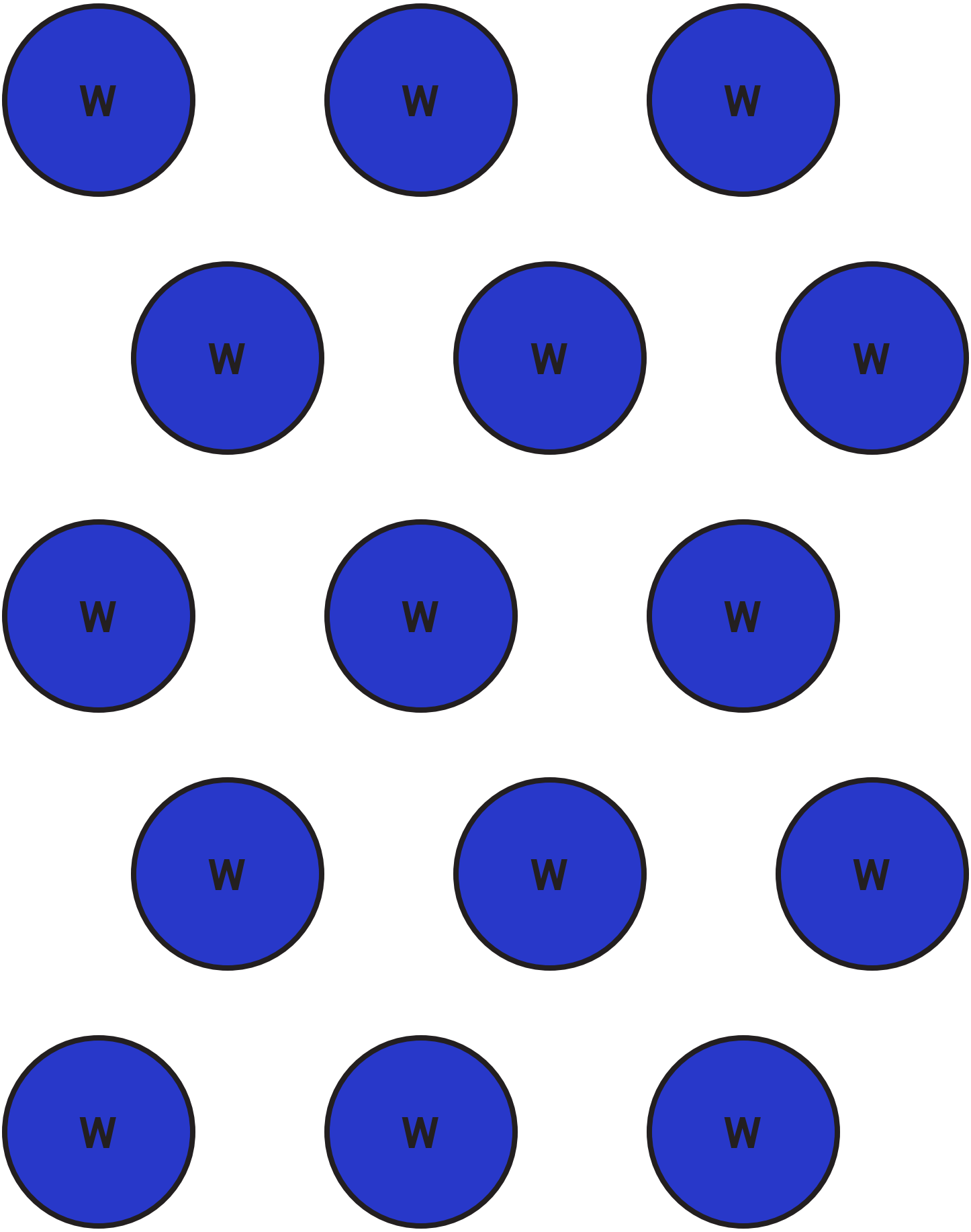


Print on **green** paper.

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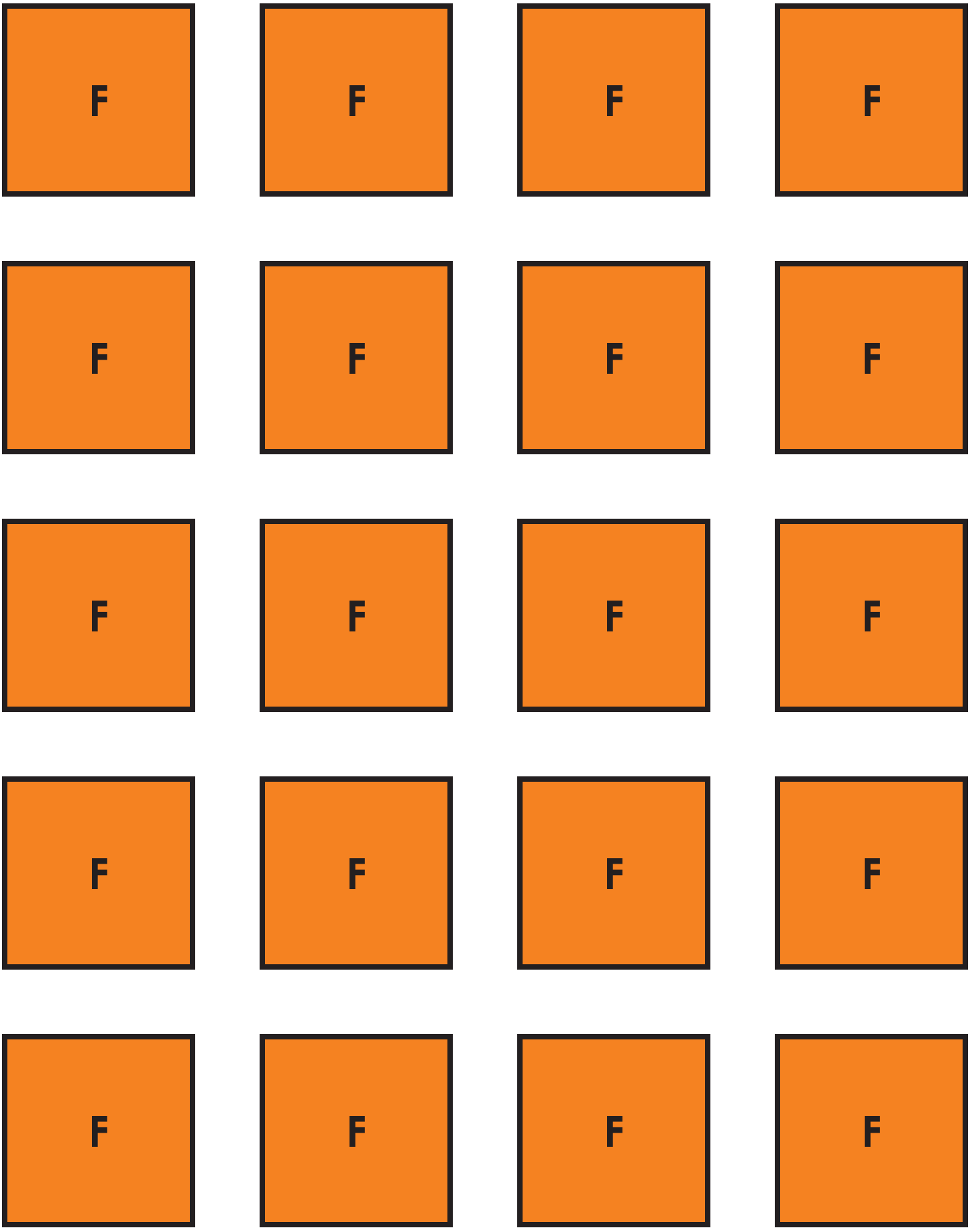
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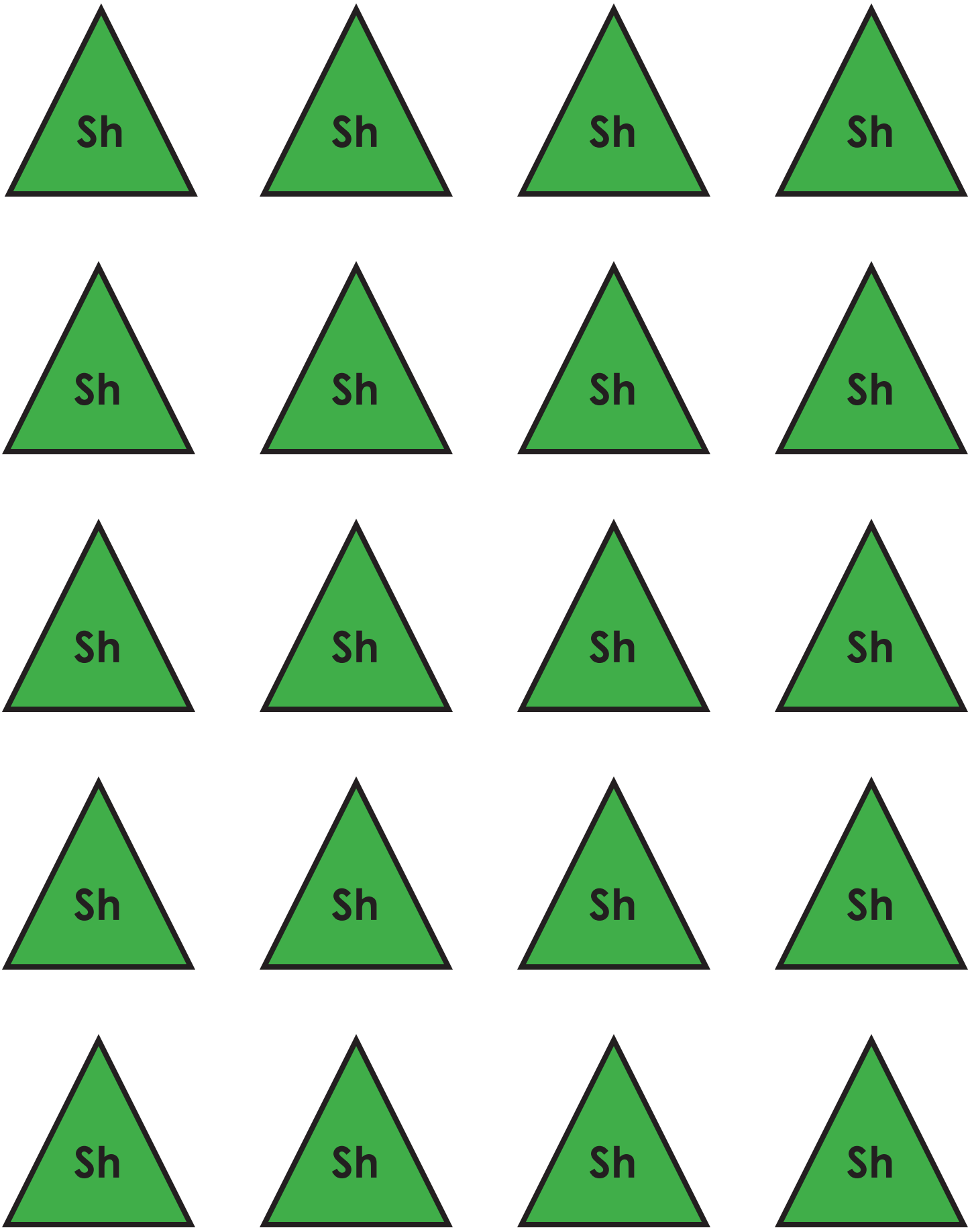
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Lesson 3A

FOCUS/KEY CONCEPTS

Students will be able to:

- **Literacy:** answer questions about what they are reading to promote understanding.
- **Mathematics:** describe basic shapes, 3-sided (triangle), 4-sided (quadrilateral), and 5-sided (pentagon).
- **Mathematics:** identify differences among various shapes and associate them with the correct names.

STANDARDS

National

- NGSS: K-2-ETS1-1, K-2-ETS1-2
- CCSS-ELA: SL.1.1, SL.K.6, RL.1.2, RL.1.7, RL.1.9
- CCSS-Math: 1.G.A.1, MP2

MATERIALS

See Unit Overview

TEACHER PREPARATION

- Prepare chart for Shapes in *The Greedy Triangle* (on chart paper, overheard, SMART board, etc.)

VOCABULARY

- **Triangle** A shape with three sides
- **Quadrilateral** A shape with four sides
- **Parallelogram** A four-sided shape with opposite sides the same length
- **Rectangle** A four-sided shape with opposite sides the same length and all angles the same
- **Square** A four-sided shape with all sides and all angles the same
- **Pentagon** A shape with five sides

The Greedy Triangle

SUMMARY OF LESSON

Through this literacy lesson, students will learn about the basic shapes: 3-sided (triangle), 4-sided (quadrilateral), and 5-sided (pentagon) by reading *The Greedy Triangle* by Marilyn Burns. This story is about an unhappy triangle who visits a shapeshifter to add sides and angles to become a new shape. This lesson builds background knowledge and sets the stage for the related STEM activity (Lesson 3B). Reading strategy: comprehension monitoring - questioning.

INTRODUCTION

1. **Connect to prior knowledge.** **Say:** *I remember once when I was unhappy because I wasn't tall enough to go on a ride at the fair with my brother. I wished I could be taller.* **Ask:** *Have you ever wished you could be different, like I wanted to be taller? Why?* **Say:** *Tell a partner about what you would like to change about yourself.* Give students 1 minute to share. **Say:** *The story today is about a triangle that is unhappy. When I read the story, I want you to listen and try to figure out why the triangle is unhappy.*

2. **Tie to engineering challenge.** **Ask:** *What is the problem we are working on?* We are designing a hamster exercise trail for a habitat cage. **Say:** *Today we are going to learn about shapes to help us design a good habitat for the hamster. In the last lesson, we used shapes to mark where the basic needs of animals were found in their natural habitat.* **Ask:** *What shapes did we use?*

3. **Identify where they are in the engineering design process. (Learn)** **Ask:** *Where do you think we are in the engineering design process? Where should we move our paper clip and why should we move it there?* Remind students they need lots of information to design a good habitat for the pet store and move paper clip to LEARN.

ACTIVITY - *The Greedy Triangle*

4. **Connect to prior knowledge.** **Ask:** *Can you name some shapes we have learned about in class? Can you describe the shape to me?* You are looking for basic shapes: triangle, square, rectangle, parallelogram. Record students' answers on chart paper (example shown below). Add to this chart as you learn about different shapes in the story.

Shapes in *The Greedy Triangle*		
Number of Sides	**Name**	**Picture**
3	Triangle	

5. **Introduce the book.** **Say:** *Today we are going to read* The Greedy Triangle *by Marilyn Burns. This book is a fiction book, and it is a story about mathematics.* **Ask:** *Are the stories in a fiction book true?* **Say:** *This is a story about a triangle who didn't like his shape.*

6. **Introduce the skill.** It is important for students' comprehension development to learn to interact with the text to promote their understanding of what they are reading. Ask higher-level questions to monitor understanding and help encourage appreciation of what they are reading through talking about the text.

7. **Read the story aloud.** While reading, use the following to guide the lesson development process:
   h. Teach new vocabulary at the point of contact.
   i. Target story comprehension with the following questions:
      - The triangle wanted to change, what did he want to change into?
      - How did the triangle become a _____ (quadrilateral, pentagon, etc.)?
      - The triangle was unhappy, why do you think he might have felt that way?
      - What lesson can we learn from the triangle?
      - Why do you think they called this book *The Greedy Triangle*?
   j. Encourage higher-level thinking and comprehension monitoring by pausing for 'teacher think alouds' and asking questions about the text.
   k. During the reading, continue to highlight the different shapes and continue to add the shapes to the chart.

