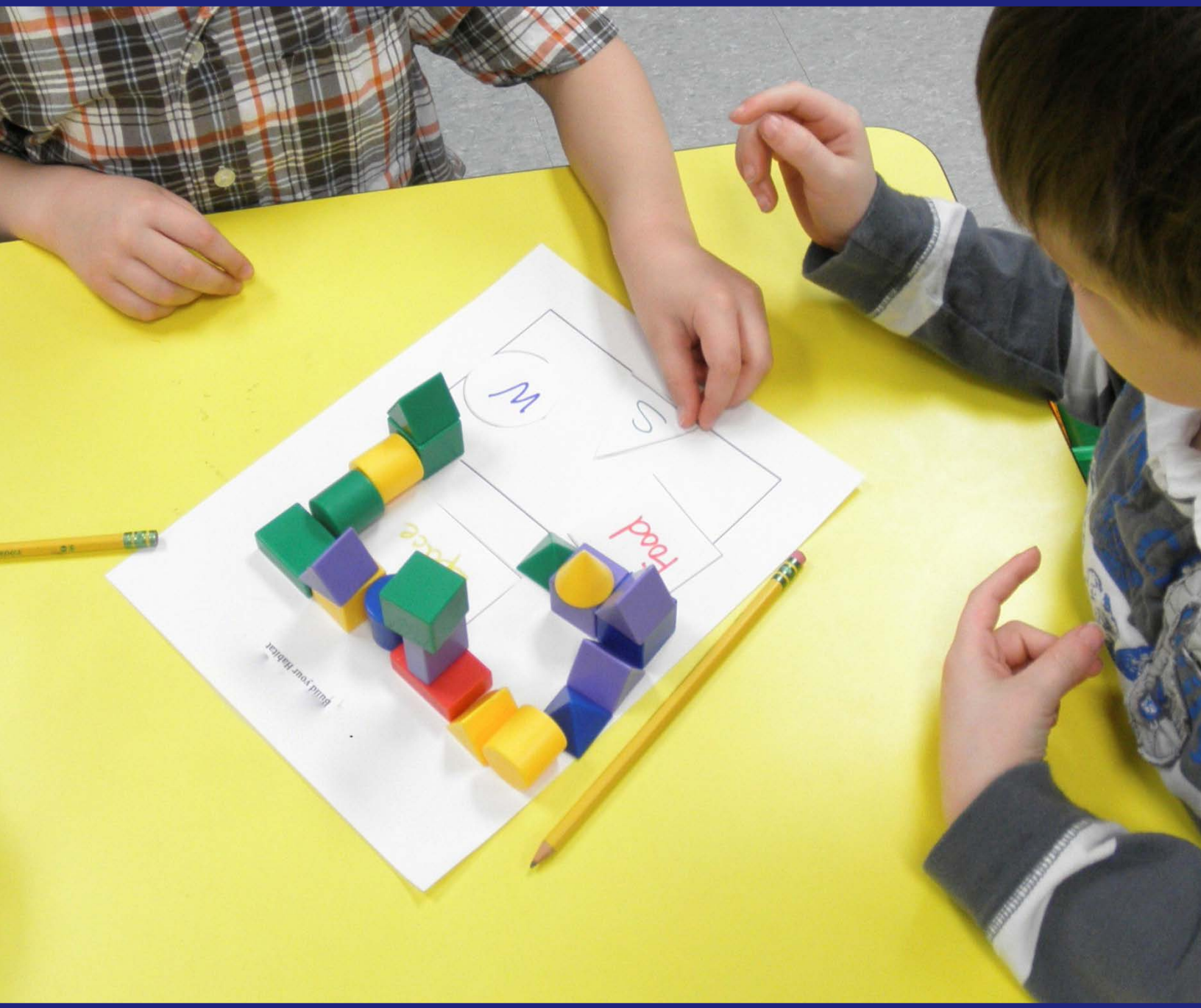
PictureSTEM

Designing Hamster Habitats



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Research Institute for Pre-College Engineering

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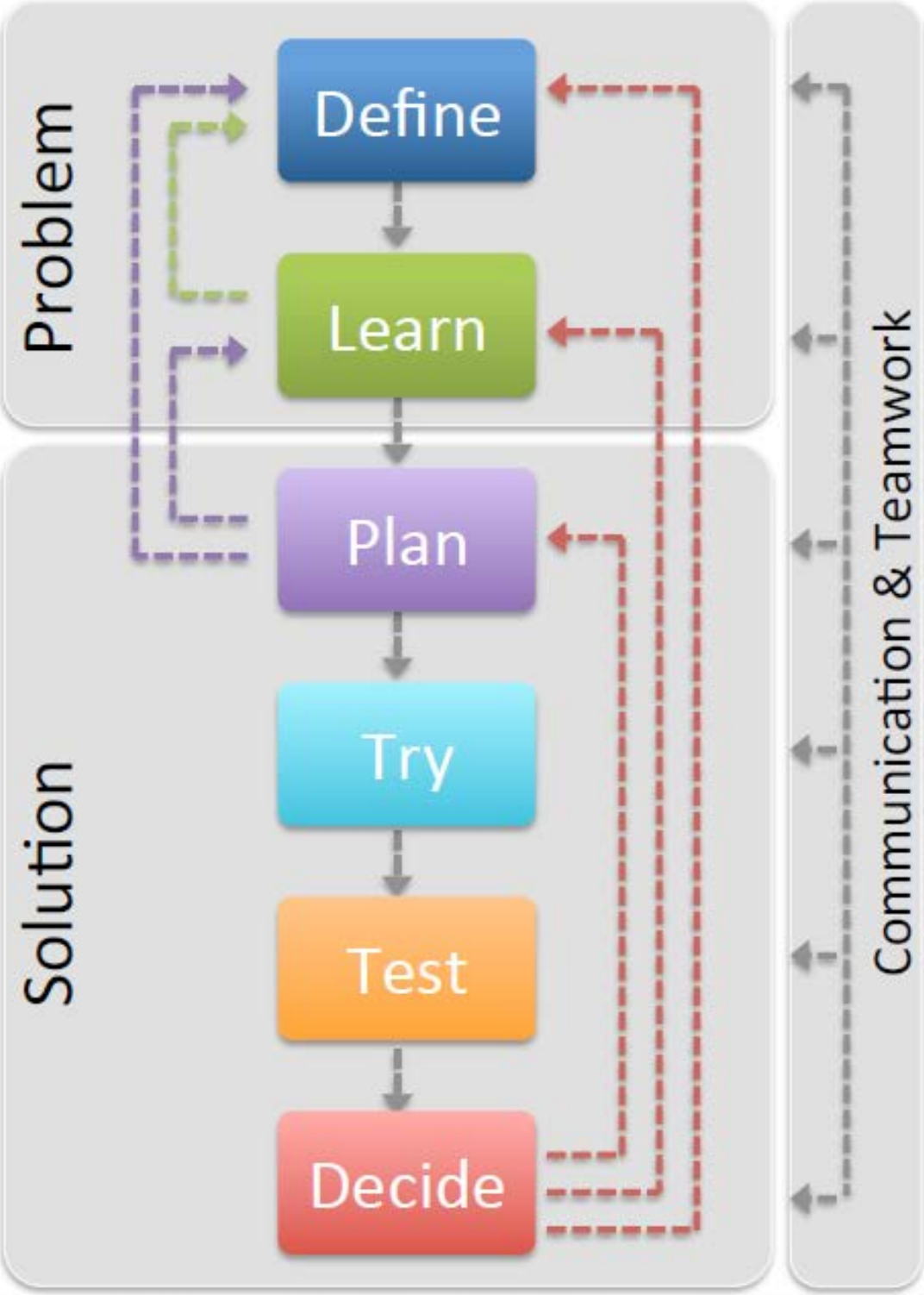
Engineering Design Process

A way to improve



Lesson Summaries

- **SECTION NEEDS UPDATING**
- **Introduction to the problem:** In this extension lesson, students will have a chance to plan and build a habitat for their HEXBUG Nano© with common materials found around the classroom. After designing the habitat, they will have the opportunity to share their designs with the class followed by a sharing session and time to redesign their habitat.
- **Lesson 1A:** In this lesson, students are introduced to hamsters as they build background knowledge about hamster's lives in the wild and in captivity. The focus for this lesson is on the basic needs of animals they learned 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 hamster, which provides for their hamster's basic needs.
- **Lesson 1B:** In this activity, students learn that animals have different physical characteristics such as fur, wings, scaly skin, and fins which help to distinguish them into specific groups. This lesson builds upon Activity #1A, by first introducing students to a sorting activity in which they identify animals based on their physical characteristics, which also help to distinguish specific animal groups. This lesson builds background knowledge for the engineering design challenge in which students have to design a habitat that provides for their hamster's basic needs.
- **Lesson 2A:** In the previous lesson, we have learned that animals have different physical characteristics such as those with furs, wings, scaly skin, and fins or living under water. We have also learned that the habitat of an animal also provides it with food and other basic needs. This activity, builds on this knowledge by helping students identify a suitable habitat for an animal after reading about the adventures of Mrs. Frizzle and her class. In this story, they are looking for a pet frog that has escaped and Mrs. Frizzle suggests that they look for her in the place where she will be most happy – the pond, her natural habitat.
- **Lesson 2B:** In this activity, students learn that every hamster has specific needs, 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 habitat for a hamster.
- **Lesson 3A:** At the end of this activity, students will be have learned about the basic shapes of objects, 3-sided (triangle), 4-sided (quadrilateral), and 5-sided (pentagon), as you read a story about an unhappy triangle who visits a shape-shifter to add sides and angles to become a new shape. This lesson will build background knowledge and set the stage for the related STEM activity (Exploring Animals and Tangrams).

Lesson Summaries

- **Lesson 3B:** Students are to build on their knowledge and understanding of concepts about two dimensional 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 are also able to exhibit fluency in naming these shapes appropriately and working on translating and rotating these shapes as they work on creating different tangram animals with the shapes.
- **Lesson 4A:** This lesson transitions from science and mathematics learning of earlier lessons into engineering with a focus on the testing phase. Through this trade book students are introduced to Leo the cockroach, whose job it is to test the toys at the toy company before selling them. This lesson will help to set the context for why it is important to test materials before designing, which leads into the activity titled The Importance of Testing, where students test their shapes with the stackability and flickability tests.
- **Lesson 4B:** After reading the story about Leo Cockroach and setting up the idea of why it is important to test toys or other designs before they are sold or sent for production, students will build upon this idea by testing the shapes that they will use in their final 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 trails. Students will also start working on their engineering design challenge of making a hamster trail by completing the individual brainstorming and group planning steps of an engineering design process.
- **Lesson 5A:** This lesson sets the context for the engineering design process by introducing a fictional story, *The Perfect Pet* (Palatini & Whatley, 2003), an amusing story about a girl trying very hard to persuade her parents to let her have a pet. Each of the pets that she suggests have different needs that her parents use as a reason not to get it, such as a horse needing a lot of space and a dog needing a lot of exercise. 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.
- **Lesson 5B:** After reading the story about Sarah and Doug, students will have a chance to build a habitat for their own pet, an imaginary hamster. In this lesson, students will apply the science and mathematics knowledge that they have learned in previous lesson to help them build an exercise habitat for their imaginary pet hamster. They build this exercise habitat as a habitat trail using 3D shapes and will need to identify where in the habitat it provides for their hamster's basic needs. After designing the habitat, they will have the opportunity to share their designs with the class followed by a redesign of their habitat trails.

Designing Hamster Habitats

STEM Overview

SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS TOPICS

Intro: Students are introduced to the engineering challenge and begin to take part in engineering practices. Students work together to define the problem, criteria (goals), and constraints (rules). Students also create a working definition of what an engineer is and what type of work they do.

Lesson 1B: *Animal habitats and basic needs*.

Students are introduced to the ideas of habitats and basic needs. They learn that animals live in a habitat that provides their basic needs including food, water, air, and shelter.

Lesson 2B:
Students are introduced to the concept of differing characteristics between animals. They learn that animals have different characteristics that allow them to survive in different types of environments.

Lesson 3B: *Spatial reasoning*. Spatial thinking is a teachable skill that develops over time with practice and is a key predictor of future success in mathematics, science, and engineering. Working with tangrams gives students experience working with simple geometric shapes which are arranged to make complex shapes developing stronger problem solving skills. Tangrams can help students measure area without a formula helping them visualize how to rotate them and slide them into different positions. Using tangrams in this lesson will help students when they begin planning their hamster habitat.