CLOSURE

8. **Guided practice.** To check student understanding of the story by using higher level questioning and thinking, discuss the first two questions of the **Thinking About *The Greedy Triangle*** worksheet as a class. Discuss the last question and allow students to answer the question on their own by writing or drawing pictures. **Say:** *At the beginning of class, I talked about the time I was unhappy about not being tall enough to go on a ride at the fair. So, to make myself happy, I went on a ride I was tall enough to ride on!* **Ask:** *Think of a time you were unhappy. What did you do about it?* Have students write their answers on their worksheet and have them share their answers with the class.

9. **Whole class summary.** Review the chart that you made of the different basic shapes. This will be helpful when you talk about the tangrams and how shapes fit together in the STEM+C lesson.

10. **Tie back to engineering challenge.** **Say:** *We are going to use the shapes in this story in the next two lessons to learn about more shapes and to learn about how to tell Perri how a hamster could move through our habitats and exercise trails.*

TEACHER NOTES

Lesson 3A

ASSESSMENT

Pre-Activity Assessment
As a whole class, while keeping the Shapes in *The Greedy Triangle* chart paper in mind as the activity assessment, ask students if they have heard of each of the basic shapes (triangle, square, rectangle) and if they are able to explain, give an example or draw a picture of any of those shapes.

Activity Embedded Assessment
To assess the reading comprehension skill of comprehension monitoring, have students answer questions similar to the example questions listed in step 2 above.

Post-Activity Assessment
Complete the **Thinking About *The Greedy Triangle*** worksheet as a class.

Lesson 3A

Name_____

Thinking about *The Greedy Triangle*

1. **What happened to the greedy triangle?**

2. **What is one lesson we can learn from this story?**

3. **Think about a time when you were unhappy. What did you do about it?**

Lesson 3B

Exploring Animals and Tangrams

FOCUS/KEY CONCEPTS

Students will be able to:

- **Mathematics - Spatial reasoning:** rotate, flip, and slide 2D shapes in order to combine them to create new shapes.

STANDARDS

National

- NGSS: K-2-ETS1-1
- CCSS-ELA: SL.1.1, SL.K.6
- CCSS-Math: 1.G.A.1, 1.G.A.2

MATERIALS

- Shapes in *The Greedy Triangle* chart
- Book: *Three Pigs, One Wolf, and 7 Magic Shapes* by Grace Maccarone
- Large version of the duck tangram
- **Tangrams Oral Checklist** (Educator Resource)
- A set of tangrams (for each student OR pair)
- **Magic Shapes** tangram placemats (1/student, 4 animals with 4 differentiated levels)

TEACHER PREPARATION

- Prepare chart for duck tangram (on chart paper, overheard, SMART board, etc.)

VOCABULARY

- **Rotate** To turn around
- **Slide** To move along a surface while in contact with other surface
- **Flip** To turn over

SUMMARY OF LESSON

In this STEM+ C lesson, students build upon their knowledge and understanding of concepts about 2D shapes (triangle, square, and parallelogram) in order to sort objects in a set of tangrams based upon the characteristics that they learned in the related literacy activity (number of sides, picture, and name). Students work to exhibit fluency in naming these shapes appropriately and translating and rotating these shapes as they create different tangram animals with the shapes. This background knowledge is needed for both the algorithm development in Lesson 4B and the use of 3D shapes in Lesson 5B.

INTRODUCTION

1. **Connect to prior knowledge.** **Ask:** *In our last lesson, we read* The Greedy Triangle. *Who can remember that story and tell us what it was about?* A greedy triangle who thought that every other shape was having more fun and wanted to become a new shape, so it visited the "shapeshifter." **Say:** *Today, we are going to continue to learn about these basic shapes as we look at how they can be put together to form other shapes. We are going to read a story titled* Three Pigs, One Wolf, and 7 Magic Shapes, *and in that story we are going to meet some animals that we are going to make with our shapes. Are you ready to use our shapes to make those animals?*

2. **Tie to engineering challenge.** **Ask:** *What is the problem we are working on?* **Say:** *Today we are going to learn more about shapes to help us design a good exercise trail for the hamster.*

3. **Identify where they are in the engineering design process. (Learn)** **Ask:** *Where do you think we are in the engineering design process? Where should we move our paper clip and why should we move it there?* Remind students they need lots of information to design a good habitat for the pet store and move paper clip to LEARN.

ACTIVITY - Tangrams

4. **Review tangram shapes.** Review the Shapes in *The Greedy Triangle* chart to make sure that students are able to identify the shapes that make up each tangram set. **Say:** *Today you will be reading a story and you will be making the same animals that you see in the story so you will need to pay attention to the animals. When you see a new animal, raise your hand and we will record that animal on the chart paper to help us remember later.*

5. **Read the story aloud.** Start to read through the book *Three Pigs, One Wolf and 7 Magic Shapes* by Grace Maccarone with the students. You can pause while reading and have students make the tangram animals as you read or read the entire story and make the tangram animals after you finish reading.

6. **Model how to use tangrams.** Either while you are reading or after you finish the entire story, students will be working on manipulating the shapes to make the different images in the book *Three Pigs, One Wolf and 7 Magic Shapes*. **Say:** *You might need to rotate (or turn), flip, and slide the shapes to make some of the animals in the story*. Show

Exploring Animals and Tangrams

your students the first animal and have them identify the names of the different shapes that they will be using to make their animals. Together fill in the first animal as a model of what they will be doing. Remind them that they might need to rotate, flip, or slide the shapes to make some of the animals in the story.
NOTE: You may need to practice the actions of rotating, sliding, and flipping with the shapes to scaffold this activity.

7. **Individual or pair practice.** Give each pair or individual student outlines (tangram mats) of the animals they are going to fill using the appropriate shapes to form the animals in the story. Encourage students to name the animals whose outlines they have filled to promote connection between names of animals and their symbolic representations.
NOTE: There are four different levels for this activity to account for different ability levels with shapes and tangrams: level 1 - full-size shapes with each tangram piece defined, level 2 – reduced-size shape in the corner with each tangram piece defined, level 3 - full-size shapes with only the outline, level 4 – reduced-size shape in the corner with only the outline. You can use the **Tangrams Oral Checklist** as an assessment during this activity.

CLOSURE

8. **Whole group summary.** To bring closure to the activity, have students put their tangrams back into the bags and come sit in the front of the room. Together as a class, show one big version of the duck tangram. **Ask:** *Can you please help me move my tangrams to fit into the picture?* As you are putting tangrams onto the board/ chart paper, **ask:** *Can someone explain how they know where the pieces go and what characteristics of the shape helped you to know that?* For example, the other shapes are too big or too long, or the long flat edge showed me that the pieces needed to fit together. This type of talking aloud will help you to gather some information about the students' knowledge of the attributes of 2D shapes and their ability to put these shapes together to form bigger shapes, like two triangles to form a square or rectangle.

9. **Tie back to the engineering challenge**. **Say:** *Today, we learned about how we can fit shapes together to create new shapes.* **Ask:** *What are some of the things you did to get the shapes to fit together?* Rotate, flip, or slide the shapes. **Say:** *When you work on your design for Perri, you will need to rotate, flip, or slide the shapes you use to create a fun and exciting exercise trail for the hamster.*

TEACHER NOTES

Lesson 3B

ASSESSMENT

Pre-Activity Assessment
Discussion with students around the basic shapes that they learned in the reading lesson to make sure that they have an understanding and can name the basic shapes.

Activity Embedded Assessment
Completion of the student tangram sheets at one of the three levels depending on the ability of the students. Oral checklist of which level students could master (see **Tangram Oral Checklist**).

Post-Activity Assessment
Test student knowledge of the attributes of 2D shapes. Watch the students put the shapes together.

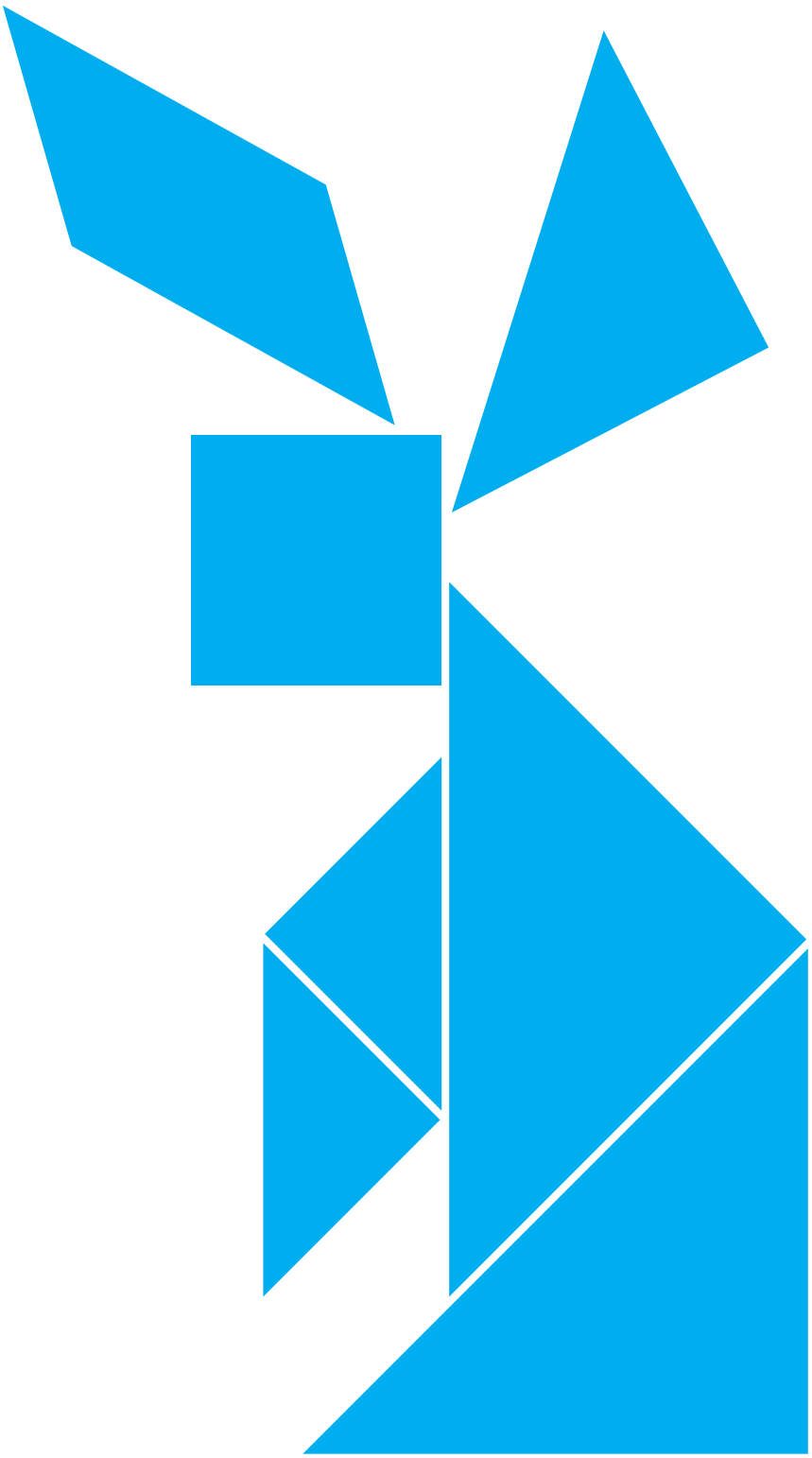
EXTEND THE LESSON
Read the book *Grandfather Tang's Story* by Ann Tompert . The book tells the story of Grandfather Tang, little Soo and the wonders of tangrams as they rearrange themselves from foxes and rabbits to crocodiles and lions. You can have students recreate these tangram animals as well.

Lesson 3B

Magic Shapes

Level 1

Directions: Use tangrams to make the animal from the story below.

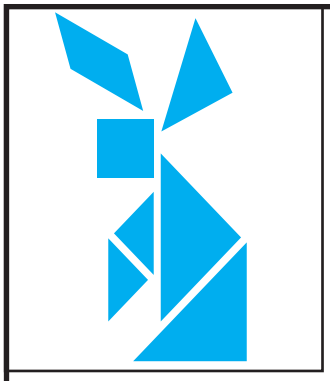


Lesson 3B

Magic Shapes

Level 2

Directions: Use tangrams to make the animal from the story below.

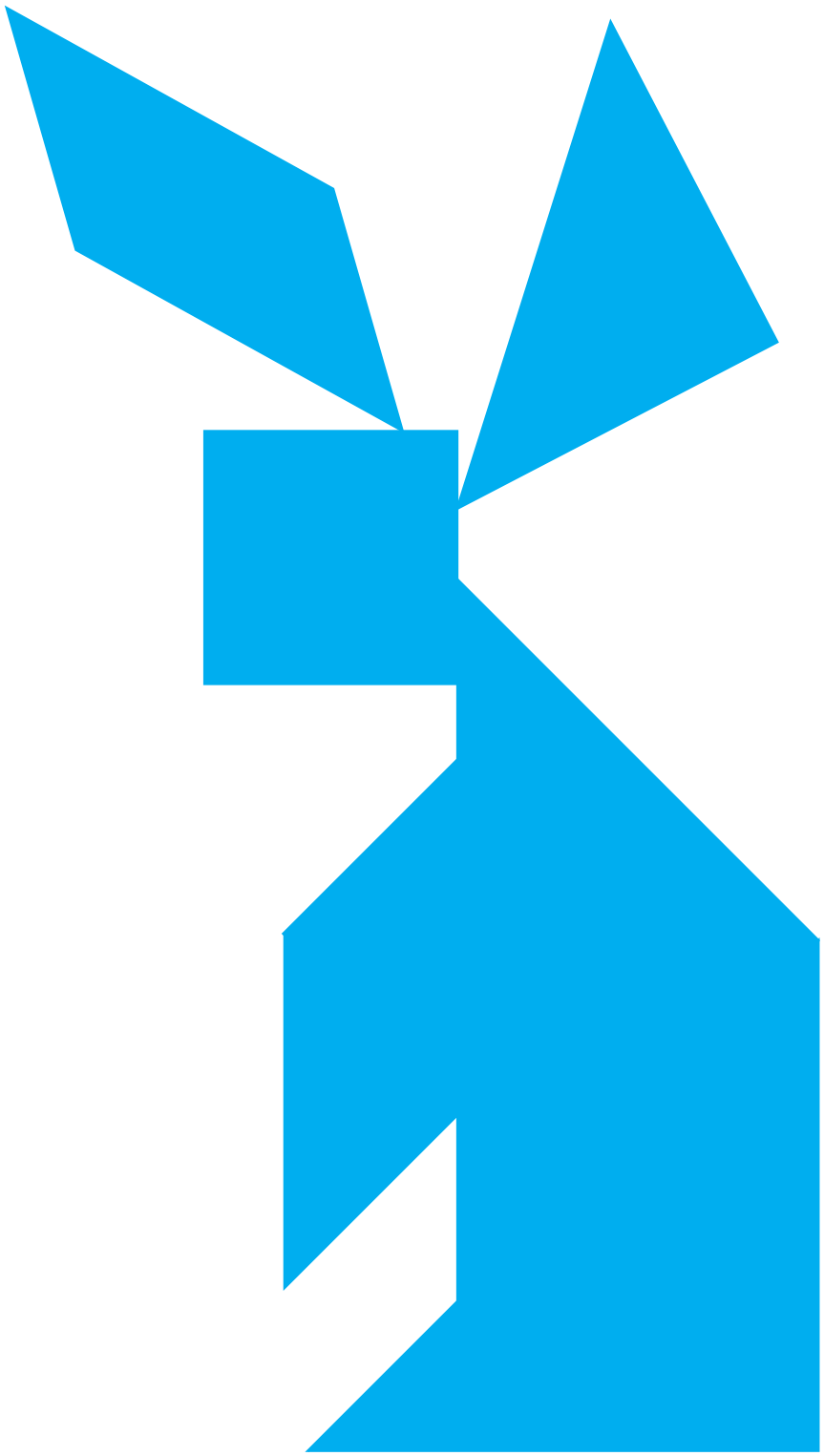


Lesson 3B

Magic Shapes

Level 3

Directions: Use tangrams to make the animal from the story below.