Lesson 4B: This lesson transitions from science and mathematics learning of earlier lessons into engineering with a focus on the testing phase of the engineering design process. Students also begin to plan their solution to the engineering challenge.

Lesson 5B: This lesson focuses on the engineering design process. Students build, test, and redesign their

Designing Hamster Habitats

Literacy Overview

READING COMPREHENSION STRATEGIES

Lesson 1A: 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 as you read about that animal.

Lesson 2A: It is important for students' comprehension development to make connections between their own lives and the story. In this lesson, you will be modeling what it is like to make connections between the story and your own life through a "teacher think aloud". A "teacher think aloud" is where the teacher pauses and comments on a specific part of the story, which in this case is possible connections the students might be able to make between their lives and the story.

Lesson 3A: This lesson focuses on reading comprehension. Students may not have had much practice with thinking about what they are reading as developing readers and so this is a chance to hear your questions and "teacher think alouds " as well as what other students might be saying about the text.

Lesson 4A: This lesson focuses on students' vocabulary and their ability to find new words in text. Students are encouraged to note new words and use context to help them define what the word means.

Lesson 5A: As good readers, it is important to have students start to identify important details that are happening in the story. This will help students build up to larger strategy of comprehension.

HEXBUGs as an Introduction to Engineering

Lesson Intro 1

FOCUS/KEY CONCEPT

- **Engineering:** Engineering is solving a problem or meeting a need.
- **Engineering:** There are certain steps that engineers use when solving a problem (design cycle)

STANDARDS

NGSS: K-2-ETS1-1, K-2-ETS1-2, K-2-ETS1-3

MATERIALS

- HEXBUG Nano© (1 per pair of students)
- Building materials (see below)
- Basic needs shapes
- Chart Paper for criteria
- 1 inch graph paper (optional)

TEACHER PREPARATION

- For each pair of students, prepare a set of HEXBUG Nano© (1 per pair of students), and a small storage container to keep each HEXBUG while not in use.
- For each pair of students, prepare an assortment of materials and place in a bin (suggested materials: construction paper, copy paper, tissue paper, blocks, Unifix cubes, Legos, aluminum foil, fabric scraps, craft sticks, etc.)

VOCABULARY

- **Engineer** Uses mathematics, science, and creativity to solve problems to help people
- **Engineering design process** A series of steps used by engineers to help them solve a problem or meet a need.
- **Criteria** A standard on which a judgement is based
- **Failure** Lack of success and not meeting a predetermined goal.

INTRODUCTION:

1. **Organize students.** Have students sit with their assigned partners for the HEXBUG Nano activity.
2. **Tie to engineering challenge. Say:** *There is this competition that we want to enter, called the Ultimate HEXBUG Maze Competition. So to enter the competition, we have to design a maze for our HEXBUG Nano.*
3. **Discuss the rules of the maze. Say:** *This maze can't be any maze, but it has to be a special maze that meets the following maze criteria.* **Ask:** *What do you think the word, criteria means? I said that the maze has to meet the criteria.* (take student ideas) **Say:** *The criteria of our maze to be ready for the competition is* (have these written up on chart board to reveal as they are introduced):

   Criterion 1: Has to go from the starting point to the finish point

   Criterion 2: Has to make 2 turns

   Criterion 3: Has to make noise

   Criterion 1. Say: *Let's look at these criteria and explain them a little more so we all know what we need to do.* (hold up a HEXBUG) **Ask:** *What do you think I mean when I say it has to "go from start to finish without being touched"?* (take student answers). **Say:** *We want it to run through the maze on its own and go from the start to the finish.*

   Criterion 2. Ask: *What do you think I mean when I say the HEXBUG has to make 2 turns?* (take student answers). *We want the HEXBUG to turn either left or right (moving HEXBUG to model those movements) at least two times.*

   Criterion 3. Say: *The last criterion is to have the HEXBUG make a noise. How do you think that might happen?* (take some student answers). *We can think about what happens when it moves – the legs go really fast, so they might make different sounds when it goes over something* (put it over aluminum foil to model) *or runs into something* (have it run into block). **Say:** *Do you hear that? That is what the noise criterion means.*

ACTIVITY – Building a HEXBUG maze:

Introduce the HEXBUG Nano. Say: *I need to show you how to care for our HEXBUGs because we don't want the battery to run out or for the HEXBUGs to get lost.* (Show students how to turn them on, how they work, and where to place them when they are not being used). **Ask:** *Before we go back to our desks, who can remember what our problem is?* (take student answers) **Ask:** *How are we going to solve this problem?* **Say:** *Before we build and test our HEXBUG maze, I want to give you some time to play with the HEXBUGs to see how they work. I want both you and your partner to practice turning them on and keeping them on the table. When I see that you have had some time to play, then I will stop us and have us start building.* (while students are playing with the HEXBUGs, monitor and pass out their materials tub for each table).

4. **Introduce materials**. After students have had a chance to play with the HEXBUG, ask them to place their HEXBUG inside the tub that was just passed out so that it won't distract them. **Say:** *Before we start our designs, I want to show you some of the materials that you have in your tub that you can use to make your maze.* (introduce the materials that you have placed in the tub and ask students if they know the names of the materials). **Ask:** *One last thing, who can remember the three criteria for the maze?* (take student answers and review if they can't remember). **Say:** *Great! Now we know our criteria.*

HEXBUGs as an Introduction to Engineering

6. **Building and Testing the HEXBUG maze. Say:** *Let's start working on building our mazes, when you and your partner think that your maze is ready to be tested, then you can pull your HEXBUG back out of its storage bin and test it in your habitat. After you have practiced running your HEXBUG through your maze and think that your maze has met the criteria then I want you to raise your hand and I will come by to judge if your design is ready to enter the competition.*

CLOSURE:

7. **Sharing their Designs.** After all of the students have created their maze designs, **Say:** *Now, we will all share our designs with the class. Pay attention because you and your partner might get ideas that you might want to try in your redesign.* (Taking pictures or videos of their maze is helpful because it can be easier for students to explain from a picture/video how they set up their maze.)
8. **(Optional): Redesign of their mazes.** Take pictures of each team's initial design if you haven't already. Allow students time for the redesign of their maze to make it even better. This will 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 and take a picture of their design. Have students compare the redesign of their maze to their first design. If time allows, have students share with their classmates the design they ultimately chose and why they chose that design.

TEACHER NOTES:

ASSESSMENT

Pre-Activity Assessment

Introduce students to the idea of engineering

Activity Embedded Assessment

An oral assessment completed by the teacher after each pair of students has created their maze design. Have students identify where and how their maze meets each of the criteria as they have the HEXBUG run through their maze design.

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. **Note:** We would like to acknowledge Laura Bottomley and Liz Perry for their contribution because this activity was modified from an activity presented by them at the 2013 ASEE K-12 Workshop.

EXTEND THE LESSON

Lesson Intro 2

Defining the Problem

FOCUS/KEY CONCEPT

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

STANDARDS

- NGSS: K-2-ETS1-1,SL.K.1, SLK.6

MATERIALS

- Chart paper (at least 3 pieces)
- Markers (for teacher)
- Perri's First Letter (large print or projectable version)
- Perri's Second Letter (large print or projectable version)
- Copy of the Engineering Design Process (poster, large print, or projectable version)
- Engineering Design Process card (1 per student)
- Paper clip (for Engineering Design Process cards) (1 per student)

TEACHER PREPARATION

- **Collect the listed materials needed for the lesson.**
- **Write Problem, Goals/Criteria, Rules/Constraints on the top of chart paper**

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
- **Constraint** Limit to how a design problem can be solved

INTRODUCTION:

1. **Introduce engineering.** ***Say:*** *We are going to be working as engineers over the next few days. 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.*
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. 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, criteria (goals), and constraints (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 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 constraints (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?*
5. **Introduce the engineering challenge.** Read the ***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.

Defining the Problem

TEACHER NOTES:

ACTIVITY:

7. **Define the problem. 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 students' 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. ***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.
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 his current habitat cage.* Talk with students about what an engineer is and what they do. *Engineers use mathematics, science, and creativity to solve problems to help people.*
11. **Identify the criteria and the constraints.** ***Say:*** *In her letter, Perri said that there are several things that she would like to be true about the basket. I'm going to read her letter again, raise your hand when you hear something that Perri wants to be true about the exercise trail.* Read Perri's letter aloud again.

    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:*** *We are going to try to decide which of the listed items are criteria and which are constraints.* Define criteria as things that we use to decide how good a solution to the problem is. Define constraints as something that limits the ways we can solve a problem.

    Point to the list and say: *Which ones of these are constraints (limit the ways we can solve the problem) and which of these are criteria (things that we will use to judge the success of our design)?* Have the students help you decide which are criteria. Mark the correct criteria (numbers 2 and 4) and the constraints. (numbers 1, 3, 5, and 6).

    Note: We will define the constraints and criteria as the unit continues.

CLOSURE:

13. **Check in with students.** Encourage students to share any questions they may have about the problem, criteria, and constraints. 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 coming up with ideas for a solution.

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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 and 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 | Reply All | Forward | Move | Related | Follow Up

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

Dear Students,

Thank you for your ideas about expanding the hamster habitat. I really liked your ideas. I have decided to expand the hamster habitat cage 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 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 must 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 1A

Is My Hamster Wild?

FOCUS/KEY CONCEPT

- **Literacy** Help students 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

CCELA-Literacy: RL.1.1, RL.1.5 , RL.1.6
NGSS: K-2-ETS1-1, K-ESS2-2, K-ESS3-1

MATERIALS

- Book: *Is My Hamster Wild? The Secret Lives of Hamsters, Gerbils & Guinea Pigs* by Rain Newcomb & Rose McLarney.
- Large copy of the Animal Topic Map (on chart paper, overheard, or SMART board)
- Animal Topic Map for each student
- Large world map (optional)

TEACHER PREPARATION

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

INTRODUCTION:

1. **Prior knowledge.** Students will need to have a basic understanding of animals and some familiarity with 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 thing they named) *it is an animal?* (they might say it breathes, eats, is alive, can bark, getting at some of the characteristics of animals).
3. **Introduce the unit.** After taking some initial student ideas about animals, introduce the unit Designing Hamster Habitats. **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 story to the class. Post class copy of the story to refer to during the unit) ***Ask:*** *Do you think we can help Perri's Pet Palace by designing good habitat 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). *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 paperclip?* (Move paperclip to LEARN)

ACTIVITY – Summarizing informational text:

6. **Introduce the book.** Introduce *Is My Hamster Wild? The Secret Lives of Hamsters, Gerbils & Guinea Pigs* by Rain Newcomb & Rose McLarney. (option: Read only pages 1-29 for this lesson). **Say:** *This is a non-fiction or informational text. Informational text can tell us about lots of true information about a lot of things. We will be looking for new vocabulary words and learn new information about animals.*

Is My Hamster Wild?

8. **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 BLM** as you read about that animal.
9. **Start reading.** Read the book, using interesting words from the text to fill in the Animal Topic Map. Sample interesting words:
   - p. 7 rodent
   - p. 9 gnawing
   - p. 11 nocturnal
   - p. 11 predators
   - p. 14 extinct
   - p. 23 burrow
10. **Individual practice**. Leave enough time at the end of the whole group lesson to review the **Animal Topic Map BLM** that your students have created about the hamster and all of the great facts and information that they have learned from this book

CLOSURE:

11. **Whole group summary.** At the end of the activity, give students the following questions to test their understanding of the readings and their recall from what they filled out as part of the **Animal Topic Map**. **Ask:** *Who can tell me what the mystery animal is we learned about today was?* (hamster) *What did you learn about what hamster eat?* (they eat fruits berries) *Where do hamsters live? What do hamsters look like? Is there anything else that we learned about hamsters?* ***Say:*** *All the things you learned about hamsters will help you identify their basic needs.*

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

TEACHER NOTES:

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" (They might say it breathes, eats, is alive, can bark, getting at some of the characteristics of animals).

Activity Embedded Assessment

Completion of the Animal Topic Map while reading the story with students.

Post-Activity Assessment

At the end of the activity, give students the following questions to test their understanding of the readings and their recall from what they filled out as part of the animal topic map:

Who can tell me what is the mystery animal we learned about today ? (hamster)

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?

EXTEND THE LESSON

Use a world map to show where hamsters were discovered. Trace the journey from Syria to USA.

Animal Topic Map

Use words or draw pictures with words.

My Animal is:

Food:

Habitat:

What it looks like:
(Physical Characteristics)

Interesting Facts:

Lesson 1B

Animals and Their Basic Needs

FOCUS/KEY CONCEPT

- **Science**: A property is a characteristic that something has.
- **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

NGSS: K-2-ETS1-1,LS.1.A

MATERIALS

- Set of animal cards (for each pair of students)
- Sorting placemat (for each pair of students)
- SMART board /chart paper for a whole class basic needs list.

TEACHER PREPARATION

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

INTRODUCTION:

1. **Connect to literacy lesson.** Then Connect back to what students learned by listening to the story about hamsters and what they need to survive (eg. 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 Side 1 of your sorting placemat, 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)

Animals and Their Basic Needs

7. **Part 2: Sort by basic needs. Say:** *We are going use our sorting placemat 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:

8. **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 if an animal or organism does not have, it will be difficult for the organism to survive for a long time)

9. **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. What are some things that we might need to consider in our designs to help keep the hamsters happy and healthy?(*Basic needs).

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

11. **Introduce the word habitat. Say:** *We have been talking a lot about say that animals live in a "habitat"* (A habitat is the natural home or environment of an animal, plant, or other organism). After taking some student ideas, 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:

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.

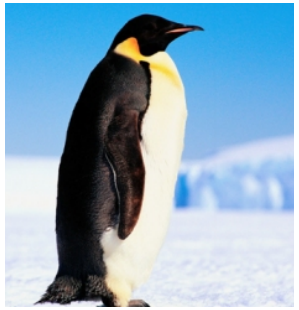
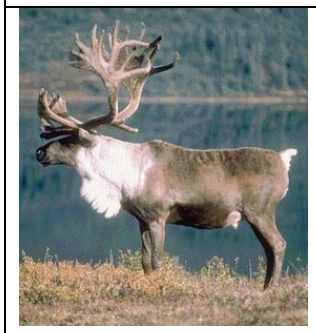
Activity Embedded Assessment

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 .

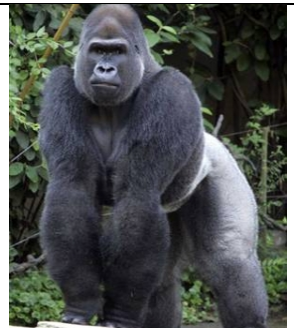
EXTEND THE LESSON

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

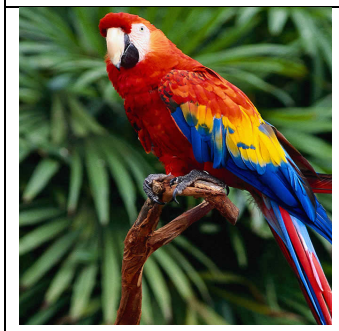
SNAKE

TIGER

MONKEY



GORILLA



PARROT

TREE FROG

SHARK

FISH

DOLPHIN

LOBSTER

OCTOPUS

STARFISH

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

Side 1: What Characteristics do I Have?

Fur	**Wings**
Scaly or slimy skin	**Fins or live under water**

Side 2: Basic Needs

PART 1. I get my food from…	PART 2. I find shelter in…	
Eating plants	**Trees or Bushes**	**A Shell**
Eating other animals	**Caves, Rocks or Dens**	**Coral Reef or Ocean**

Answer sheet for Animal Cards Sorting

Animal	Characteristics	Food Source	Finds shelter in…
Seal	Fur	Other animals	Caves, Rocks or Dens
Fox	Fur	Other animals, sometimes plants	Caves, Rocks or Dens
Penguin	Wings that are used as fins (cannot fly), thick feathers (not fur)	Other animals	Caves, Rocks or Dens (Make nests or burrows out of sticks and grass). Some penguins use each other as shelter
Snowy Owl	Wings	Other animals	Trees or Bushes
Reindeer	Fur	Plants	Trees or Bushes
Polar Bear	Fur	Other animals	Caves, Rocks, or Dens (Arctic ice)
Camel	Fur	Plants	Trees or bushes (may sleep under a tree)
Lizard	Scaly or slimy skin	Most eat other animals, some eat only plants	Caves, Rocks, or Dens
Coyote	Fur	Other animals	Caves, Rocks, or Dens
Vulture	Wings	Other animals	Trees or Bushes
Desert Tortoise	Scaly or slimy skin	Plants	Its Shell
Jack Rabbit	Fur	Plants	Trees or bushes (Nests in grass or bushes)
Snake	Scaly or slimy skin	Other animals	Caves, Rocks, Dens, under trees or bushes
Tiger	Fur	Other animals	Caves, Rocks, or Dens
Monkey	Fur	Plants and other animals (bugs)	Trees ore bushes
Gorilla	Fur	Plants and other animals (bugs)	Trees or bushes (build nests to sleep on)
Parrot	Wings	Plants (seeds and fruit), sometimes other animals	Trees or bushes
Tree Frog	Scaly or slimy skin	Other animals (bugs)	Trees or bushes
Shark	Fins or live underwater	Other animals	Coral Reef or Ocean
Fish	Fins or live underwater	Plants or other animals	Coral Reef or Ocean
Dolphin	Fins or live underwater	Other animals	Coral Reef or Ocean
Lobster	Fins or live underwater	Other animals (mostly shellfish)	Coral Reef or Ocean
Octopus	Fins or live underwater	Other animals	Coral Reef or Ocean
Starfish	Fins or live underwater	Other animals (shellfish), and sometimes plants	Coral Reef or Ocean

The Magic School Bus Hops Home

Lesson 2A

FOCUS/KEY CONCEPT

- **Science:** Build on students' knowledge about how the physical characteristics of animals influence their choice of habitat.

STANDARDS

CCELA: RL1.7, RL1.9

NGSS: ETS1-1

MATERIALS

- Set of **Animal Cards** and **Animal Place Mats** (from STEM lesson 1B) for each group of students OR project the **Animal Cards** on a SMART Board.
- Book: *The Magic School Bus Hops Home by Scholastic*
- Large copy of the **Basic Needs** chart (on chart paper, or white board)
- **Making Connections BLM** (1 per student)

TEACHER PREPARATION

For Pre-Activity

- Have sets of **Animal Cards** and **Animal Place Mats** from STEM Lesson 1B available for groups of students.

Literacy Lesson 2A

- 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>

INTRODUCTION:

1. **Introduction to Literacy Lesson :** To help students start thinking about making connections between their homes and animal homes **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 to help students begin to make connections to the things that we need our home to provide. **Say:** *These are **characteristics** that decribe where we live and today we will read a story about a frog named Bella and learn a little bit about where frogs live. While we are reading, I want you to be thinking about connections between Bella's home and your home.*
2. **Tie to engineering challenge. Say:** *We are going to read about the adventures of Mrs. Frizzle and her class. In this story, the class is looking for a pet frog that has escaped and Mrs. Frizzle suggests that they look for her in the place where she will be most happy – the pond, her natural habitat.* (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 paperclip 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 paperclip to LEARN)

ACTIVITY – Making connections:

4. **Introduce the book**: **Say:** *Today we will read* The Magic School Bus Hops Home: A Book About Animal Habitats. *This book is a narrative information book, so it tells a story while providing content information that is fictional or real facts .* (Note: Some science trade books include a section at the end that gives the facts or "true" parts of the story).

5. **Introduce/Explain the reading strategy.** *Say: Today we are going to continue to work on becoming better readers by making connections to our life. Good readers take time to think about what they read and relate it to something in their life or something they know. This helps us to understand what we have read.* Today, *while we are reading, I want you to be thinking about connections between Bella's home and your home.* (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 story and their lives).

The Magic School Bus Hops Home

5. **Start Reading. Say:** *Today we will read* The Magic School Bus Hops Home: A book About Animal Habitats**.** (Show the class the cover) **Ask:** *Can you describe a few things you see on the cover of our book? (*Take a few examples from the class). Read the book out loud and 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
6. **Re-read and practice.** Say: G*ood readers make connections when they read. We are going to practice by filling out some thing that happened in the story and then connecting something that happened in our life with what happened in the story.*

CLOSURE:

7. **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? (*The frog escaped because she wasn't happy and she went to find a place that was a better fit for her needs. 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 worksheet.

Activity Embedded Assessment

Making Connections worksheet, which asks students to make connections between human and animal homes.

Post-Activity Assessment

With students fill out **Basic Needs Chart** looking at basic needs labeled Human and Animal homes to help students to see the connection between their homes/needs and the animals' homes/needs.

EXTEND THE LESSON

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

Making Connections

Happened in the Story **Connection to my Life**

Use words or draw pictures with words.

Lesson 2B

Help Me Find My Home

FOCUS/KEY CONCEPT

- **Science**: Living things are diverse with many different observable characteristics.
- **Science:** Natural systems have many components that interact to maintain the system.

STANDARDS

NGSS: K-2-ETS1-1,LS.1.A

MATERIALS

For each pair of students:

- *Help Me Find My Home* habitat placemats
- Deck of animal cards
- Pattern blocks (or other 2D basic shapes)
- Copies of Help Me Find my Home Assessment

TEACHER PREPARATION

- If you do not have 3D blocks, 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 is hot with 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

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 decribe 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 specific needs, 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?* (point to the classroom Engineering Design Process chart) *Where should we move our paperclip 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 paperclip to LEARN)

ACTIVITY – Help me find my home:

4. **Part 1: Help Me Find My Home?** Give each pair of students one **deck of animal cards** and one of four different animal habitat placemats. Students will 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 and 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.*

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 pattern blocks 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. **Say:** *Where an animal finds its habitat provides its basic needs 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 how it is the same for some animals and different for some animals and 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 worksheet.

TEACHER NOTES:

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 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 sheet.

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EXTEND THE LESSON

Can You Help Me Find My Home?

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

Can You Help Me Find My Home?

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

Can You Help Me Find My Home?

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

Can You Help Me Find My Home?

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

Can You Help Me Find My Home?

Draw a line from each animal to the correct habitat

Desert

Arctic

Rainforest

Ocean

Penguin

Dolphin

Monkey

Parrot

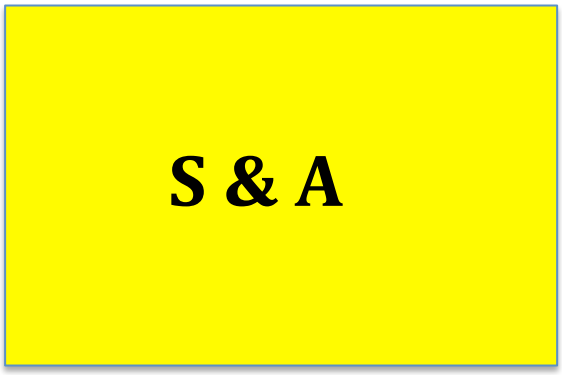
Camel

Octopus

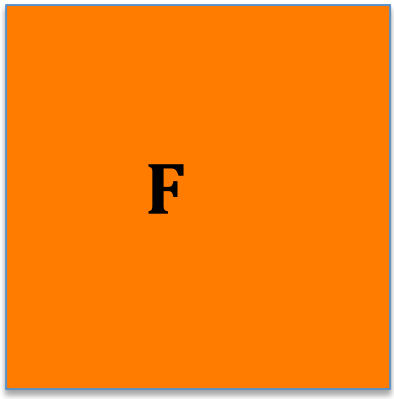
Tree Frog

Polar Bear

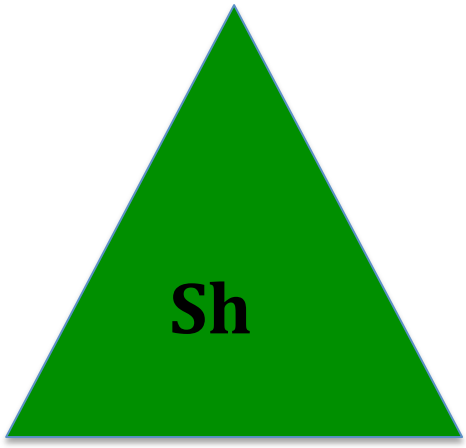
Water



Space & Air



Food



Shelter

W W W

W W W

W W W

W W W

W W W

S & A	**S & A**	**S & A**
S & A	**S & A**	**S & A**
S & A	**S & A**	**S & A**
S & A	**S & A**	**S & A**
S & A	**S & A**	**S & A**

F	F	F	F
F	F	F	F
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Sh Sh Sh

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Lesson 3A

The Greedy Triangle

FOCUS/KEY CONCEPT

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

STANDARDS

CCELA: RL.1.7, RL.1.2

CCM: MP.2, 1.G.A.1

NGSS: ETS1-2

MATERIALS

- Book: *The Greedy Triangle* by Marilyn Burns
- **Shapes in *The Greedy Triangle* Chart** (on chart paper, overheard, SMART board, etc.)
- **Thinking About *The Greedy Triangle* BLM**
- Chart paper

TEACHER PREPARATION

- Prepare chart for **Shapes in *The Greedy Triangle***
- **Thinking About *The Greedy Triangle*** 1 per student

VOCABULARY

- **Triangle** A shape with three sides
- **Quadrilateral** A shape with four sides
- **Pentagon** A shape with five sides
- **Square** A four-sided figure with all the sides equal
- **Rectangle** A four-sided figure with opposite sides equal

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. 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 min 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.*
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 paperclip 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 paperclip 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?* (looking for basic shapes: triangle, square, rectangle, parallelogram) Record students' answers on chart paper. Add to this chart as you learn about different shapes in the story.