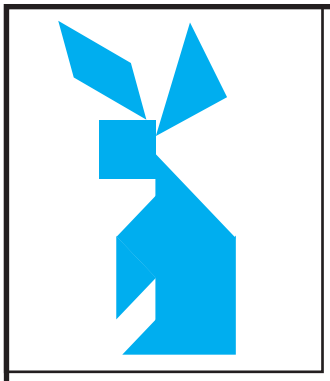


Lesson 3B

Magic Shapes

Level 4

Directions: Use tangrams to make the animal from the story below.

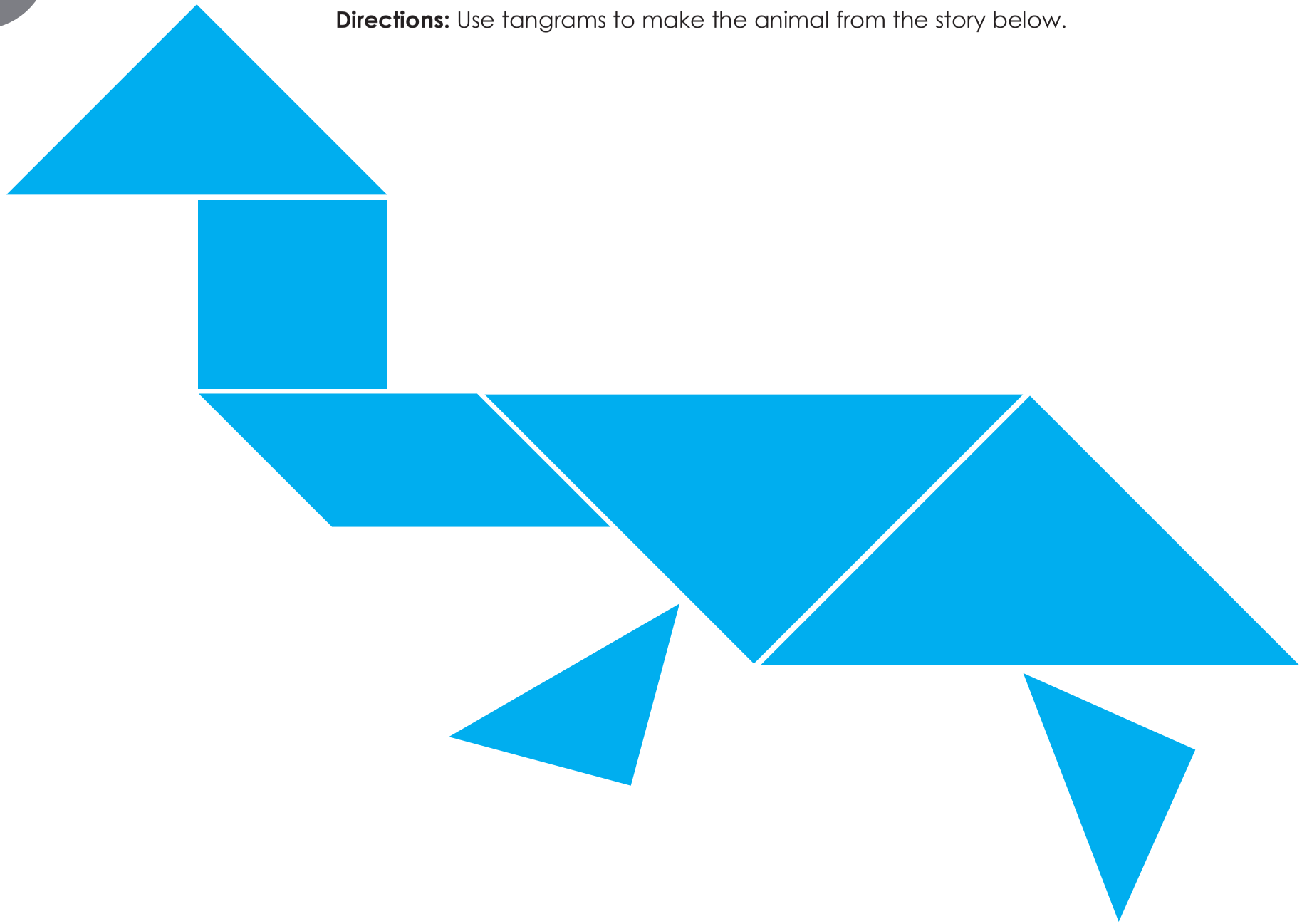


Lesson 3B

Magic Shapes

Level 1

Directions: Use tangrams to make the animal from the story below.

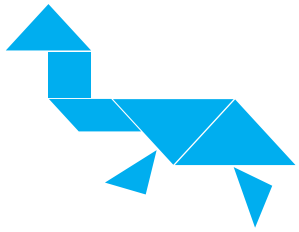


Lesson 3B

Magic Shapes

Level 2

Directions: Use tangrams to make the animal from the story below.

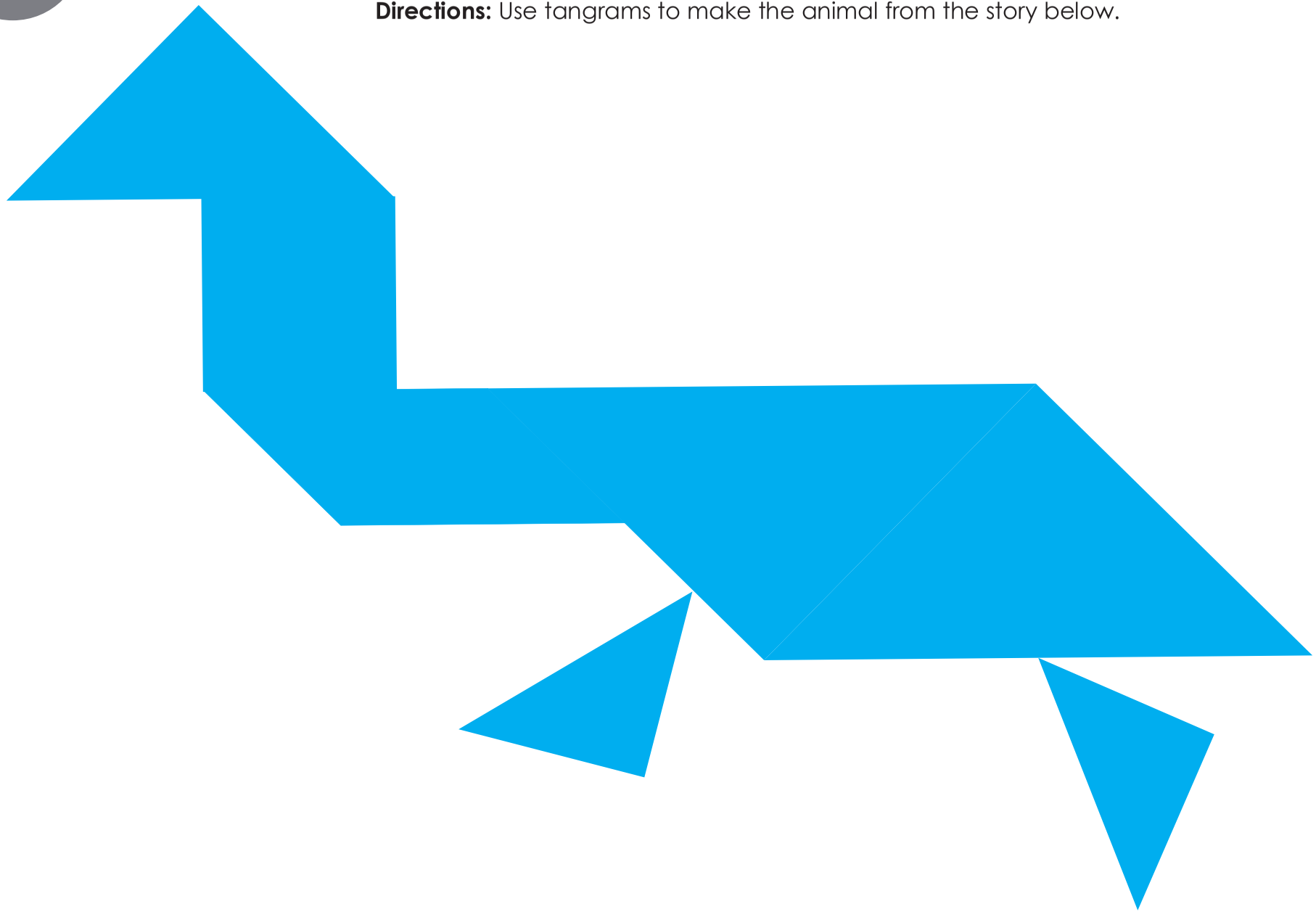


Lesson 3B

Magic Shapes

Level 3

Directions: Use tangrams to make the animal from the story below.

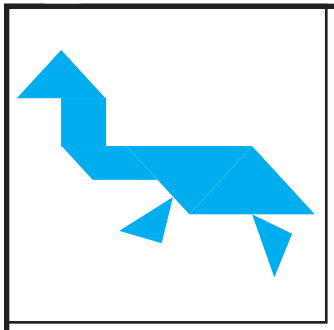


Lesson 3B

Magic Shapes

Level 4

Directions: Use tangrams to make the animal from the story below.



Lesson 3B

Magic Shapes

Level 1

Directions: Use tangrams to make the animal from the story below.

Lesson 3B

Magic Shapes

Level 2

Directions: Use tangrams to make the animal from the story below.

Lesson 3B

Magic Shapes

Level 3

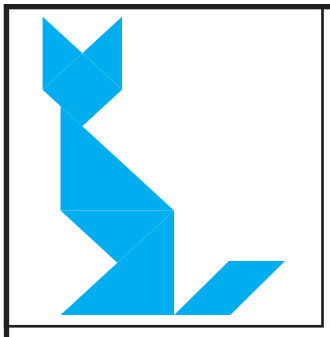
Directions: Use tangrams to make the animal from the story below.

Lesson 3B

Magic Shapes

Level 4

Directions: Use tangrams to make the animal from the story below.

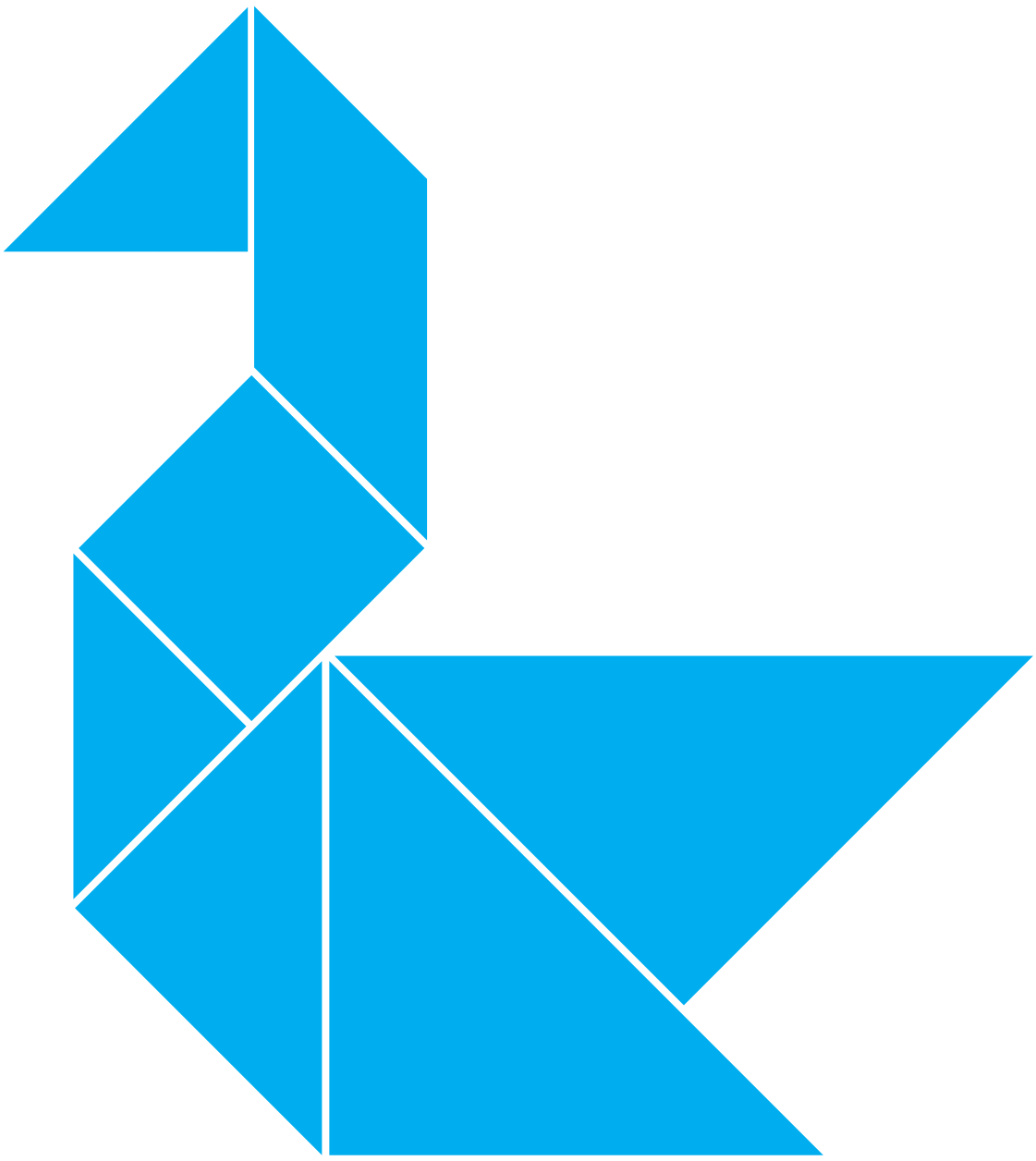


Lesson 3B

Magic Shapes

Level 1

Directions: Use tangrams to make the animal from the story below.

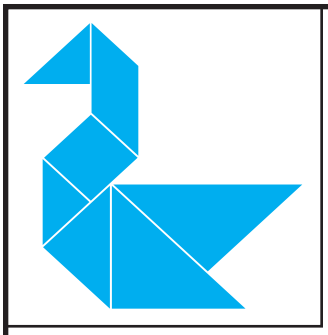


Lesson 3B

Magic Shapes

Level 2

Directions: Use tangrams to make the animal from the story below.