Shapes in the Greedy Triangle Chart Example

Number of sides	Name	Picture
3	Triangle	

5. **Introduce the book.** The Greedy Triangle *by Marilyn Burns.* ***Say:*** *This book is a fiction book, and it is a story around mathematics.* ***Ask:*** *Are the stories in a fiction book true?* (take student answers) ***Say:*** *This is a story about a triangle who didn't like his shape.*
6. **Introduce the skill.** It is important for students to 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.

The Greedy Triangle

7. **Read the story aloud.** While reading, use the following to guide the lesson development process:
    a. Teach new vocabulary at the point of contact.
    b. 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*?
    c. Encourage higher-level thinking and comprehension monitoring by pausing for 'teacher think alouds' and asking questions about the text.
    d. During the reading continue to highlight the different shapes and continue to add the shapes to the chart.

CLOSURE:

8. **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 lesson.
9. **Individual practice.** Have students complete **Thinking About *The Greedy Triangle* BLM** to check student understanding of the story by using higher level questioning and thinking.

TEACHER NOTES:

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

Have students complete the **Thinking About *The Greedy Triangle*** BLM

EXTEND THE LESSON

Read the book *Grandfather Tang's Story* by Ann Tompert. The book tells the story of Grandfather Tang and little Soo and the wonders of tangrams as they rearrange themselves from foxes and rabbits to crocodiles and lions.

Thinking about The Greedy Triangle

What happened to the Greedy Triangle?

What lessons can we learn from this story?

Do you remember a time when you were unhappy, what did you do about it?

Lesson 3B

Exploring Animals and Tangrams

FOCUS/KEY CONCEPT

- **Mathematics**: Spatial reasoning. 2-dimensional shapes can be combined to create new shapes

STANDARDS

CCSS. Math.Content.1.G.1, 1.G.2

MATERIALS

- Shapes in *The Greedy Triangle* chart from Lesson 3A
- Book: *Three Pigs, One Wolf, and 7 Magic Shapes* by Grace Maccarone and David Neuhaus
- Large version the duck tangram (on chart paper, overheard, SMART board, etc.)
- Copy of oral checklist
- A set of tangrams (for each student OR pair)
- Copies of the 'magic shapes' to follow along with the story (1/student, there are 4 differentiated levels)

TEACHER PREPARATION

- Prepare chart for duck tangram

VOCABULARY

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

INTRODUCTION:

1. **Connect to prior knowledge. Say**: *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 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?* (Hamster habitat with exercise trail.) **Say:** *Today we are going to learn more about 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? (*point to the classroom Engineering Design Process chart) *Where should we move our paperclip 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 paperclip 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 saw 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* 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.

Exploring Animals and Tangrams

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 be rotate (or turn), flip, and slide the shapes to make some of the animals in the story.* Show 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:

   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 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 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 attributes of the shape helped you to know that?* (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 two-dimensional shapes and their ability to put these shapes together to form bigger shapes, like two triangles to form a square or rectangle.

TEACHER NOTES:

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(tangrams.doc or tangrams.pdf) at one of the three levels depending on the ability of the students. Oral checklist of which level students could master (see attached checklist).

Post-Activity Assessment

Test student knowledge of the attributes of two-dimensional shapes. Watch the students put the shapes together.

EXTEND THE LESSON

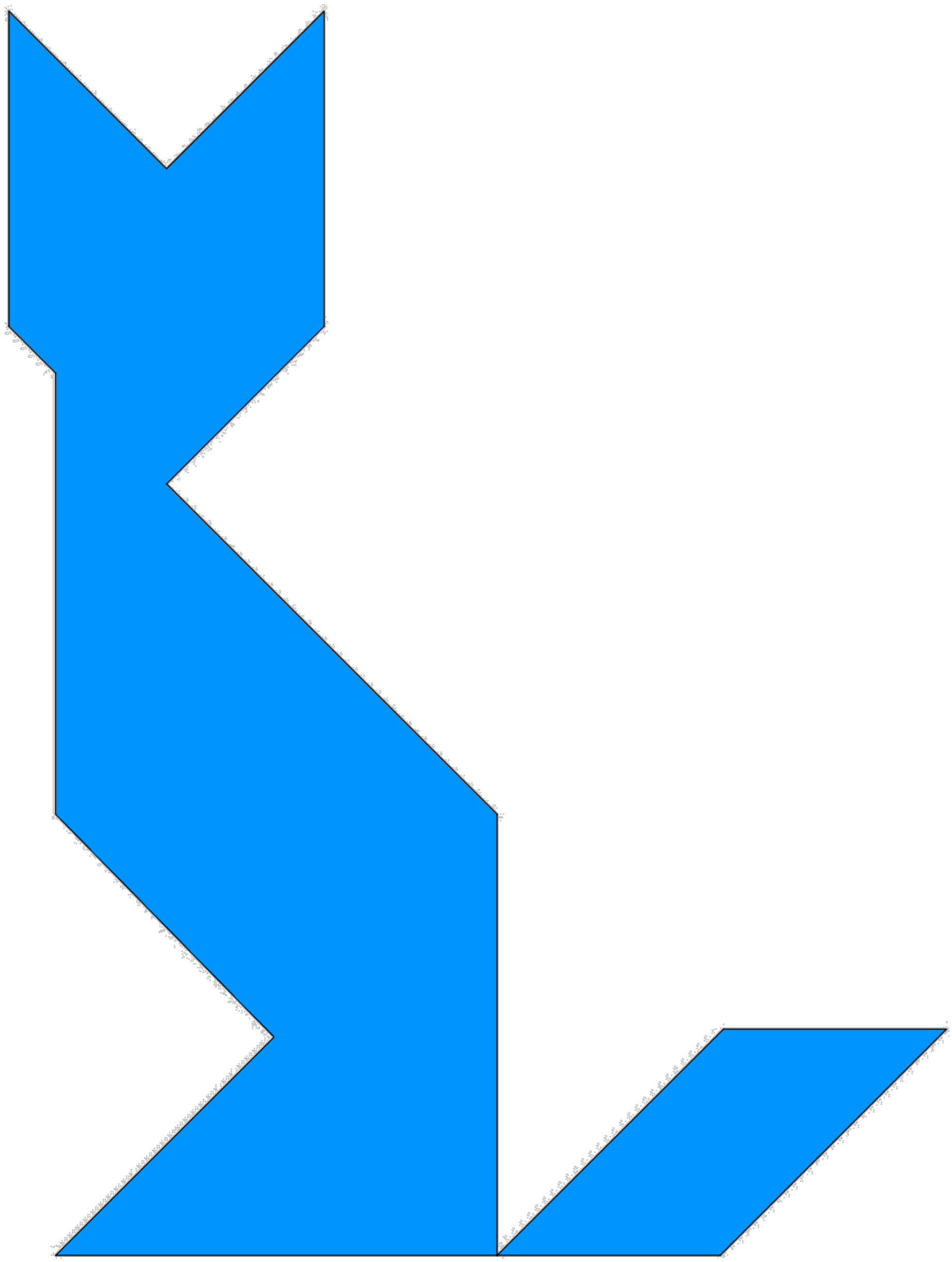
Tangrams Oral Checklist

Mark the level for each student (or partners) during the Tangram Animals activity:

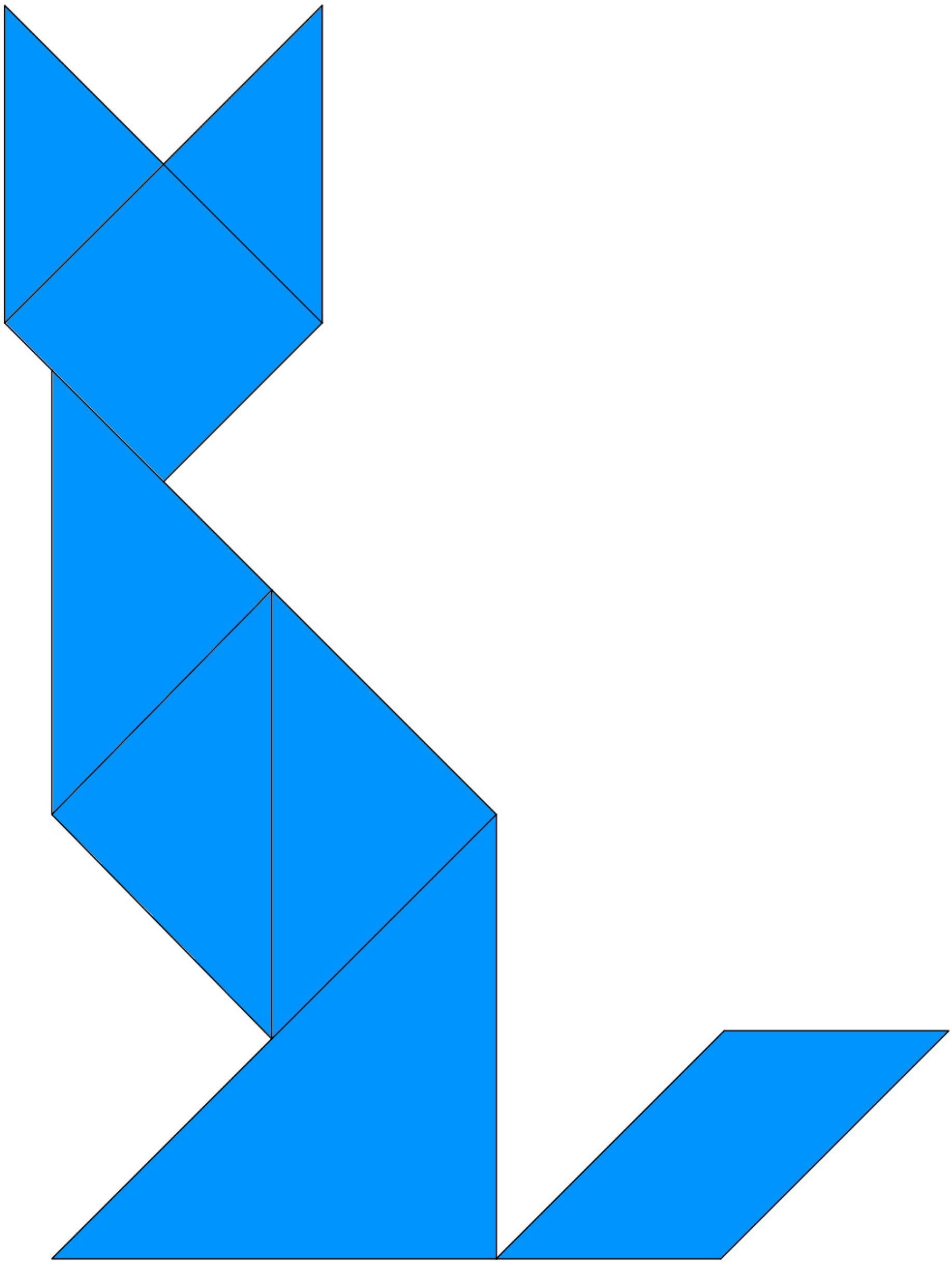
M=Mastery, P=Progressing

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

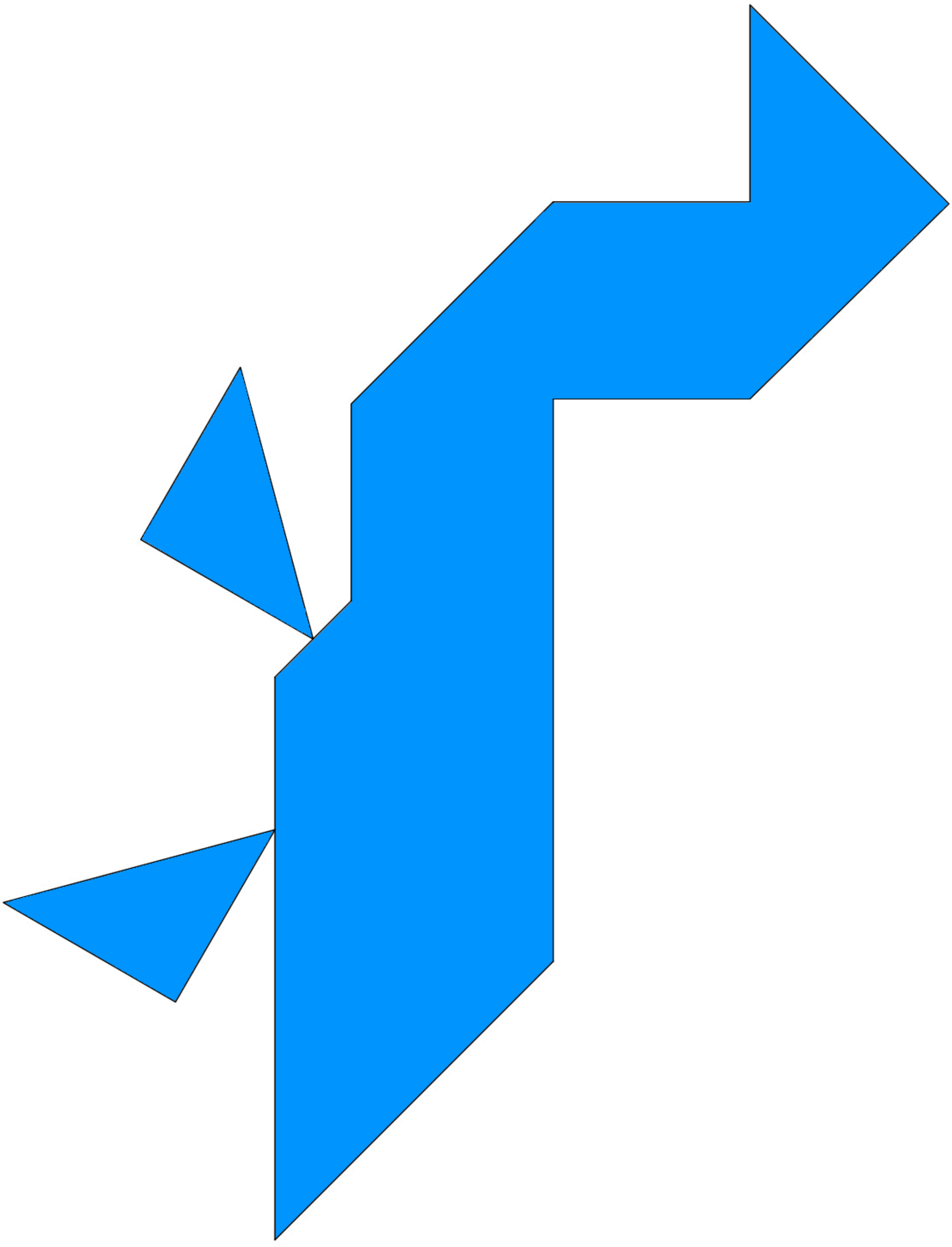
Use the tangrams to make the animal below from the story.



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



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



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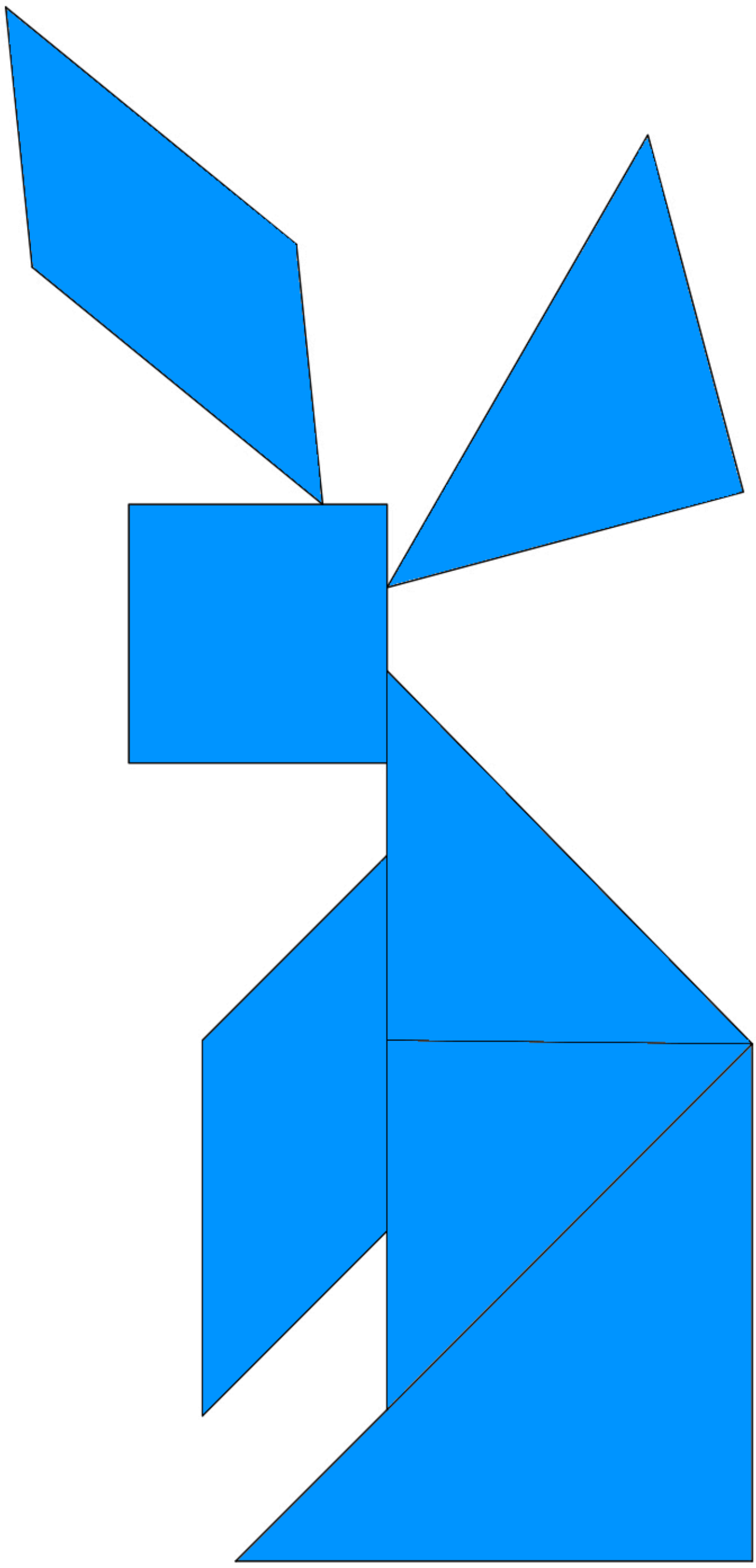

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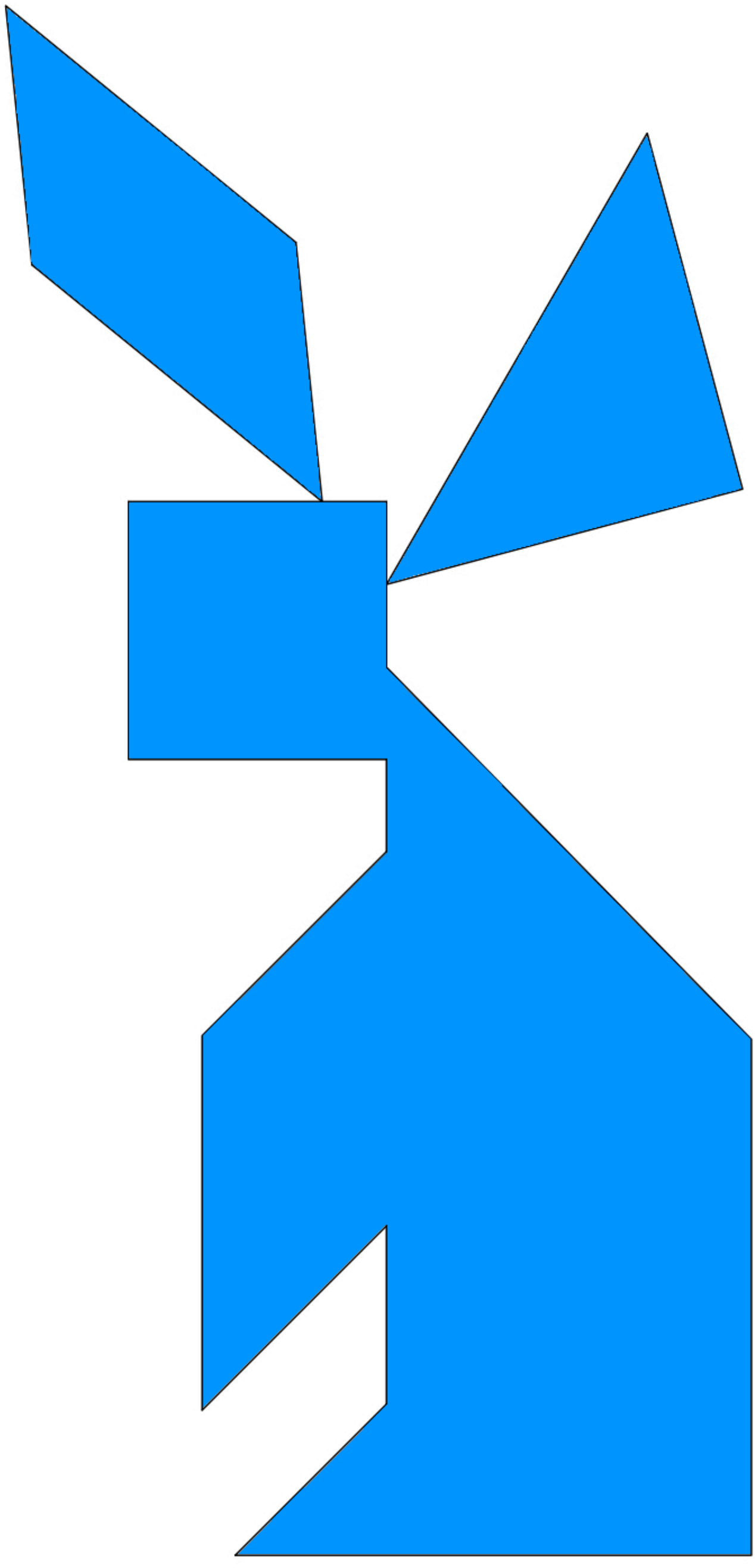

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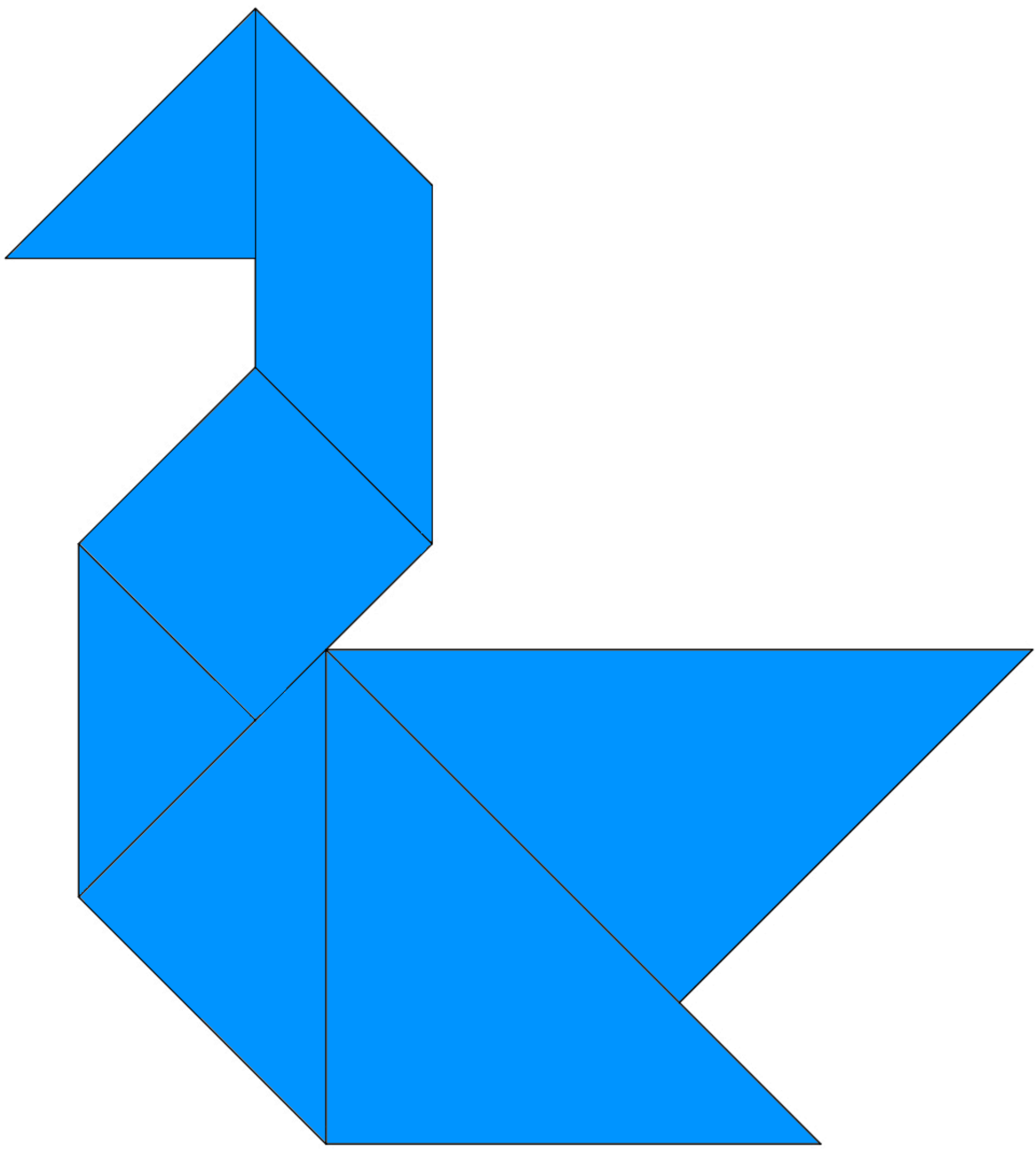

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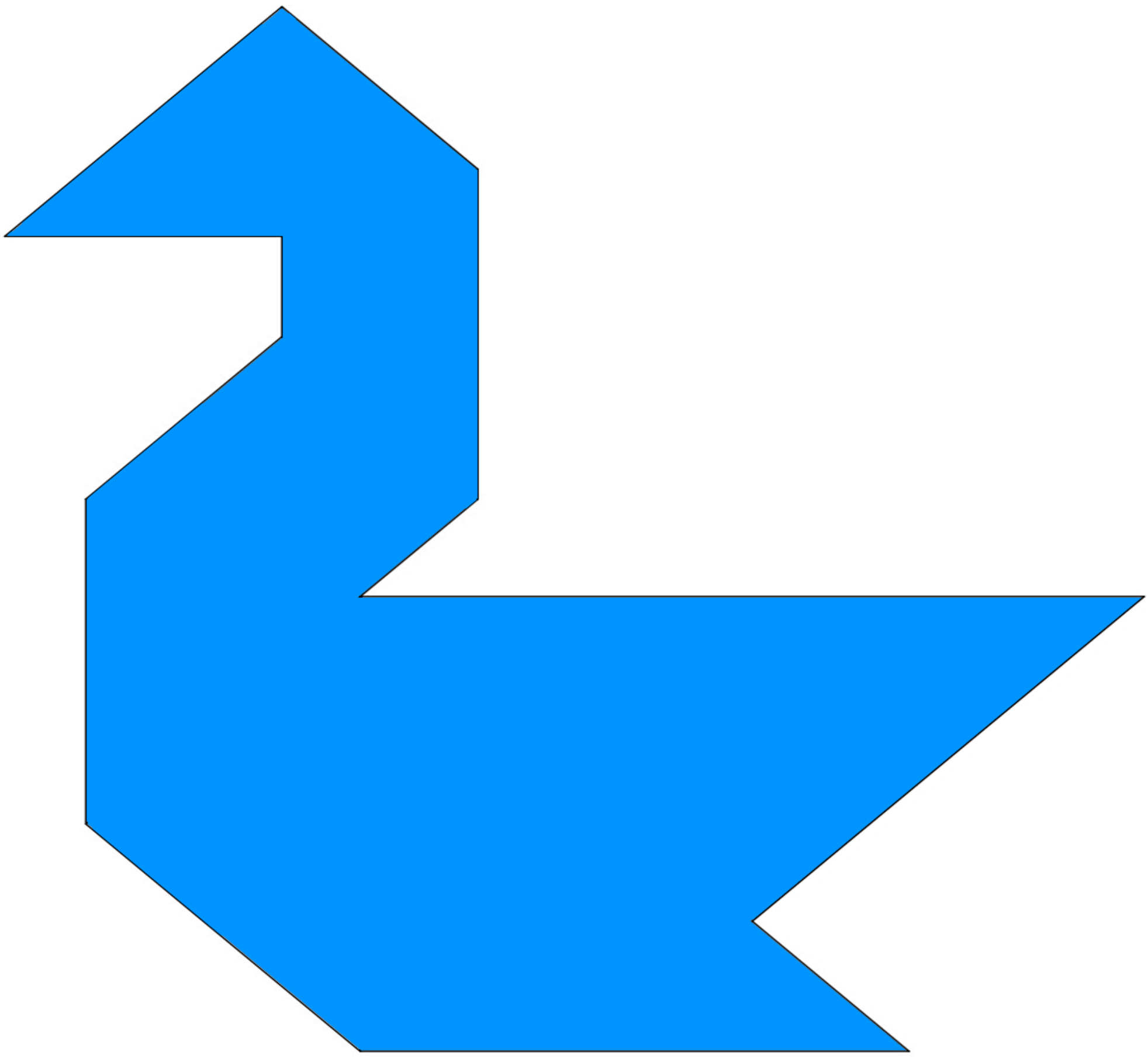

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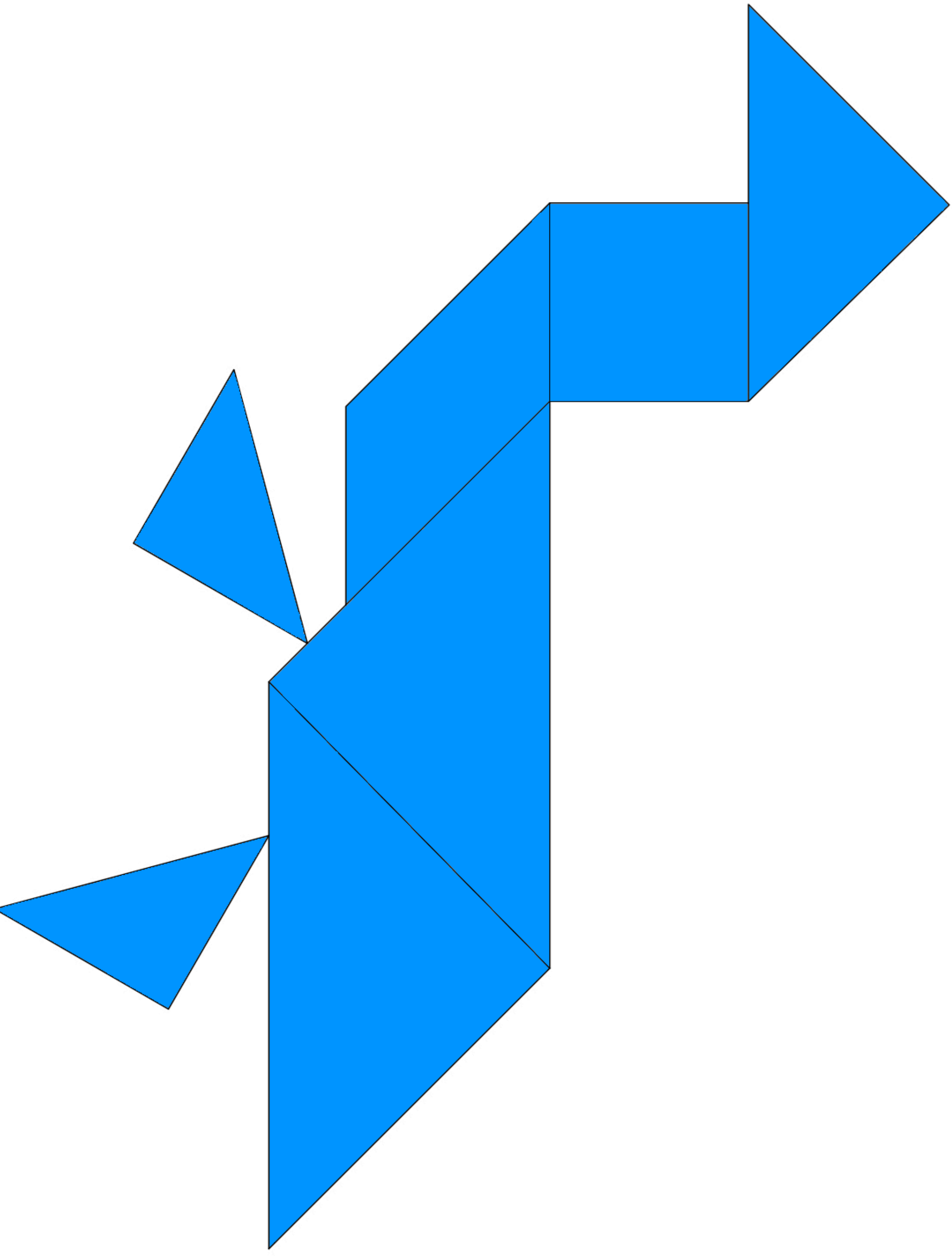

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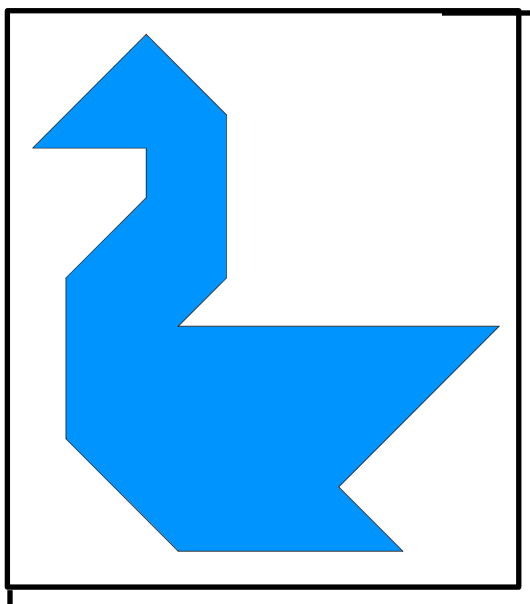

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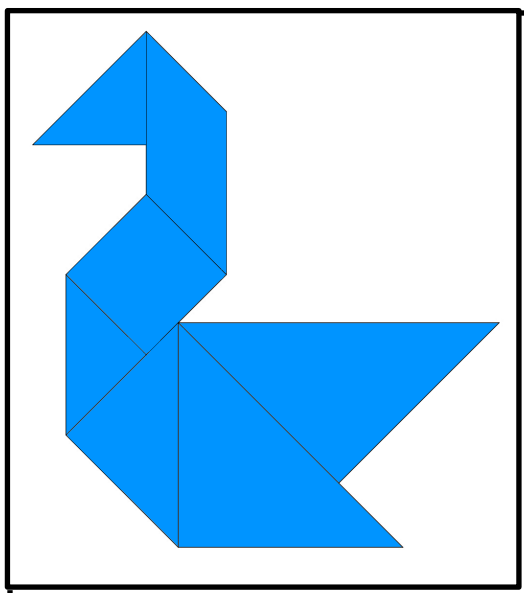

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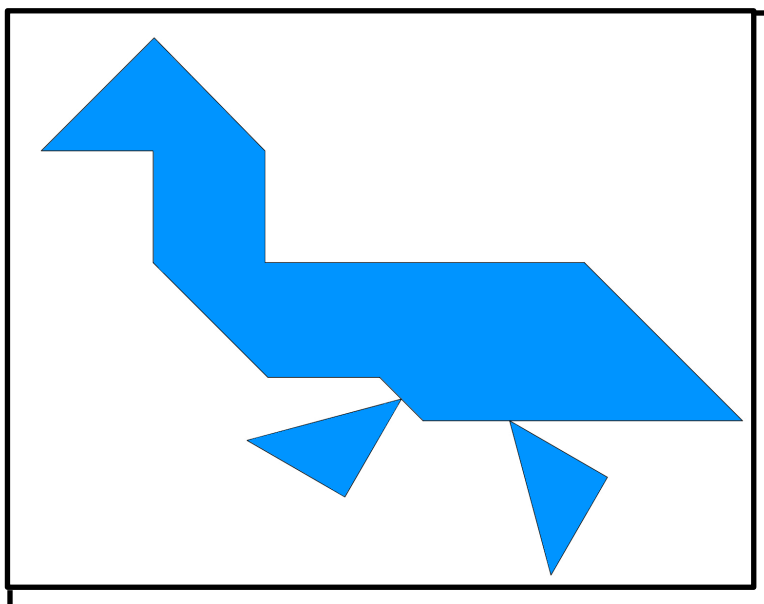