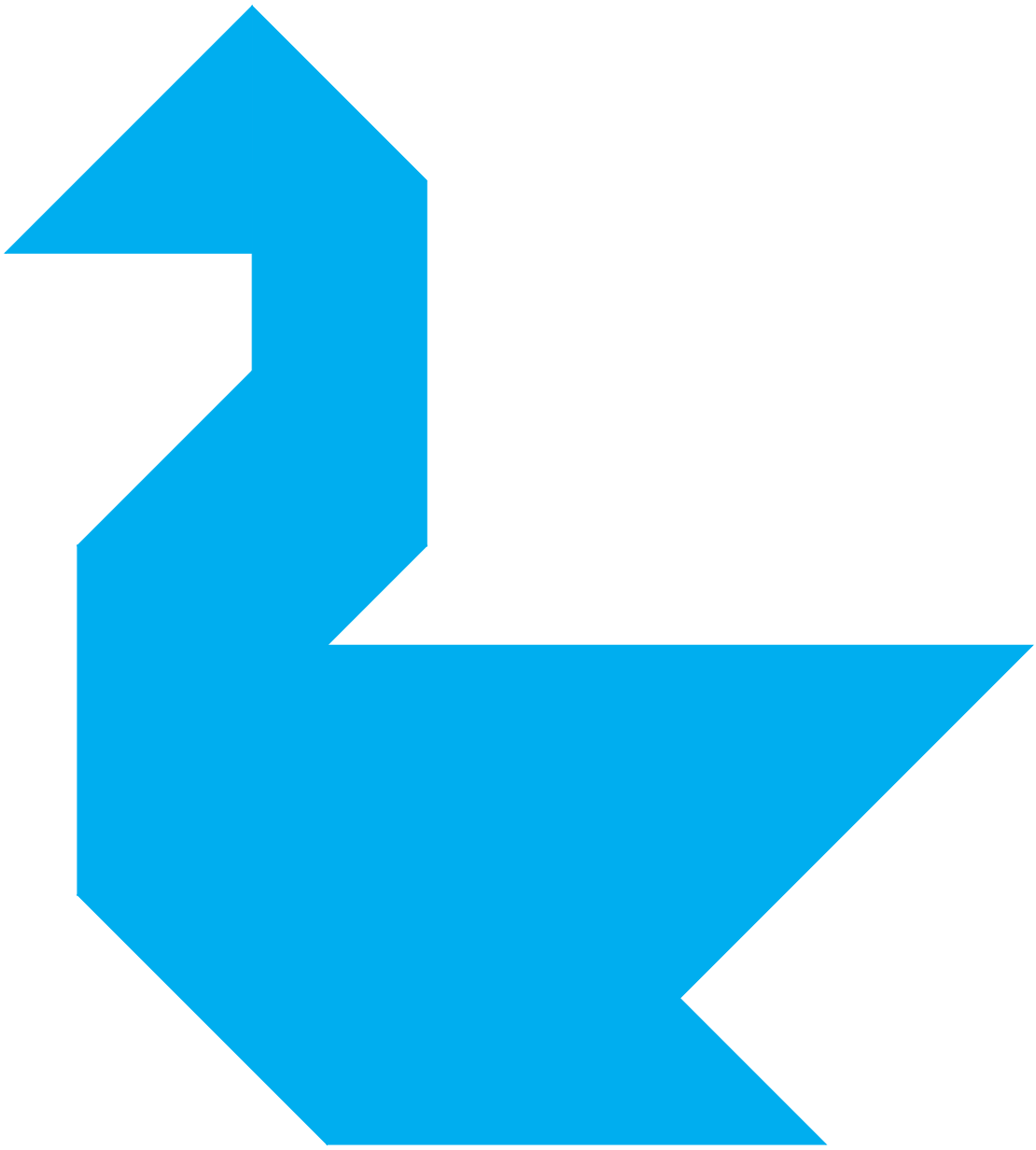


Lesson 3B

Magic Shapes

Level 3

Directions: Use tangrams to make the animal from the story below.

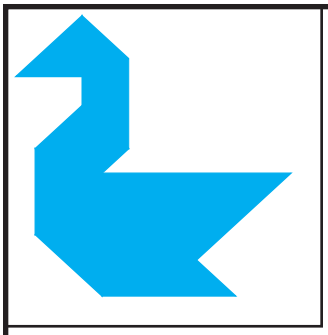


Lesson 3B

Magic Shapes

Level 4

Directions: Use tangrams to make the animal from the story below.



Lesson 3B

Tangrams Oral Checklist

Mark the level of student (or partners) during the **Magic Shapes** activity:

M = Mastery

P = Progressing

Name of Student (or Partners)	**Level 1:** Full size with shapes outline	**Level 2:** Small picture with shapes outline	**Level 3:** Full size with outside outline only	**Level 4:** Small picture with outside outline only

Lesson 4A

Joey and Jet

FOCUS/KEY CONCEPTS

Students will be able to:

- **Literacy:** use prepositions to describe actions. Use flowcharts to organize the sequence of events in a story.
- **Computational Thinking - Algorithms & Procedures:** sequence the events of the story using a flowchart.

STANDARDS

National

- NGSS: K-2-ETS1-1
- CCSS-ELA: SL.1.1, SL.K.6, RL.1.7, L.1.1.I
- CSTA: 1A-A-5-3

MATERIALS

See Unit Overview

TEACHER PREPARATION

- **Flowchart -Jet Chases** and **Flowchart - Jet Returns** placemats for each student. Lamination is recommended for reuse.
- One classroom **Flowchart-Jet Chases** for demonstration
- One set of **Jet Preposition Cards** for each student. Lamination is recommended for reuse.

VOCABULARY

- **Preposition** Words that show relationships between objects in a sentence. The prepositions in this lesson are all related to spatial relationships. Prepositions from the book: among, through, on, down, up, across, between, over, into, out of.

SUMMARY OF LESSON

In this literacy lesson, students work on prepositions and sequencing in a story using the book *Joey and Jet* by James Yang. This book takes students through a game of fetch from the perspective of the dog, Jet. Students sequence the actions from the story, reverse the sequence, and learn preposition words to use when giving directions to Perri on how the hamster will move through the exercise trail. Reading strategy: sequencing to help retell events of the story.

INTRODUCTION

1. **Connect to prior knowledge.** Ask students about the game of fetch. Allow students to describe what they know. Follow up with making sure everyone understands the game. **Say:** *The story today is about a boy named Joey and his dog Jet that are playing fetch. Jet has to run through many obstacles as he chases the ball and returns to Joey.*

2. **Tie to engineering challenge.** **Ask:** *What is the problem we are working on? What do we need to give Perri so that her customers know how to build your designs?* A picture of our habitat prototypes and a set of directions of how the hamster will travel through the exercise trail. **Say:** *Today we are going to learn about putting actions in order to help us when we have to give our directions to Perri.*

3. **Identify where they are in the engineering design process. (Learn)** **Ask:** *Where do you think we are in the engineering design process? Where should we move our paper clip and why should we move it there?* Remind students they need lots of information to design a good habitat for the pet store and move paper clip to LEARN. **Say:** *We are learning about flowcharts, and how they can help us make a step-by-step plan for our hamster habitat.*

ACTIVITY - Sequencing

4. **Discuss prepositions as a part of speech.** Gather the students for a "Read Aloud". **Say:** *Before we begin reading our book, let's play Simon Says.* This game will prepare students to listen for the prepositions in the book and words to use for giving directions. Give several directions using prepositions from the book - examples: put your hands **on** your head, put your right arm **out**, etc. **Say:** *Simon gave you directions to follow. Tell me some of the words that helped you follow my directions?* Post the preposition words they say on the board, interactive whiteboard, etc. Make sure to use some or all of the following prepositions: *among, through, on, down, up, across, between, over, into, out of.*

5. **Introduce the literacy skill – describing major events in a story using flowchart retelling.** A flowchart is a way to help students think about the sequence of key events in a story. By placing each event in a rectangle and connecting them with arrows, this graphic organizer helps students to organize their thoughts as they retell a story. **Say:** *We are going to learn about using flowcharts as a way to keep track of what happens in our story today.* Explain flowcharts to the students. Put a sample flow chart on the board. Explain how a flow chart works and why it helps retell the important events in a story.

6. **Introduce the book.** *Joey and Jet* by James Yang. **Say:** *This is a story about a boy named Joey playing fetch with his dog, Jet. We are going to try to remember what Jet is doing while he is chasing his ball so we can retell the story.*

7. **Read the first part of the story aloud.** Stop reading when you reach the page that says "out of a hole!" (about ¾ of the way through the book). While reading, guide the literacy learning:
   - **Teach prepositions at the point of contact:** Tell students to raise their hand when they hear a preposition that matches one on the board. You can point out that all the preposition words in the book are written in bold so they can recognize them when you show the pictures.
   - **Target story comprehension:** As you read, help students remember the steps that Jet goes through to get the ball. Review this as you progress through the book.

8. **Work on prepositions.** Give each student a set of preposition cards. Have the students fill in the correct prepositions by writing it on each card

9. **Flowchart the beginning of the story.** Have the students return to their desks for the flow chart activity. **Say:** *Now we are going to retell the story of Joey and Jet by using our cards.* Have students do the following:
   a. Have students put the cards in the order that Jet did each action as he chased the ball. You may need to review the story with them as they do this.
   b. Give each student a copy of the **Flowchart – Jet Chases** placemat. **Ask:** *How many rectangles do you see on your flowchart? Do you see anything else on the flowchart?* Take answers. Ask them what the arrows mean. **Say:** *Look at each card and think about our story. Now you can retell the story by placing a card on each rectangle in the same order it happened in the story.* Have the students check their flowcharts as you reread the first part of the story (Jet chasing the ball).

10. **Flowchart the rest of the story before reading it. Ask:** *What has just happened in our story?* Jet has reached the ball. **Ask:** *What has to come next in the game of fetch?* Jet has to return the ball. **Say:** *We are going to try to figure out what actions Jet will have to take to get back to Joey.* Pass out the **Flowchart – Jet Returns** placemat. Have students try to order the things that Jet will have to do to get back to Joey. Have students check their work as you read the final part of the story.
    NOTE: The return flowchart is not simply the reverse of the chase flowchart. Jet must again first go into a hole, then out of a hole. The hills are not in the correct order in the return trip in the book (Jet should go down, then up the hill). Accept both directions for the hill.

CLOSURE

10. **Whole class summary.** Review the steps Jet had to take to get to the ball and to return it to Joey. **Ask:** *Was any part of reversing Jet's action difficult for you? Why?* Take answers - highlight higher-order thinking skills needed to reverse the hill and holes.

11. **Tie back to the engineering challenge.** Remind students how this connects to the directions they need to give to Perri for their hamster habitat design.

TEACHER NOTES

Lesson 4A

ASSESSMENT

Pre-Activity Assessment
Discuss with students about the game of fetch. Look for how students sequence the game.

Activity Embedded Assessment
Completion of the prepositions on the cards: Look for students' ability to recognize and write the prepositions needed for each action.

Completion of the **Flowchart – Jet Chases** placemat: look for student ability to recall the events of the story in order.

Completion of the **Flowchart – Jet Returns** placemat: look for students' ability to reverse the actions while still making sense of them (noting the order of the holes and hills in particular).

Post-Activity Assessment
Listen for answers to the whole class summary that show students noticed having to think differently when considering the holes and hills.

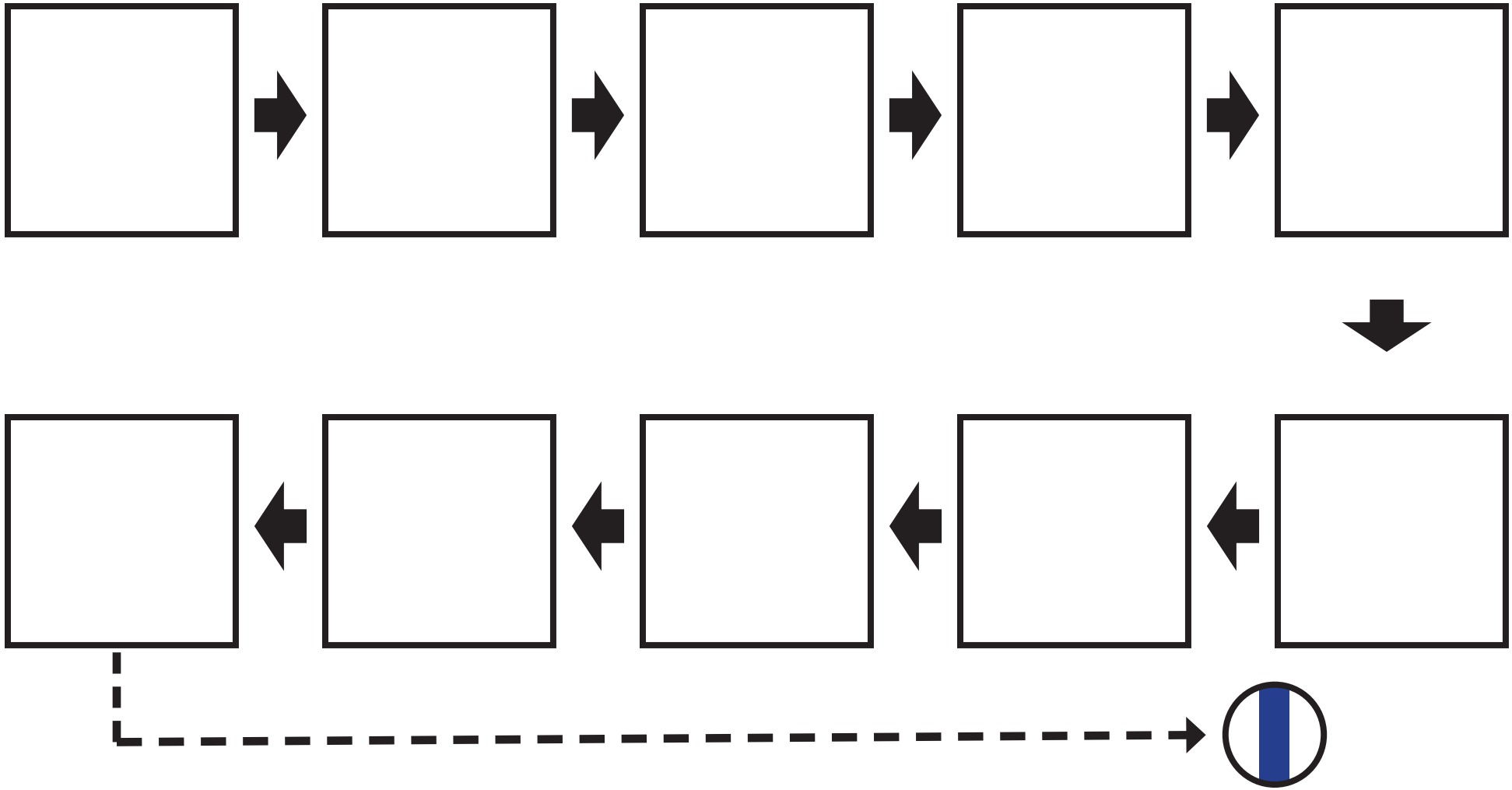
EXTEND THE LESSON

Have students make flowcharts for the events of other stories.

Lesson 4A

Flowchart - Jet Chases

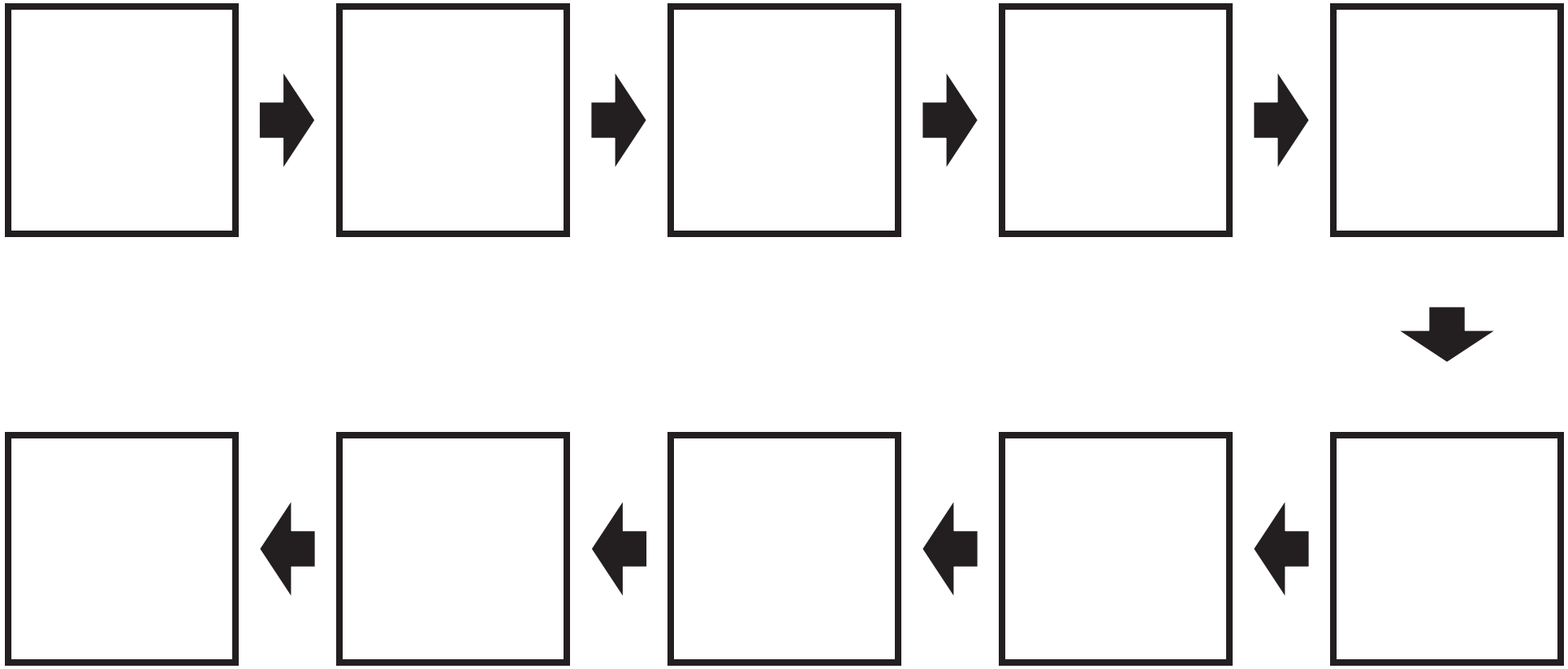
Jet chases the ball...



Lesson 4A

Flowchart - Jet Returns

Jet found his ball and ran...



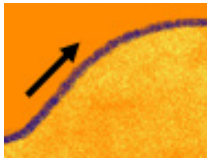
...back to Joey!

the birds

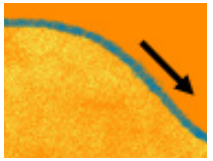
the trees

the water

the hill



the hill



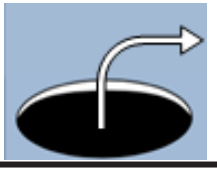
the street

the tables

the roofs

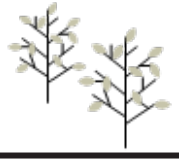
a hole

of a hole



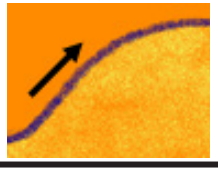
the birds

the trees

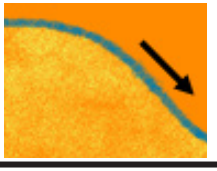


the water

the hill



the hill



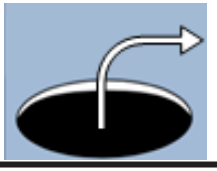
the street

the tables

the roofs

a hole

of a hole



Lesson 4B

FOCUS/KEY CONCEPTS

Students will be able to:

- **Mathematics:** compose 2D shapes to create composite shapes.
- **Computational Thinking - Algorithms & Procedures:** follow and create algorithms.

STANDARDS

National

- NGSS: K-2-ETS1-1
- CCSS-ELA: SL.1.1, SL.K.6
- CCSS-Math: 1.G.A.2
- CSTA: 1-A-A-5-3, 1A-A-3-7

MATERIALS

- Shapes in *The Greedy Triangle* chart
- **Tangram Mat**
- **Develop Your Own Algorithm** worksheet
- Algorithms for Lesson 4B Educator Resource

TEACHER PREPARATION

- Put up The Shapes in *The Greedy Triangle* chart from Lesson 3A
- Laminate **Tangram Mats**
- Prepare displays of **Algorithms List**

VOCABULARY

- **Algorithm** A set of steps to follow to complete a task

Algorithms with Tangrams

SUMMARY OF LESSON

This STEM+C lesson ties into the work with tangrams and sequencing in the previous lessons as students are introduced to the concept of algorithms. Students use their knowledge of both sequencing and tangrams to develop algorithms to make basic tangram shapes. As part of the design requirements for Perri, students will develop an algorithm to give to Perri that helps Perri and her customers understand how a hamster will use the habitat they designed.

INTRODUCTION

1. **Connect to prior knowledge.** **Ask:** *In our last lesson, we made shapes with tangrams as we read the book* "Three Pigs, One Wolf and 7 Magic Shapes". *Who can help remind the class what we did?* The story had the pigs meeting the 7 magic shapes that were in the forms of animals or objects. As the pigs met the 7 magic shapes' characters, we made the same characters with our tangrams. **Ask:** *What did you have to do with the seven shapes to make them look like the characters in the book?* We had to rotate (turn) them, flip them, and move (slide) them together so they looked like the characters.

2. **Tie to engineering challenge.** **Ask:** *What is the problem we are working on?* **Say:** *To help make sure that her customers know how to set up your design, Perri asked that we give directions for how the hamster will travel. Today we are going to learn to give directions related to the shapes to help us design a good habitat for the hamster.*

3. **Identify where they are in the engineering design process. (Learn)** **Ask:** *Where do you think we are in the engineering design process? Where should we move our paper clip and why should we move it there?* Remind students they need lots of information to design a good habitat for the pet store and move paper clip to LEARN.

ACTIVITY - Following algorithms using tangrams

4. **Review tangram shapes.** Review the Shapes in *The Greedy Triangle* chart to make sure that students are able to identify the shapes that make up each tangram set. This time, you will need to add information to be able to differentiate the triangles: small triangles, medium triangles and large triangles. **Say:** *Today we will be learning to make and follow* ***algorithms****. Say it with me: al-go-ri-thm. An algorithm is a set of steps to follow to complete a task. We are going to make and follow algorithms to make shapes with our tangrams.*

5. **Model how to follow an algorithm with the tangrams.** Put up **Algorithm 1. Say:** *Look at the algorithm I have written on the board. Let's try to follow this algorithm together.* Have the students follow along as you demonstrate how to follow the algorithm. You may need to read these steps out loud as you go. To do this, use an overhead projector and clear tangrams, an interactive whiteboard and movable tangrams, a document camera, or some other appropriate class tangram demonstration tool. Have them use the **Tangram Mat** with the directions (top, bottom, left, right) for their

Algorithms with Tangrams

work space. **Say:** *Notice how everyone's tangrams should look very similar. Let's try one that allows everyone to follow the directions but also allows for differences.*

Put up **Algorithm 2**. You may need to read out loud to your students. **Say:** *Notice the differences in many of your shapes.* Give students a chance to look at others' shapes. **Ask:** *When we are following an algorithm or set of directions, why do you think it might be important sometimes for everyone to get the same results, but other times have differences?* Take lots of different answers here. Make sure to end the conversation on the engineering design challenge. The set of directions we give the pet shop would need to be specific if we want our design to be exactly how we designed it. **Say:** *We are going to focus on algorithms that give us the same results. We will use an algorithm to help Perri's Pet Palace understand our designs.*

6. **Students individually follow an algorithm.** Put up **Algorithms 3 and 4** one at a time and allow the students to follow these algorithms. You will likely need to read the steps out loud to the students. You should model how to do it after each student has had an opportunity to try each of these. If time allows, you can make up others. **Algorithm 5** is optional if there is time or some students are finished early.

7. **Students develop their own algorithm.** Have students complete the **Develop Your Own Algorithm** worksheet individually.

CLOSURE

8. **Tie to book *Joey and Jet*.** **Ask:** *What did we do today?* Use and develop algorithms to give directions to make tangram shapes. *How is this like our book Joey and Jet?* Jet's sequence of events to get the ball and go back to Joey is like an algorithm.

9. **Tie to engineering design challenge.** Remind students of the engineering challenge through questions. Also remind them that they will communicate their hamster habitat designs through an algorithm of how the hamster will travel through their habitat trail.

TEACHER NOTES

Lesson 4B

ASSESSMENT

Pre-Activity Assessment
Discussion about making tangram shapes. Look for student identification of geometry translations (flip, slide, and rotate).

Activity Embedded Assessment
Completion of the shapes by following the algorithms. Look for students' ability to follow instructions, understand the basic information about the shapes and the ability to do the geometric translations.

Post-Activity Assessment
Have students follow simple algorithms. Test students' knowledge of the attributes of two-dimensional shapes. Watch the students put the shapes together.

EXTEND THE LESSON

1. Show a tangram shape and an algorithm for the shape that has something wrong. Have students debug the algorithm.
2. Show a tangram shape and provide students with all of the steps of the algorithm cut up. Have students sequence the steps to make a correct algorithm.
3. **Advanced** – Have students work in pairs. Give each student a different tangram shape. Have the students make an algorithm based on their shape. Then have them trade written or spoken algorithms while the other tries to make the shape with the tangrams.

Lesson 4B

Tangram Mat

top

left

right

bottom

Lesson 4B

Name_____

Develop Your Own Tangram Algorithm

Develop your algorithm.

Directions: Circle the statement of your choice for each step of your algorithm.

Step 1:	Use the _____.				
Circle one:	little triangle	medium triangle	big triangle	parallelogram	square
Step 2:	Put it _____.				
Circle one:	at the top	at the bottom	on the left	on the right	
Step 3:	Use the _____.				
Circle one:	little triangle	medium triangle	big triangle	parallelogram	square
Step 4:	Put it on the _____ of the first shape.				
Circle one:	top	bottom	left	right	
Step 5:	Slide it so it touches the first shape.				

Try your algorithm.

Directions: Follow your algorithm above using tangrams and your mat.

Answer the question.

Do you think that everyone who follows your directions above will get the same shape?

Circle one: yes no

Lesson 4B

Algorithms List

Algorithm 1

Step 1: Use the two large triangles.
Step 2: Put the long edge of each triangle together to make a big square.
Step 3: Use the medium triangle.
Step 4: Put the long edge of the medium triangle against the top of the square.

Algorithm 2

Step 1: Use the two small triangles.
Step 2: Put them side-by-side.
Step 3: Use the parallelogram.
Step 4: Put it below the two small triangles.
Step 5: Slide it so it touches at least one of the triangles.

Algorithm 3

Step 1: Use the square.
Step 2: Put the square in the middle of your work space.
Step 3: Use one large triangle.
Step 4: Put the middle of the long edge of the large triangle against the right side of the square.
Step 5: Use the other large triangle.
Step 6: Put the middle of the long edge of the large triangle against the left side of the square.

Algorithm 4

Step 1: Use the small triangle.
Step 2: Put the small triangle toward the top of your workspace.
Step 3: Rotate it so the long edge is toward the bottom.
Step 4: Use the medium triangle.
Step 5: Rotate it so the long edge is toward the bottom.
Step 6: Put it below the small triangle so it touches in the middle.
Step 7: Use the large triangle.
Step 8: Rotate it so the long edge is toward the bottom.
Step 9: Put it below the medium triangle so it touches in the middle.
Step 10: Use the square.
Step 11: Put the side of the square below the large triangle so it touches it in the middle.

Algorithm 5 (optional)

Step 1: Use one of the small triangles.
Step 2: Rotate it so that the long edge is toward the left.
Step 3: Use the other small triangle.
Step 4: Put it to the right of the first small triangle.
Step 5: Rotate it so that the long edge is toward the right.
Step 6: Slide the two small triangles so that the points touch in the middle of the workspace.
Step 7: Use the square.
Step 8: Put it below the two triangles.
Step 9: Turn the square so that the points are toward the top and bottom and left and right.
Step 10: Slide the square so that it fits in the space created by both triangles and touches both.

Lesson 5A

FOCUS/KEY CONCEPTS

Students will be able to:

- **Literacy:** identify new vocabulary words ("juicy" words) and use strategies for determining the meaning of those words.
- **Engineering:** discuss the importance of testing materials before you build a prototype.

STANDARDS

National

- NGSS: K-2-ETS1-1
- CCSS-ELA: SL.1.1, SL.K.6, RL.1.2, RL.1.4

MATERIALS

- A large copy of the vocabulary word sheet (on chart paper, overheard, SMART board, etc.)
- Book: *Pop! The Invention of Bubble Gum* by Meghan McCarthy
- **My Juicy Words** graphic organizer

TEACHER PREPARATION

- Prepare a large copy of vocabulary word sheet

VOCABULARY

- **Engineer** Uses mathematics, science, and creativity to solve problems to help people

Pop! The Invention of Bubble Gum

SUMMARY OF LESSON

This literacy lesson transitions from science and mathematics learning of earlier lessons into engineering, with a focus on testing in engineering and that engineers often fail and learn from that failure, by reading the narrative nonfiction book *Pop! The Invention of Bubble Gum* by Meghan McCarthy. Students learn about the invention of bubble gum and how the inventor tested his different mixtures and learned from each of the failures before he got it right. This lesson helps set the context for why it is important to test materials before designing, which leads into the Lesson 5B activity titled "The Importance of Testing", where students test their shapes with the "stackability" and "flickability" tests. Reading strategy: finding "juicy" words (identifying new words).

INTRODUCTION

1. **Connect to prior knowledge.** **Say:** *I want you to think about your favorite toy and picture it in your head. Ok, quickly turn and share your favorite toy with a partner.* Give 30 seconds to share. **Say:** *Now I want you to raise your hand if your favorite toy broke the very first time you played with it.* **Ask:** *Why do you think that no one raised their hands?* Toy engineers test their toys before they sell them. Take a few student answers. **Say:** *Today, we are going to learn about the invention of bubble gum which took a lot of trying, testing, failure, and redesigning before they got it right. Before I read, I want you to think about why it is important to test materials, toys, or objects before you try to sell them to people.* Give students a few minutes to think about this and then take some student answers. **Say:** *Let's read and see if we can find out any ideas to help us as we design.*

2. **Tie to engineering challenge.** **Ask:** *What is the problem we are working on? How will we know if we meet the criteria, if our design is a good design?* Take student responses. **Say:** *We will have to test our prototypes to see if we have a good design.*

3. **Identify where they are in the engineering design process. (Learn)** **Ask:** *Where do you think we are in the engineering design process? Where should we move our paper clip and why should we move it there?* Remind students they need lots of information to design a good habitat for the pet store and move paper clip to LEARN.

ACTIVITY - Finding new words

4. **Introduce the book.** *Pop! The invention of Bubble Gum* by Meghan McCarthy. **Say:** *Today, we will be talking about engineering.* **Ask:** *Can anyone tell me what the word engineering means?* Have a few students say their definitions. **Say:** *We are going to be learning about the man who invented bubble gum, Walter Diemer, who was an accountant but became an engineer when he started working on bubble gum. What do you think an engineer working on bubble gum might do?* Let students give their ideas.