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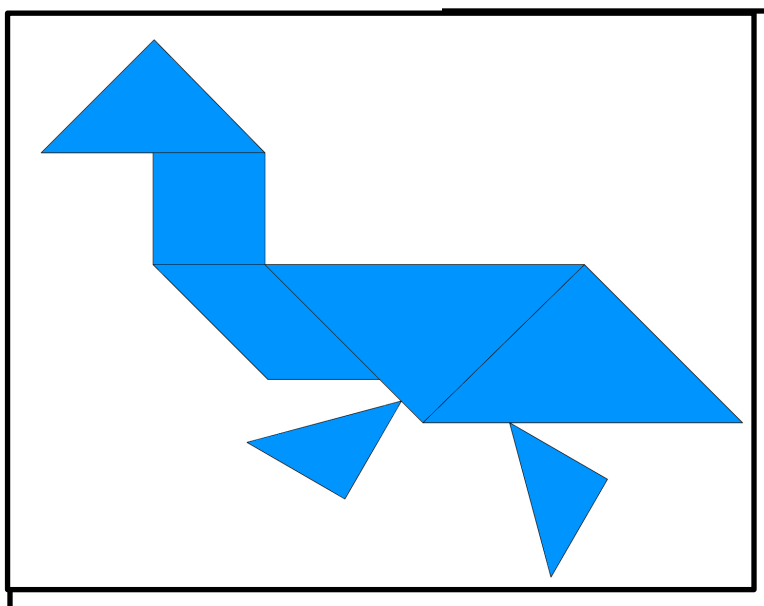

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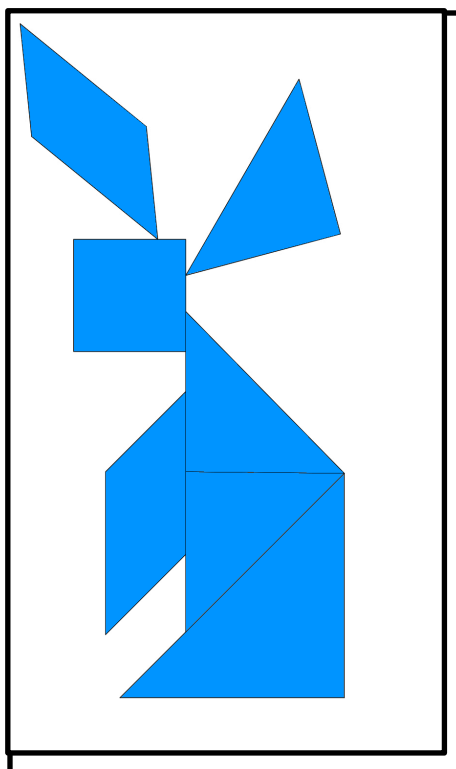

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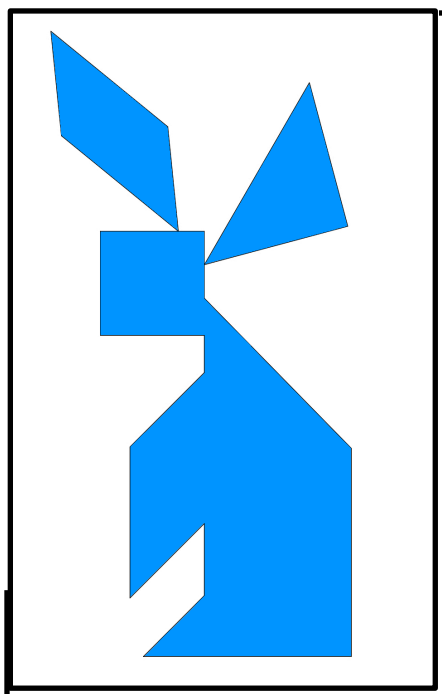

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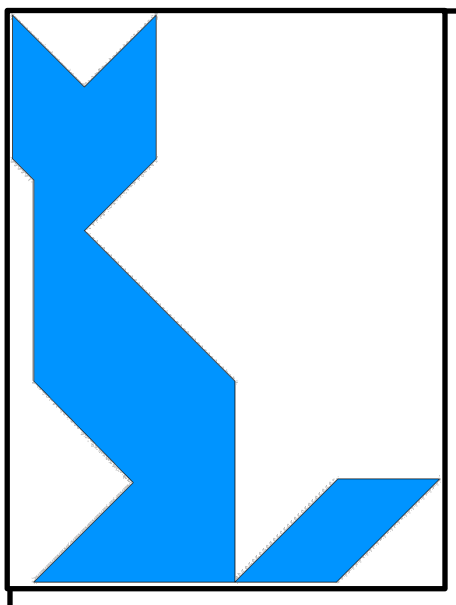

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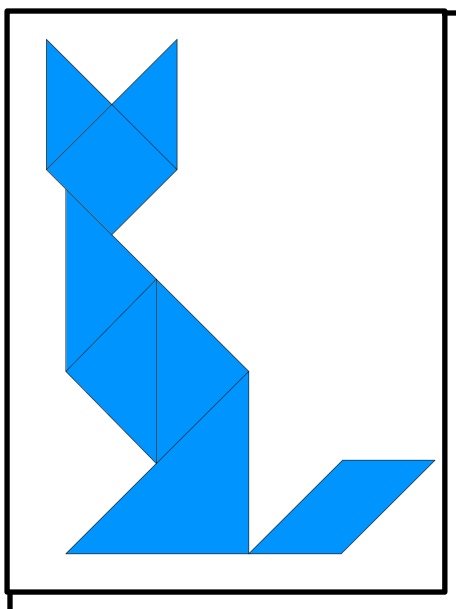


Lesson 4A

Joey and Jet

FOCUS/KEY CONCEPT

- **Literacy:** Use prepositions to describe actions. Use flow charts to organize the sequence of events in a story.
- **Computational Thinking**: Algorithms and procedures (sequencing)

STANDARDS

CCSS-ELA: L.1.1.i, RL.1.3

CSTA: L1:3.CT.2, L1:3.CT.3

MATERIALS

- Book: *Joey and Jet* by James Yang
- Flowchart Jet Chases BLM
- Flowchart Jet Returns BLM
- Jet Preposition Cards BLM
- 1 overhead marker for each student (if using laminated BLMs)

TEACHER PREPARATION

- Prepare one Flowchart Jet Chases and one Flowchart Jet Returns for each student. Lamination is recommended for reuse.
- Prepare one classroom Flowchart Jet Chases for demonstration use.
- Prepare 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 book: among, through, on, down, up, across, between, over, into, out of.

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?* (We are designing an exercise trail for a hamster habitat.) *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?* (point to the classroom Engineering Design Process chart) *Where should we move our paperclip 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 paperclip to LEARN.) **Say:** We are learning about flowcharts, and how they can make 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 demonstration 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.*

Joey and Jet

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:
   a. *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.
   b. *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. **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. Give each student a set of preposition cards. Have the students fill in the correct prepositions in each card.
   b. 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.
   c. Give each student a copy of the Flowchart – Jet Chases BLM. **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).
9. **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 BLM. 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. 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. Remind students how this connects to the directions they need to give to Perri for their hamster habitat design.

ASSESSMENT

Pre-Activity Assessment

Discussion 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 student ability to recognize and write the prepositions needed for each action.

Completion of the Flowchart – Jet Chases BLM. Look for student ability to recall the events of the story in order.

Completion of the Flowchart – Jet Returns BLM. Look for student ability to reverse the actions while still making sense of them (noting the order of the holes in particular).

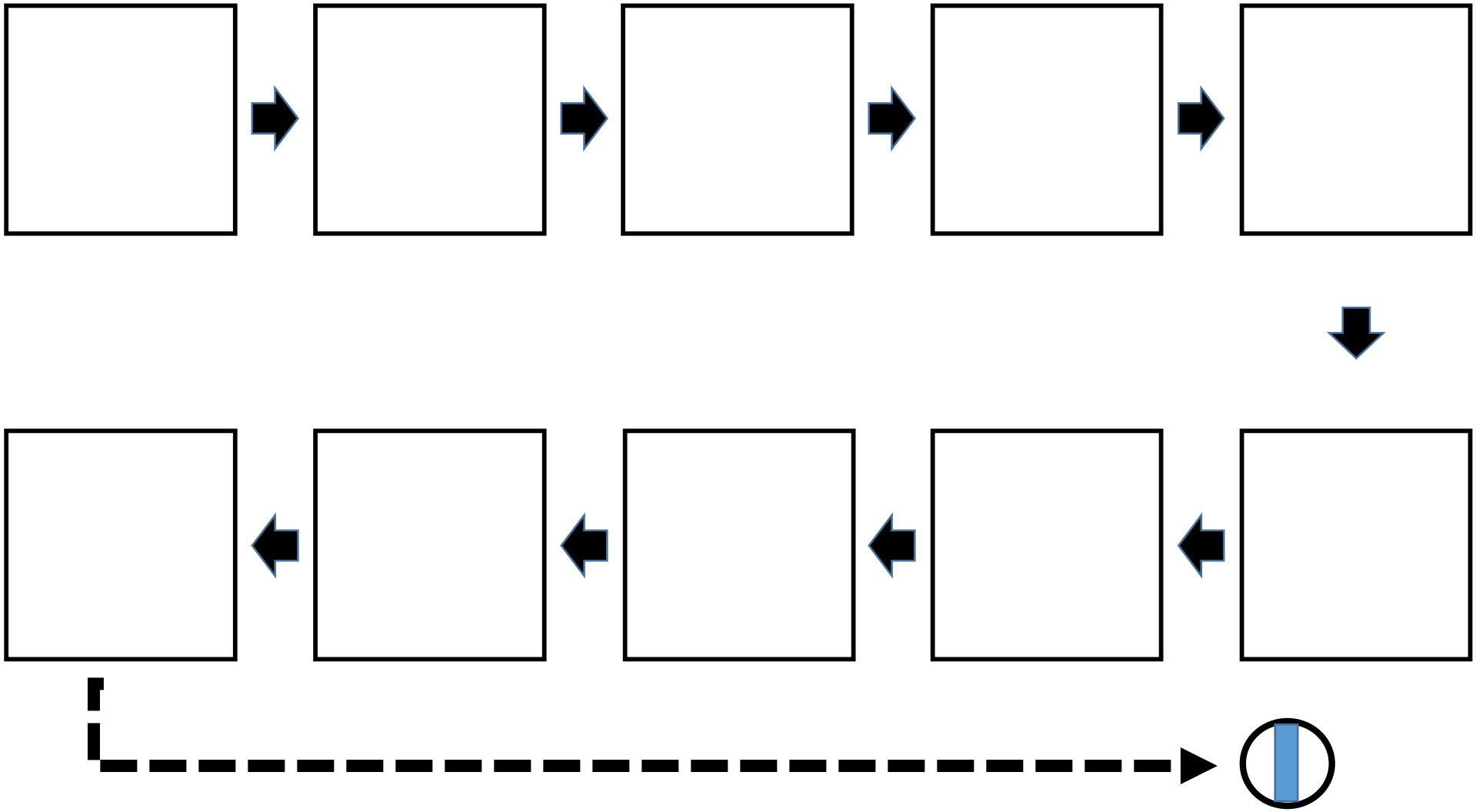
EXTEND THE LESSON

Have students make flowcharts for the events of other stories.