5. **Introduce the skill.** **Say:** *While we are reading, we are going to be looking for "juicy" words. Juicy words are words that are interesting to you that you might want to use again or are new to you. Remember to use pictures and context to help you think about the meaning.*

Pop! The Invention of Bubble Gum

6. **Reading the story.** As you read, have the students identify juicy words and write them on the vocabulary word sheet. Remember to use some of the things that help student development:
   a. Identify new vocabulary (juicy words) at the point of contact.
   b. Target the comprehension skill: determining from context or pictures to help define the juicy word.
   c. Encourage higher-level thinking and comprehension monitoring by pausing for "teacher think alouds" and asking questions about the text.

7. **Defining the juicy words.** Individually or as a class, have students fill out the **My Juicy Words** graphic organizer using words from the vocabulary sheet.

CLOSURE

8. **Whole class summary.** To help students understand that it is important to be testing materials before you use or sell your design and that engineers learn from failure, ask the students these questions.
   - **What did Walter do as a job?**
     (He was both an accountant and a gum engineer.)
   - **Why did Walter spend months playing with different gum mixtures?**
     (His prototypes of gum mixtures kept failing, so he tried again.)
   - **Why did Walter not sell his gum after he and his coworkers had gum that could blow bubbles?**
     (His test of the gum met the criteria of blowing bubbles, but it failed the next day because it got too hard to chew.)
   - **How did Walter know his bubble gum was a success?**
     (There are several good answers to this. Possible answers: Kids loved it. It sold out in one afternoon. The company made it and sold it at stores. Walter got promoted.)

   Ask: *Think back to the question that I asked you at the beginning of class "Why is it important to test materials before you start designing and/or selling your product?"* Have students think for a minute on their own and then have them either share with a partner or raise their hands and share some ideas out loud. **Ask:** *What do you think an engineer would do if something they designed did not work after it was tested?* Guide students to talk about redesigning to make it work and introduce failure as part of the engineering design process.

9. **Tie back to the engineering challenge.** **Ask:** *What can we take away from the story that can help us design our hamster habitat and exercise trails?* Guide students to talk about the need for testing; that it is okay to fail, learn from failure, and try again; and that redesign is an expected part of engineering design. Use the Engineering Design Process slider arrows to help facilitate this discussion. **Say:** *Your design will not be perfect on the first try, you will usually have to test it, find out why it is not working the way you want it to, and fix it. During the next lesson, we will test our materials for the hamster habitat and exercise trail prototypes.*

ASSESSMENT

Pre-Activity Assessment
Student discussion regarding ideas about the importance of testing.

Activity Embedded Assessment
Have students complete **My Juicy Words** graphic organizer on their own or as a class with students raising their hand when they come to a new vocabulary word.

Post-Activity Assessment
Post reading questions.

EXTEND THE LESSON
Have students set up a toy factor in the classroom to test toys.

TEACHER NOTES

Lesson 5A

Name_____

My Juicy Words

Directions: Use words or draw pictures with words.

Juicy Word:

I think it means:

Sentence or Example:

Juicy Word:

I think it means:

Sentence or Example:

Lesson 5B

The Importance of Testing and Planning

SUMMARY OF LESSON

This STEM+C lesson draws on the bubble gum story and the idea of why it is important to test designs before they are sold or sent for production in order to have students test the shapes that they will use in their final hamster habitat prototype designs. In this lesson, students will perform the "stackability" and "flickability" tests to build background knowledge about three-dimensional shapes that they will use in their designs for their hamster exercise trails. Students will also start working on their engineering design challenge of making a hamster exercise trail by completing the individual brainstorming and group planning steps of an engineering design process.

FOCUS/KEY CONCEPTS

Students will be able to:

- **Engineering:** test materials, determine the best materials to use and plan their designs before building and testing them.

STANDARDS

National

- NGSS: K-2-ETS1-1, K-2-ETS1-2, K-2-ETS1-3
- CCSS-ELA: SL.1.1, SL.K.6
- CCSS-Math: 1.OA.A.1

MATERIALS

- Copies of **Flickability** and **Stackability** data sheets (1/group)
- Set of 3D shapes (1/group)
- **Draw Your Habitat Cage and Exercise Trail** planning sheet
- **Plan Your Design – Shape Store** planning sheet (1/group)

TEACHER PREPARATION

- Make a large size **Stackability** and **Flickability** data sheets (on chart paper, overheard, SMART board, etc.)
- Each group should be given 5-10 of each type of 3D shape they will test.

VOCABULARY

- **Flickability** A shape which does not turn suddenly or roll over easily when tipped with the pointer finger.
- **Stackability** A shape on which we can place other shapes on without the shapes tipping over.

INTRODUCTION

1. **Connect to prior knowledge.** **Ask:** *Who can remember what Walter Diemer did?* He was an accountant, who became an engineer, and he invented bubble gum. *What did we learn about testing designs from Walter?* It is very important. It is often needed to test designs many times. We can learn from failure. *Why is it important to test products before you sell them?* So they are safe and meet the criteria set out for them.

2. **Tie to engineering challenge.** **Say:** *Today we are going to be engineers as we design an exercise trail for our hamsters.* Remind the students of Perri's email and reread if needed. Help the students identify the criteria of the problem from the email. Some specifics have been added to these criteria to help define the final design (help the students understand these):
   1. The exercise trail must connect to the two openings in the back of the habitat cage Perri already sells.
   2. The exercise trail should be fun and exciting for the hamster. In order to keep if fun for the hamster, we will use no more than 10 of any one shape.
   3. The exercise trail and habitat cage cannot take up too much space. We do this by limiting the number of shapes to 20.
   4. The exercise trail and habitat cage should keep the hamster happy. We will add structures to the trail like bridges, towers, caps, and dead ends. Bridges are made by one shape on top of two others for climbing up and over. Towers are made by stacking shapes on top of one another. Caps are at the top of towers made by a different shape or sit on top of another shape. Dead ends are trails that do not connect back to the main trail in which a hamster can hide. Each trail needs to include at least one of these structures.
   5. The exercise trail and habitat cage must keep the hamster healthy. So we must identify where in the cage and trail the hamster will get its food, water, shelter, and space and air. We will mark these with our 2D shapes.
   6. The hamster must not be able to escape. So all shapes must touch.

3. **Introduce the students to testing materials.** **Say:** *As engineers, it is important that we test the materials that we are going to use so that you know about the materials you will be using, so the habitat is safe*

The Importance of Testing and Planning

for our hamster. We also need to make sure that there are no gaps for our hamster to escape. Before we can design our habitat trails, we need to test the different shapes that we will be using to see if we can flick or stack them. Hamsters like tunnels and that is the part of that design that you have been asked to help make. Everyone will receive the same rectangular cage, but your job will be to design the trail. Think about the criteria as you carefully test the shapes to help you choose the best ones for your design.

4. **Identify where they are in the engineering design process. (Learn)**
   Ask: *Where do you think we are in the engineering design process? Where should we move our paper clip and why should we move it there?* Remind students they need lots of information to design a good habitat for the pet store and move paper clip to LEARN.

ACTIVITY - Testing for "Stackability" and "Flickability"

5. **Pairs testing for "Stackability".** Hand out the "**Stackability"** data sheet. Have students place the 3D shape they are testing over the testing square and stack as many of that same shape on top of each as they can, trying different configurations (flat face, side, etc.). Help students fill out the data sheet.
   NOTE: If all pairs test all shapes, these activities will take a while to complete. You can have student pairs test some shapes and share that information with the rest of their table or the class if you want to save time. Consider setting up stations of each shape and allow students to rotate through the testing stattions. There may need to be multiple stations for shapes that are tested in multiple ways. Also, students will want to do this, so having both students in a pair get to test shapes is important.

6. **Whole class summary of "Stackability".** When students have finished their tests, complete a large version of the **"Stackability"** data sheet to summarize their findings about the shapes and what they have learned about how it is easier to stack shapes when they have a flat face on the top and bottom.

7. **Pairs testing for "Flickability".** Hand out the "**Flickability"** data sheet (it may be the second side of the Stackability data sheet). Using the same 3D shapes, each group will then test the shapes for how well they roll, slide, or fall over, and which shapes work next to another shape in their design. **Say:** *If a shape doesn't roll on its own then it would make a good base shape, but if it rolls too much, like the sphere then it isn't a good choice for building. This will be done by the flickability test, you will place the shape on top of the placemat and then **gently** push at the shape with your pointer finger.* Help students fill out the data sheet.

8. **Whole class summary of "Flickability".** When students have finished their tests, complete the large **"Flickability"** handout to summarize their findings. Ask the following questions:
   - What happens during the stackability test? Which shapes did well in the "stackability" test? (rectangular prism, cube). Which

Lesson 5B

ASSESSMENT

Pre-Activity Assessment
Informal assessment looking at student's understanding of the first steps of an engineering design challenge and identifying the importance of testing materials.

Activity Embedded Assessment
Students will complete the shapes testing worksheets for stackability and flickability.

Post-Activity Assessment
Part 1: Looking at what students have learned about the characteristics/attributes of three-dimensional shapes through a class discussion of their testing results.

Part 2: Looking at what students have learned about the characteristics/attributes of 3D shapes through a class discussion of which shapes they are planning to use. Verify that students have 20 shapes or less on their **Plan Your Design - Shape Store** planning sheet.

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shapes did not do so well in the stackability test? (cone, sphere, triangular prism).

- What happens during the flickability test? Which shapes rolled in the "flickability" test? (sphere, cone). Which shapes slid in the flickability test? (cube, rectangular prism flat or on its side). Which shapes fell over? (triangular prism, rectangular prism lying on its tall side).
- Thinking about what we did today, why should engineers test materials before using them in engineering design?
- Which shapes might be good shapes to use in your hamster exercise trails and why do you think those are good shapes? (cubes, rectangular prism). What properties of those shapes are better for building your trails? (flat sides or faces compared to curved sides and edges).

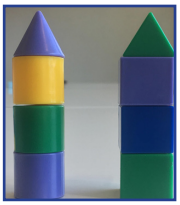
ACTIVITY - Planning

9. **Scaffolding.** **Say:** *Before we plan, we need to think about our challenge/problem a little bit more. We learned (point/refer to animal topic map) that hamsters are excellent diggers and like to make burrows underground to sleep in. To make this habitat similar to where they live in the wild, we are going to be making tunnels for our hamster with the shapes that we tested earlier in this lesson.*

   Present some examples of the options that they can use with their tunnels:

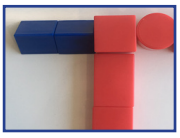
   - **Bridges** – One shape on top of two others for climbing up and over (pictured right).

   - **Towers** – The hamster can crawl up vertically in the tunnel (not needed to be the same shape).

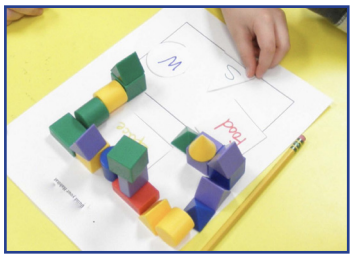


   - **Caps** – Provides a lookout at the top of a tower, or sits on top of another shape (towers with caps pictured).

   - **Dead ends** – Trails that do not connect back to the main trail in which a hamster can hide (the blue triangular prisms show a dead end).



   NOTE: The hamster exercise trail is modeled with the 3D shapes. The hamster crawls "through" the shapes. We assume the shapes are hollow once they touch one another. The image below is an exercise trail that meets Perri's criteria (the space marker is outside of the habitat - but the students meant for that to be the trail itself as the hamster's space).

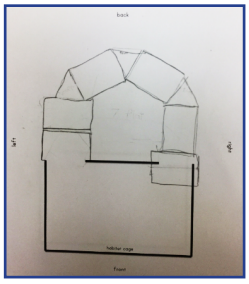


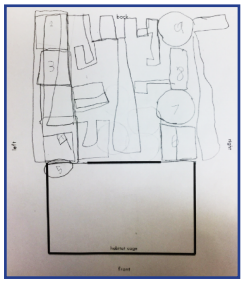
The Importance of Testing and Planning

Lesson 5B

10. **Identify where they are in the engineering design process. (Plan)**
    Say: *Engineers always have a plan before they create/build and now that we have learned a little more about our materials, we are ready to get started on our plans. Let's move our clips to the PLAN step.*

11. **Individual planning.** **Say:** *Individually, you will draw a picture of what you want your habitat trail to look like. Now, I want you to brainstorm different ideas of trails that could be used by your hamster.* Have students draw their idea(s) on the **Draw Your Habitat Cage and Exercise Trail** planning sheet**.**
    NOTE: This drawing is for the individual student only. It doesn't need to be a representation that anyone other than the student understands. The images below are appropriate representations. The students will use these to talk to their partner about their ideas. Also note that the trail goes outside the cage.





12. **Pair planning.** Have students work with their partner to fill out the **Plan Your Design – Shapes Store** planning sheet. Remind them of all of the criteria, but in particular that they can only use 20 shapes total and no more than 10 of any one shape.

CLOSURE

13. **Whole class summary.** Discuss the attributes of the shapes and why students chose specific shapes. **Say:** *Today, we had a chance to test some of the materials that we are going to use in our trail designs.* **Ask:** *Who can tell us why it is important to test your materials before you design? Who can share part of their design by telling us one shape that you are using and why you chose that shape?*

14. **Tie back to engineering challenge.** Remind students of the criteria set up by Perri. Ask them to think about these criteria as they look at their plan.

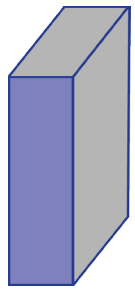
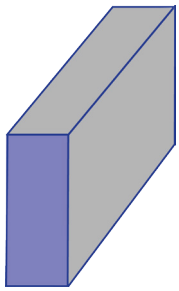
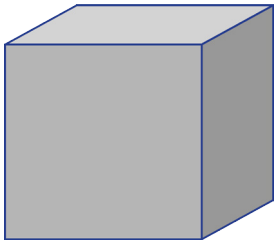
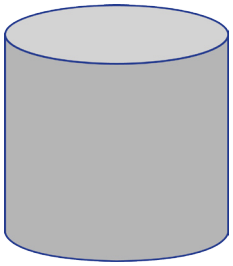
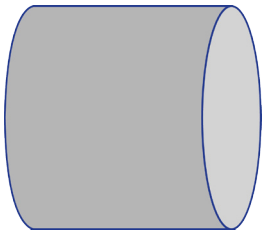
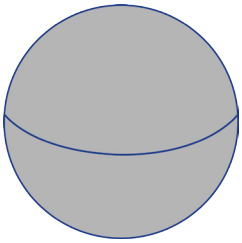
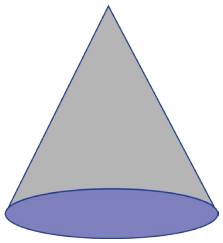
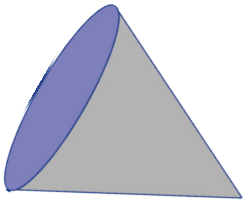
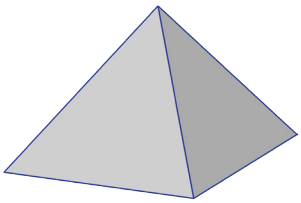
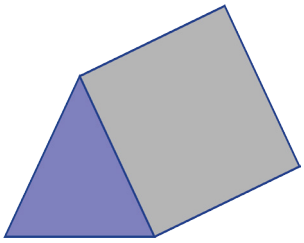
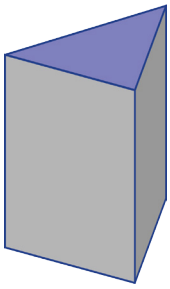
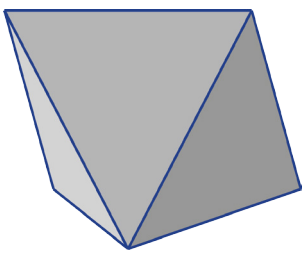
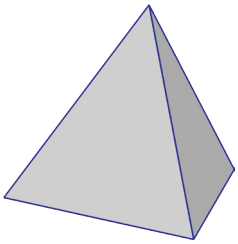
TEACHER NOTES

Lesson 5B

Name_____

Test Your Materials: "Stackability"

Directions: How many shapes can you put on top of each other before they fall? Record how many in the box next to the shape.

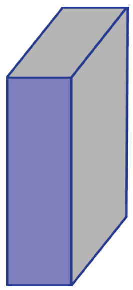
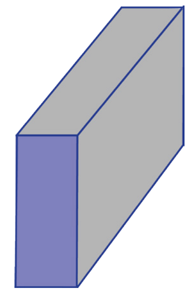
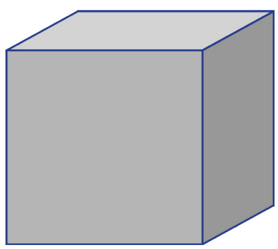
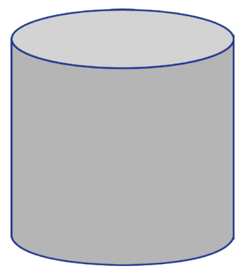
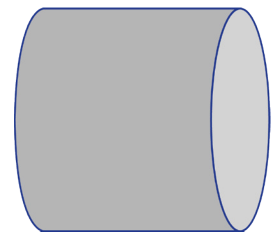
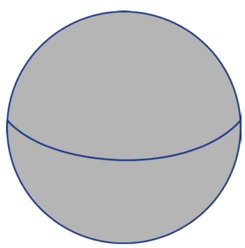
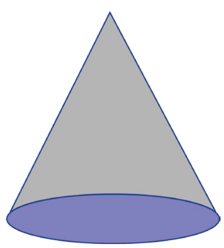
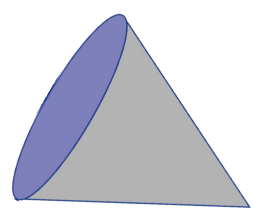
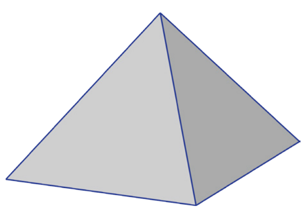
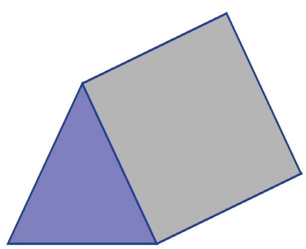
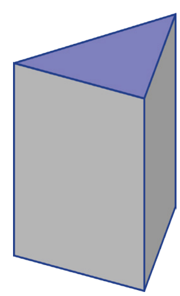
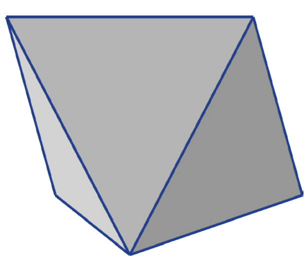
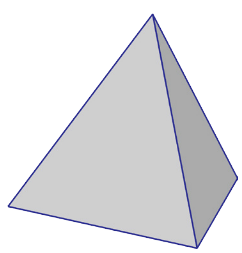
	How many?		How many?		How many?
	How many?		How many?		How many?
	How many?		How many?		How many?
	How many?		How many?		How many?
	How many?		How many?		

Lesson 5B

Name____

Test Your Materials: "Flickability"

Directions: How does your shape move when you gently tap it with your finger? Circle the answer that matches what you find out.

	slides falls over rolls		slides falls over rolls		slides falls over rolls
	slides falls over rolls		slides falls over rolls		slides falls over rolls
	slides falls over rolls		slides falls over rolls		slides falls over rolls
	slides falls over rolls		slides falls over rolls		slides falls over rolls
	slides falls over rolls		slides falls over rolls		

Lesson 5B

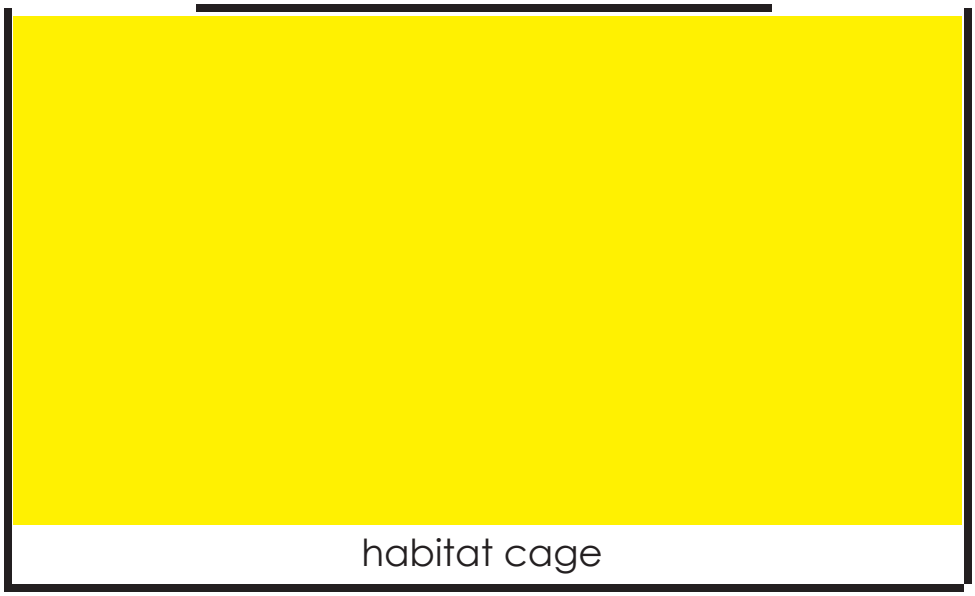
Name_____

Draw Your Habitat Cage and Exercise Trail

back

left

right



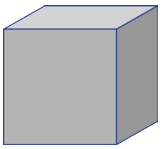
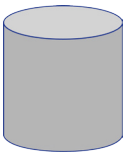
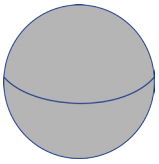
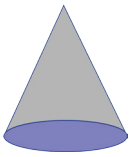
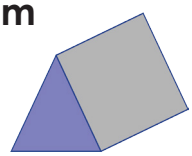
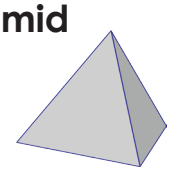
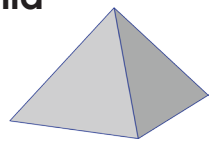
front

Lesson 5B

Names_____

Plan Your Design - Shape Store

Directions: Write how of each shape you would like in the box. Remember: you can only use 20 total shapes.

Shape	Do you want to use it?	How many?
Rectangular Prism 	**Yes** **No**	
Cube 	**Yes** **No**	
Cylinder 	**Yes** **No**	
Sphere 	**Yes** **No**	
Cone 	**Yes** **No**	
Triangular Prism 	**Yes** **No**	
Triangular Pyramid 	**Yes** **No**	
Square Pyramid 	**Yes** **No**	

Lesson 6A

The Perfect Pet

FOCUS/KEY CONCEPTS

Students will be able to:

- **Literacy:** identify important details that will help to summarize the story.
- **Science:** describe how an animal's habitat should provide for the basic needs of that animal.

STANDARDS

National

- NGSS: K-2-ETS1-1
- CCSS-ELA: SL.1.1, SL.K.6, RL.1.3

MATERIALS

- A large copy of the **Important Details** graphic organizer
- Book: *The Perfect Pet* by Margie Palatini
- **Important Details** graphic organizer

TEACHER PREPARATION

- Prepare chart for **Important Details** graphic organizer (on chart paper, overheard, SMART board, etc.)

SUMMARY OF LESSON

This literacy lesson sets the context for the engineering design process by introducing a fictional story, *The Perfect Pet* by Margie Palatini, an amusing story about a girl trying very hard to persuade her parents to let her have a pet, whose needs are her parents' reasons for not getting the pet. This sets up a discussion with the children about a pet hamster's needs, allowing them to use what they learned earlier in the unit, while at the same time setting up the engineering design challenge of creating a habitat trail that would meet the hamster's needs. Reading strategy: identifying important details.

INTRODUCTION

1. **Connect to prior knowledge.** **Say:** *Yesterday, we talked about how it is important to test our materials and why engineers do testing before they start to create their designs. We learned about our engineering design challenge and that you will be designing a habitat for hamster to be sold by Perri's Pet Palace. We started our design plans with the number and type of shapes that we wanted to use. If we are going to be designing a habitat, then we will want to think back to what we have learned about habitats.* **Ask:** *Who can remember what a habitat is?* A habitat is the natural home or environment of an animal, or plant. *Do you remember matching our animals and our habitats? What did we say all habitats need to have for all animals and plants to be happy and healthy?* Basic needs: food, water, shelter, and space/air. *Is the food the same for every animal?* No, each animal eats something different depending on what type of animal they are: plant (herbivore) or meat-eater (carnivore).

2. **Tie to engineering challenge.** **Ask:** *What is the problem we are working on? Should our design work for dogs and cats too?* Take student responses. *Why not?* Guide students to the idea that different pets have different needs, so the same habitat might not work for other animals.

3. **Identify where they are in the engineering design process. (Learn)** **Ask:** *Where do you think we are in the engineering design process? Where should we move our paper clip and why should we move it there?* Remind students they need lots of information to design a good habitat for the pet store and move paper clip to LEARN.

ACTIVITY - Identify important details

4. **Introduce the book.** *The Perfect Pet* by Margie Palatini. **Say:** *I want you to keep thinking about the needs of different animals as we start to read this book about Elizabeth. In this book Elizabeth really, really wants a pet, but her parents keep saying no to all of the pets that she suggests, but she doesn't give up easily.* **Ask:** *How many of you have a pet? How many of you want a pet or another pet?* **Say:** *Let's read and find out what happens to Elizabeth and if she gets a pet.*

5. **Introduce the skill.** As good readers, it is important to have students start to identify important details that are happening in the story. As you read the story, have students identify details about the pets that Elizabeth wanted. **Say:** *We need to pay close attention to the story*

so you can recall all the important details about the pets Elizabeth tells us about in the story.

6. **Start Reading.** **Say:** *This is a fictional book.* Show class the cover. **Ask:** *Can you name the animals all around Elizabeth?* **Say:** *We will learn about a lot of animals from Elizabeth, so listen carefully to her story.*

7. **Individual practice.** After reading the story, have students fill out the **Important Details** graphic organizer. **Ask:** *What were the pets Elizabeth wanted and what happened when she asked her parents to get that pet?* Show students the **Important Details** graphic organizer. **Say:** *Try and remember all the pets Elizabeth asked her parents for in the story. Use the Important Details sheet to write words or draw a picture of the pet she wanted and then draw or write why her parents thought the pet was not a good fit.*

CLOSURE

8. **Whole class summary.** After students have finished completing their **Important Details** graphic organizer, have the class come back together. **Say:** *Tell me about some of the pets that Elizabeth suggested and why they weren't a good fit for her "habitat" or house.* **Ask:** *What happened in the end of the story?* She ended up with a pet bug, Doug. *Why was Doug a good fit for her?* He didn't have many needs – he wasn't very big, and didn't eat very much. *Why is that important when considering a pet?* Because you need to be able to provide for your pet's needs and behaviors – food, water, shelter and space.

9. **Tie back to the engineering challenge.** **Ask:** *Why is it important to consider the proper habitat for our hamster?* To keep the hamster happy and healthy. *What will keep our hamster happy and healthy?* The basic needs: food, water, shelter, space/air. *How does this connect to what we need to do for Perri?* We need to design a hamster habitat that will meet a hamster's basic needs.

TEACHER NOTES

Lesson 6A

ASSESSMENT

Pre-Activity Assessment
To help tie in the science content, this lesson can be used to help students review the idea that different animals have different needs and that those needs are met through an animal's habitat. Before reading and before the engineering design challenge it is important that students understand this concept and so the introduction to the lesson is a great place to review this material.

Activity Embedded Assessment
Complete **Important Details** graphic organizer. This can also be done together as a class while reading the story or together at the end of the story.

Post-Activity Assessment
Discussion about why the pet were or were not a good fit.

EXTEND THE LESSON
For a sequencing challenge at the end of the lesson have students recall the pets Elizabeth wanted in the order they appeared in the book.

Lesson 6A

Name_____

Important Details

Directions: Use words or draw pictures with words.

The pet she wanted	But it was too...

Lesson 6B

Designing a Hamster Habitat and Exercise Trail

FOCUS/KEY CONCEPTS

Students will be able to:

- **Science:** identify and apply information about hamsters to the habitat designs.
- **Engineering:** test prototypes to be sure the designs meet needs.
- **Engineering:** redesign the prototype when designs could be made better or fail; redesign is an important part of engineering.

STANDARDS

National

- NGSS: K-2-ETS1-1, K-2-ETS1-2, K-2-ETS1-3
- CCSS-ELA: SL.1.1, SL.K.6
- CCSS-Math: 1.OA.A.1

MATERIALS

- Copies of the **Habitat Cage and Exercise Trail** building mat (1/pair)
- Assorted 3D shapes
- Paper hamsters on small craft sticks or small straws
- 2D basic needs shapes (see Lesson 2B)
- **Engineering Design Oral Checklist** (educator resource)
- Copies of the **Final Letter to Perri** and **Extra Algorithm Lines** (1/student)
- Optional: New copies of **Plan Your Design - Shape Store** from Lesson 5B (1/student)
- One copy of the **Thank You Email from Perri**

TEACHER PREPARATION

- Prepare one hamster, 3D shapes, 2D shapes, and building mats (1/pair)

SUMMARY OF THE LESSON

This STEM+C lesson ties to the *Perfect Pet* story by giving students the opportunity to build and test a hamster habitat and exercise trail. In this lesson, students will apply the science, mathematics, and computational thinking knowledge that they have learned in previous lessons to help them build a habitat for their imaginary pet hamster. They build this hamster habitat and exercise trail using 3D shapes and will need to identify where the habitat provides for their hamster's basic needs using the 2D markers. They will describe how the hamster moves through the trail by making a hamster algorithm. After designing the habitat, they will have the opportunity to share their designs with the class followed by a redesign of their habitats.

INTRODUCTION

1. **Tie to engineering challenge:** **Ask:** *Who can remember what problem we are trying to solve?* Example: create a habitat exercise trail for our hamsters that is like the tunnels they dig to keep them happy and healthy and we can only use 20 shapes, etc. **Say:** *I want you to listen as I read the email from Perri again and I want you to think about the problem that we are trying to solve.* Read the second email to students. Remind them of all of the criteria and what they mean for their design from Lesson 5B. **Say:** *Remember that yesterday we tested the shapes, so we have a good idea about how well they will work in building our designs. Now that we know our problem, we can continue working through our engineering design process by thinking about our plans, and building and testing our habitats.*

2. **Identify where they are in the engineering design process. (Try)**
   Ask: *Where do you think we are in the engineering design process? Where should we move our paper clip and why should we move it there?* Move paper clip to TRY.

ACTIVITY - Build and test hamster habitats

3. **Discuss basic needs criterion.** **Say:** *Remember that Perri wants our habitat to keep hamsters healthy. Good habitats provide an animal with its basic needs. We want our habitat to be good for our hamster and so it needs to meet the basic needs.* **Ask:** *Who can remember those basic needs again?* Food, water, shelter, air/space. **Say:** *Our habitat should provide for* (pointing to the basic needs chart for each) *the needs of food, water, shelter and space/air, and you will need to place each of your basic needs shapes inside your habitat trail before I come around to "test" your design. These shapes are just like what we did in Lesson 2B when we placed the animals in their habitats.*

4. **Discuss escaping criterion.** **Say:** *We also provide our hamster with a habitat that is similar to their natural habitat. Remember we discussed how hamsters burrow. They like to make burrows with multiple entrances and make tunnels to nest in. They also connect tunnels to their dens. So in order to make this habitat similar to habitat in the wild, we are going to be making tunnels for our hamster with the shapes, so we want to make sure that our hamster can't escape. We have been calling these tunnels "exercise trails." To test your*

Designing a Hamster Habitat and Exercise Trail

trails, you are going to run this paper hamster over your design, like this (teacher is modeling how to move the hamster "through" the design), *and if there are any gaps, then you have to pretend the hamster is escaping.* **Ask:** *Is it good if your hamster can escape?*
NOTE: The hamster runs "through" the touching shapes as if they are hollow.

5. **Continue modeling other criteria and how they will be tested.**

6. **Identify one last part of the design for Perri.** Remind students that the email to Perri included the need to send her a set of directions for how your hamster will travel through your exercise trail as well as a picture of the habitat cage with your exercise trail prototype. This is like the instructions we did in the Algorithms Lesson 4B. **Say:** *You will provide directions for Perri about how a hamster will travel through its habitat.*

7. **Build habitats.** Set up a "shape store" where students can come to fill their orders based on their **Plan Your Design-Shape Store** planning sheet from Lesson 5B. Have the students start building their design on the **Habitat Cage and Exercise Trail** building mat using the information they gathered from their Lesson 5B exercises. NOTE: Do not let students trade out or have additional shapes until the redesign stage. The original design should be built from the shapes they ordered from the shape store.

8. **Test habitats. (Test)** As a class, move paper clips to TEST. To make sure their habitat meets the criteria, students will test their new habitat for the teacher by:
   - Making sure that all of the shapes are touching (so the hamster can't escape).
   - Using the colored basic needs shapes to identify places to provide for the hamster's basic needs (food, water, shelter, space).
   - Counting the total number of shapes while pointing to the shapes that they used in their design.

   Once students have completed their tests, take a picture of their habitat trail to capture the design and allow for it to be shared and compared easily later in the lesson. Use the **Engineering Design Oral Checklist** to record your assessment of student learning.
   NOTE: Consider also having the students take video recordings of each other explaining how the hamster moves through the trail. This may help as they fill out their letter to Perri at the end of this lesson. This can serve as a "rehearsal" and help them use the preposition words needed in the letter.

9. **Share habitat designs and take pictures of their first design.** Have students share their habitat design with others while reminding them that they want to pay attention to other students' designs because they might get ideas that they want to try in their redesign. The pictures are for Perri, but also may be useful for students later. It can be easier for students to explain from a picture how many shapes they used, how they set it up, and where each of the hamsters' needs are met.

Lesson 6B

VOCABULARY
- **Escape** To leave an area, to get away
- **Redesign** Making changes to an original design to try to make it better

ASSESSMENT

Pre-Activity Assessment
Review the hamster topic map and the basic needs chart from the first lesson with the students by asking them things about hamsters that will lead to their characteristics and basic needs (food, habitat, characteristic, etc.).

Activity Embedded Assessment
Oral assessment done by the teacher using the **Engineering Design Oral Checklist**, which has students identify where and how their habitat meets the basic needs requirement, how many shapes they used, and what improvements they have made/would like to make to their habitat.

Post-Activity Assessment
Have students look at and compare the pictures of the two designs and decide on the design that they think is best, and why they think that design is best. This will help students to reflect on their designs and how well they met the challenge. Students fill out the **Final Letter to Perri** as their final assessment.

Lesson 6B

Designing a Hamster Habitat and Exercise Trail

10. **Redesign habitats. (Decide)** As a class, move paper clips to DECIDE. Have students think about how well their design worked and potential changes they would make to their design. Allow students time for the redesign of their habitat to make it even better (you may want to allow them to plan with a new **Plan Your Design - Shape Store** planning sheet). This will also give them a chance to fix anything that they might have forgotten during their first design. Have students test their designs in the same manner as before. Take a picture of their design so it can be used to compare it to their first design.

11. **Individually write final letter to Perri.** Have students individually decide which picture will be sent to Perri and have them tell you (and the class, if time allows) why they chose that design. Have students fill out the **Final Letter to Perri** using the **Extra Algorithm Lines** if needed. Collect the letters and tell the students you will send the letters and the chosen pictures to Perri. NOTE: You may need to model how the students should fill out the algorithm portion of the worksheet. Show the class how you would choose the prepositions based on the shapes and fill in a few algorithm lines.

CLOSURE

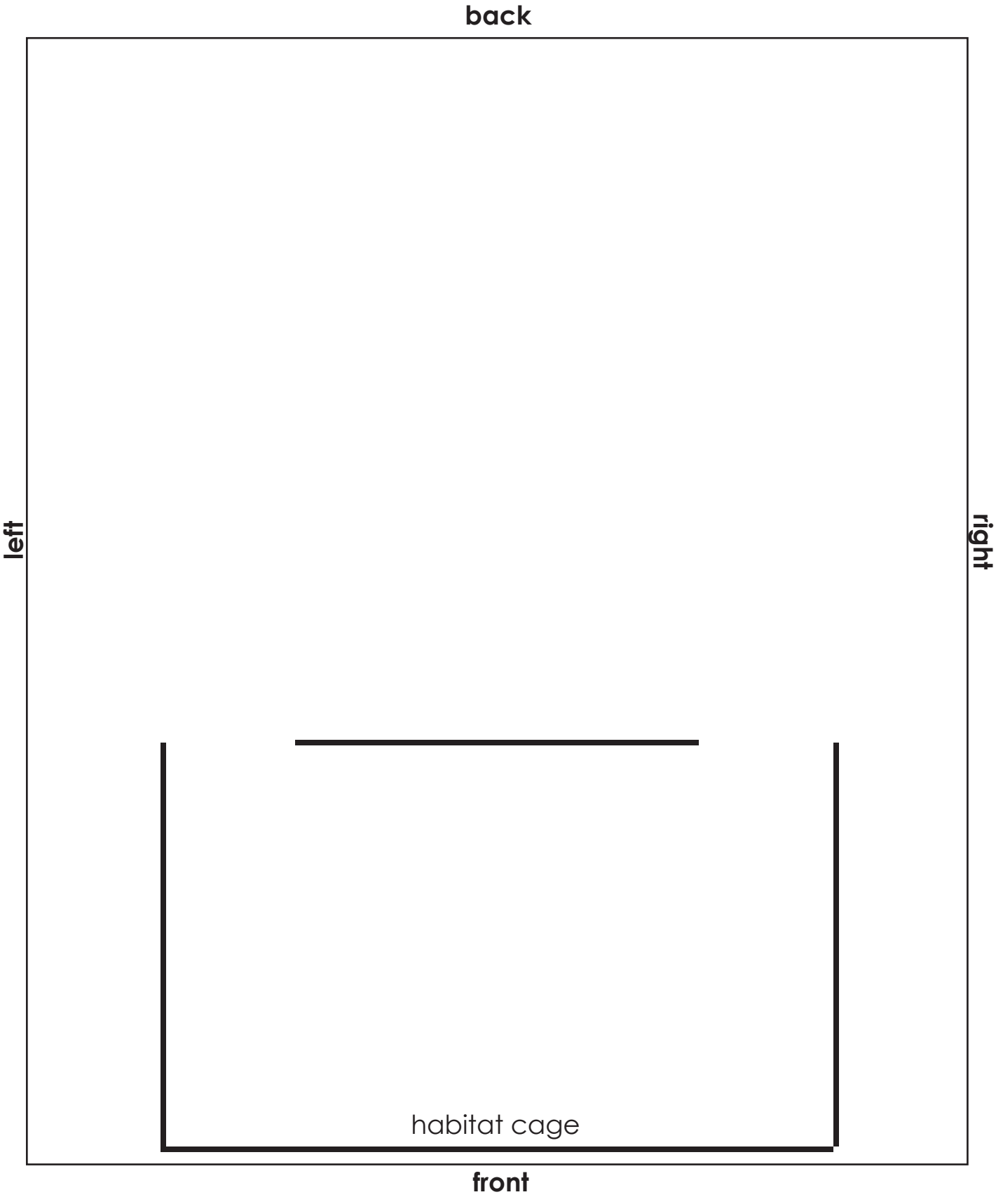
11. **Present the Thank You Email from Perri.** After a time (perhaps a break or come back to this during a downtime later), tell students that you received a final email from Perri. Present the **Thank You Email** to the students as a way to let them know that their engineering work was appreciated by Perri. Celebrate what you accomplished as a class.

TEACHER NOTES

Designing a Hamster Habitat and Exercise Trail

Lesson 6B

Habitat Cage and Exercise Trail



Lesson 6B

Engineering Design Oral Checklist

Assign a value based on the ability of the partners to complete each of the tasks.

Score	2	1	0
Can the hamster escape?	No holes and connects to the two openings	Holes are present, but student identifies holes during testing	Holes are present, but student does not address them
Number of shapes	Correctly counts shapes in design	Makes 1 error	Several errors or needs help counting
Basic needs (F, W, Sh, S & A)	The hamster can get to all four basic needs	The hamster can get to 2-3 basic needs	The hamster can get to 0-1 basic needs
Special structure	Has a structure and identifies it correctly	Has a structure, but identifies it incorrectly	Has no structure
Ideas for redesign	Has some ideas	Ideas with prompting	Unable to think of ideas

Names of Student Partners	Can the hamster escape?	Number of Shapes	Basic needs	Special structure	Ideas for redesign

Lesson 6B

Name_____

Final Letter to Perri

Dear Perri,

I have included a picture of my first design and my redesign of the habitat cage and exercise trail.

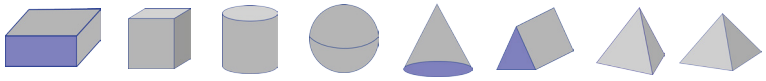
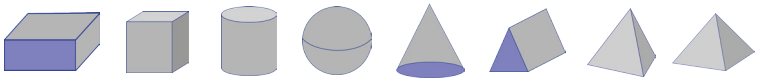
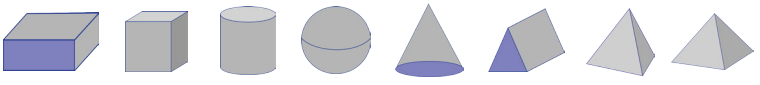
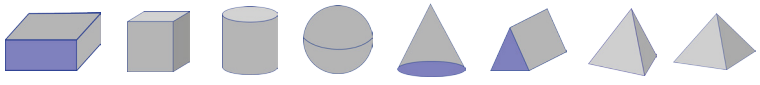
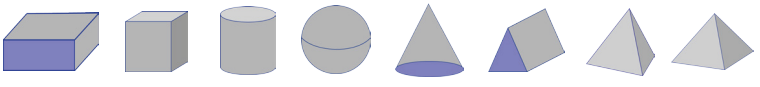
I suggest you use (circle one) **the first design .** **the redesign.**

I have met the following criteria:	Check if completed
1. The exercise trail connects to the two openings.	
2. I have used no more than 10 of any one shape.	
3. I have no more than 20 total shapes.	
4. I have at least one structure.	
5. I have included all of the basic needs for the hamster.	
6. All of the shapes touch so the hamster cannnot escape.	

Circle which structure(s) you used: **tower** **cap** **bridge** **dead end**

Below is the algorithm for my exercise trail:

Word bank: through, up, down, over, into, out of

Step	Write the preposition	Circle the shape(s)
1	the	
2	the	
3	the	
4	the	
5	the	

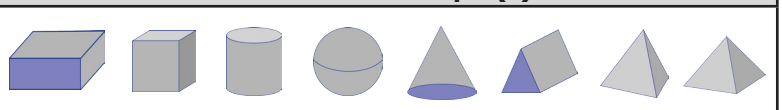
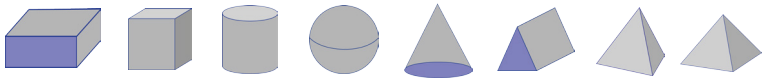
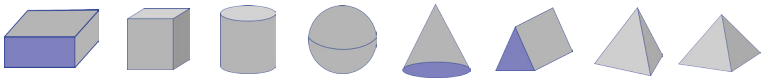
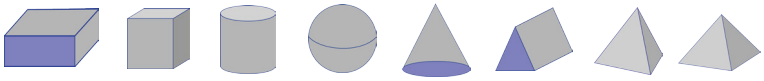
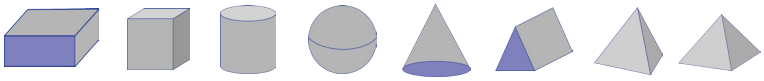
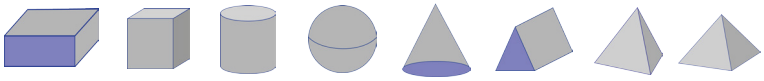
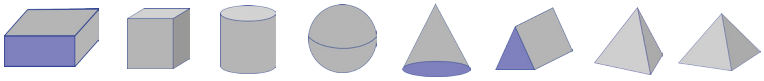
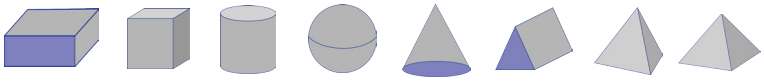
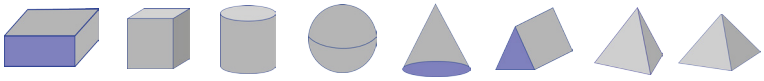
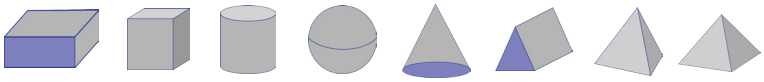
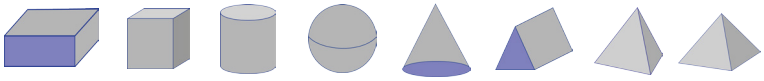
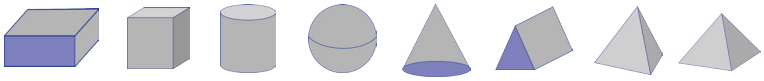
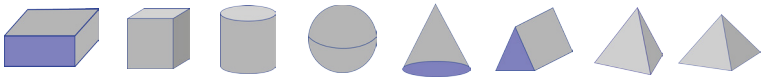
Signed, _____

Lesson 6B

Name _____

Extra Algorithm Lines

Word bank: through, up, down, over, into, out of

Step	Write the preposition	Circle the shape(s)
6	the	
7	the	
8	the	
9	the	
10	the	
11	the	
12	the	
13	the	
14	the	
15	the	
16	the	
17	the	
18	the	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From: perrispetpalace@gmail.com
To: StudentsEngineers@gmail.com
CC:
Subject: Thank you from Perri's Pet Palace

Dear Students,

Thank you for all of your hard work on designing and testing the hamster habitat cages with exercise trails. I received your letters and pictures. I really like all of the different prototypes you and your classmates designed. I look forward to sharing these designs with my customers. Good job, engineers!

The addition of the trails to the cage will give the hamsters more space for running and exploring. I know the hamsters will be healthier and have more fun because of the exercise trails. They will be very happy pets, and all of their basic needs have been met.

Thank you for all of your help!

Perri Martinez
Owner, Perri's Pet Palace