TEACHER NOTES:

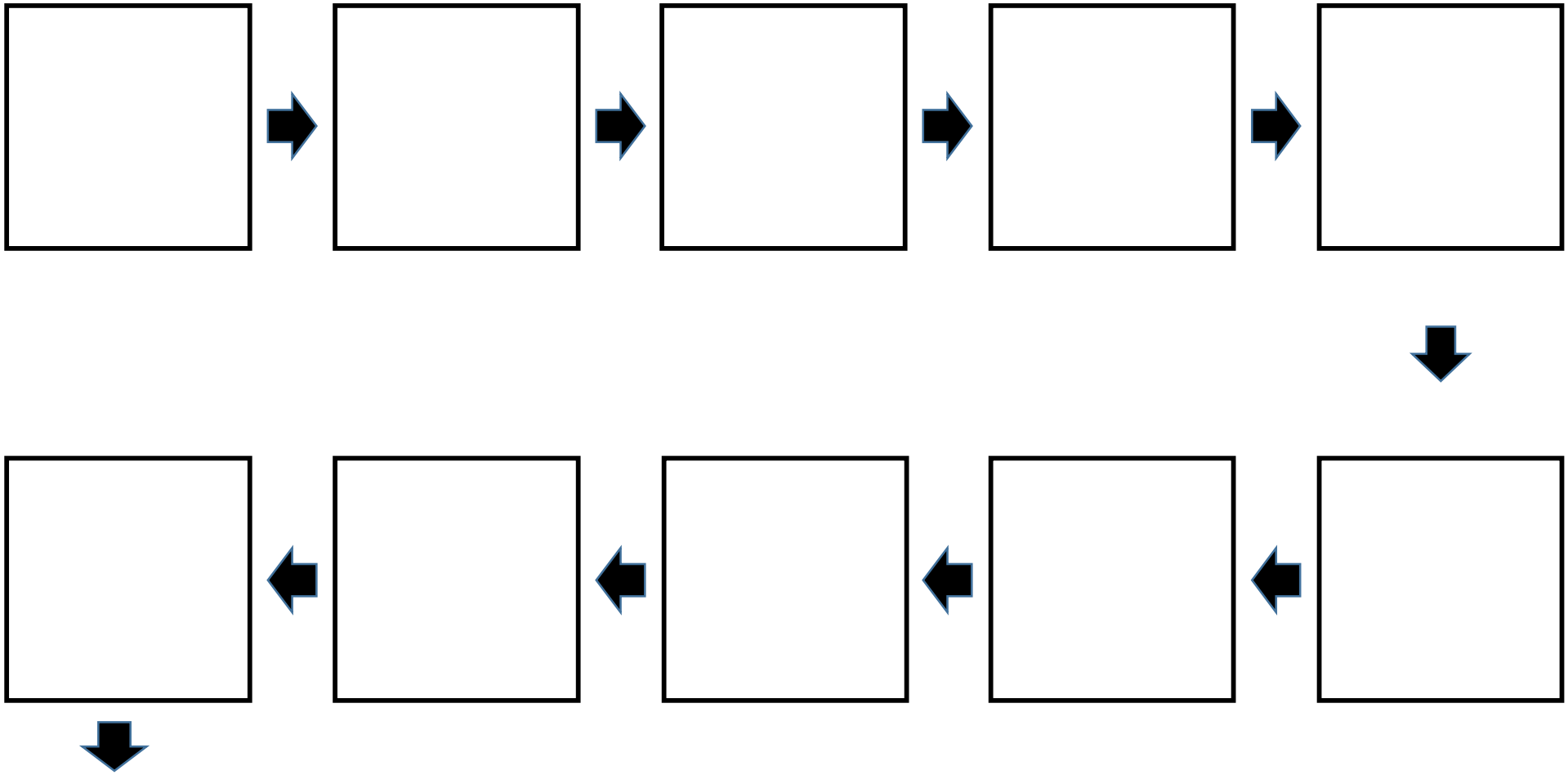
Flowchart – Jet Chases

Jet chases the ball…



Flowchart – Jet Returns

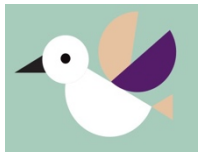
Jet found his ball and ran…



and back to Joey!

Jet Proposition Cards – 2 sets

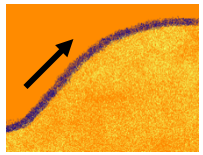
_____ the birds



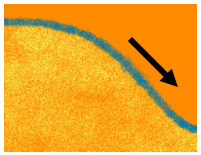
_____ the trees

_____ the water

_____ the hill



_____ the hill

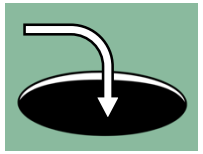


_____ the street

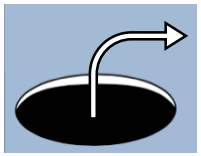
_____ the tables

_____ the roofs

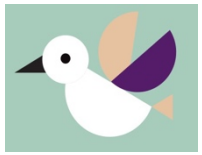
_____ a hole



_____ of a hole



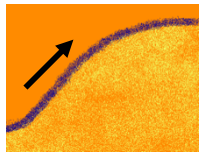
_____ the birds



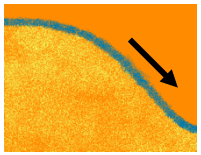
_____ the trees

_____ the water

_____ the hill



_____ the hill

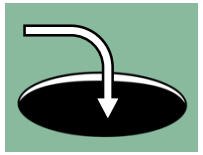


_____ the street

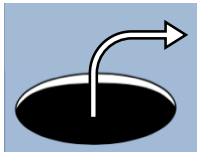
_____ the tables

_____ the roofs

_____ a hole



_____ of a hole



Lesson 4B

Algorithms with Tangrams

FOCUS/KEY CONCEPT

- **Mathematics:** Compose 2-D shapes to create composite shapes.
- **Computational Thinking**: Algorithms and procedures

STANDARDS

CCSS-Math: 1.G.2

CSTA: L1:3.CT.2, L1:3.CT.3

MATERIALS

- Shapes in *The Greedy Triangle* chart from Lesson 3A
- Tangram Mat BLM
- Develop Your Own Algorithm BLM
- Algorithms for Lesson 4B Educator Resource

TEACHER PREPARATION

- Put up chart from Lesson 3A.
- Laminate Tangram Mat BLMs
- Print Develop Your Own Algorithm BLM
- Prepare displays of algorithms.

VOCABULARY

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

INTRODUCTION:

1. **Connect to prior knowledge. Say:** 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 shape characters, we made the same characters with our tangrams). **Ask:** What did you have to do with the 7 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?* (We are designing a hamster habitat and exercise trail.) **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? (*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 – 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 triangle, 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 the **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 moveable 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 work space.

Algorithms with Tangrams

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 to all get the same results and 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, 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 BLM* 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:

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 student ability to follow instructions, understand the basic information about the shapes, and ability to do the geometric translations.

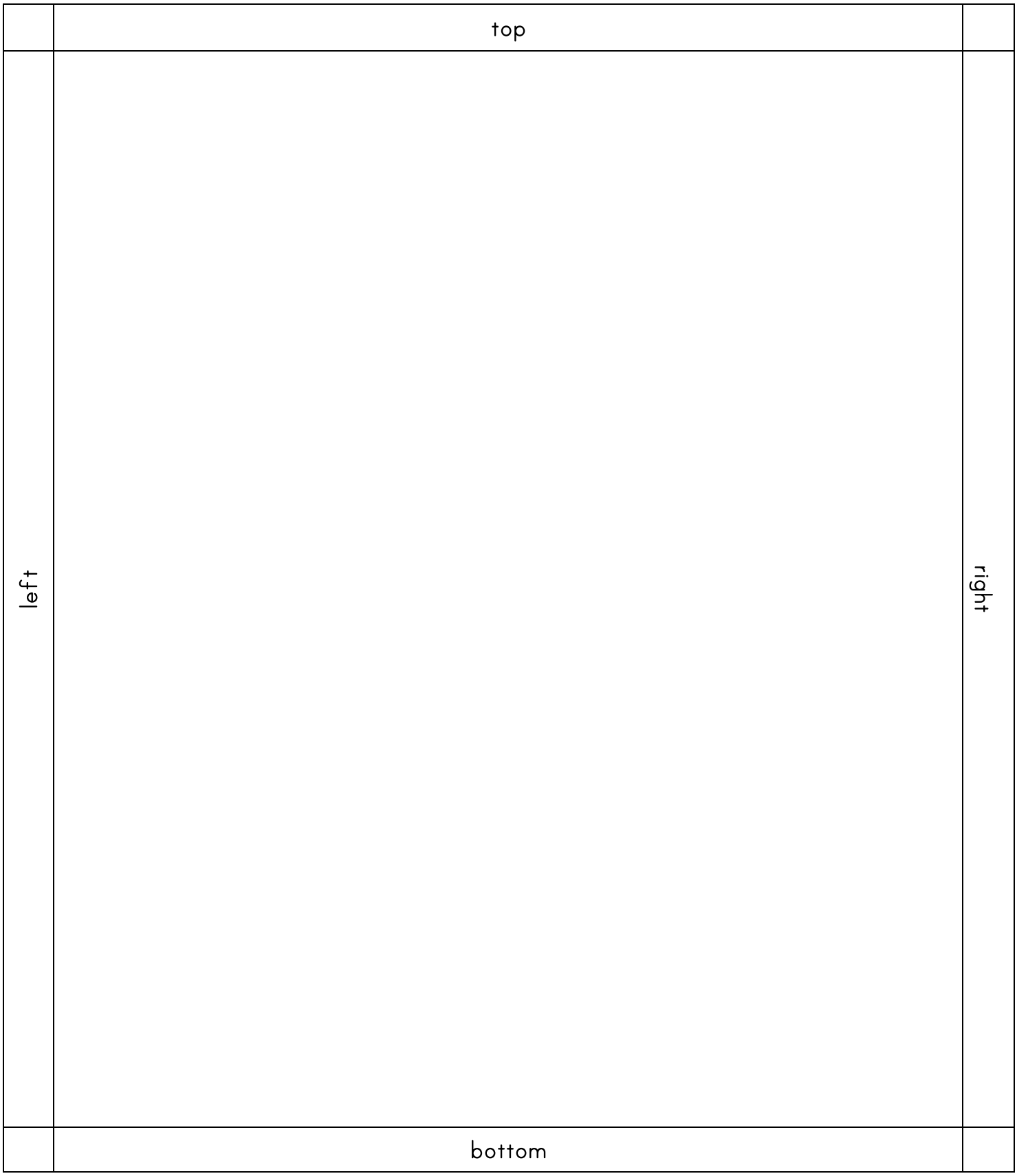
Post-Activity Assessment

Have students follow simple algorithms. Test student 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.

Tangram Mat



Develop your own tangram algorithm

Name _____

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

Algorithms for Lesson 4B

Algorithm 1

Use the two large triangles.
Put the long edge of each triangle together to make a big square.
Use the medium triangle.
Put the long edge of the medium triangle against the top of the square.

Algorithm 2

Use the two small triangles.
Put them side-by-side.
Use the parallelogram.
Put it below the two small triangles.
Slide it so it touches at least one of the triangles.

Algorithm 3

Use the square.
Put the square in the middle of your work space.
Use one large triangle.
Put the middle of the long edge of the triangle against the right side of the square.
Use the other large triangle.
Put the middle of the long edge of the triangle against the left side of the square.

Algorithm 4

Use the small triangle.
Put the small triangle toward the top of your workspace.
Rotate it so the long edge is toward the bottom.
Use the medium triangle.
Rotate it so the long edge is toward the bottom.
Put it below the small triangle so it touches in the middle.
Use the large triangle.
Rotate it so the long edge is toward the bottom.
Put it below the medium triangle so it touches in the middle.
Use the square.
Put the square below the large triangle so it touches it in the middle.

Algorithm 5 (optional)

Use one of the small triangles.
Rotate it so that the long edge is toward the left.
Use the other small triangle.
Put it to the right of the first small triangle.
Rotate it so that the long edge is toward the right.
Slide the two small triangles so that the points touch in the middle of the workspace.
Use the square.
Put it below the two triangles.
Turn the square so that the points are toward the top and bottom and left and right.
Slide the square so that it fits in the space created by both triangles and touches both.

Lesson 5A

Leo Cockroach…Toy Tester

FOCUS/KEY CONCEPT

- **Literacy:** Identify new vocabulary words and strategies for determining the meaning of those words
- **Engineering:** Discuss the importance of testing materials before you build a prototype.

STANDARDS

CCELA: RL.1.2 RL.1.7

CCM: 1.G

NGSS: CC1.OA - CC1.G

MATERIALS

- A large copy of the vocabulary word sheet (on chart paper, overheard, SMART board, etc.)
- Book: *Leo Cockroach… Toy Tester* by Kevin O'Malley
- Optional: **Interesting Words** Sheet (1/student)

TEACHER PREPARATION

- Prepare a copy of the **Interesting Words** for each student

VOCABULARY

- **Engineer** Uses mathematics, science, and creativity to solve problems to help people
- **Cockroach** A beetle like insect with long antennae and 6 legs

INTRODUCTION:

1. **Tie to engineering challenge. Ask:** *What is the problem we are working on?* (Designing a hamster habitat with exercise trail) *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.*
2. **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 paperclip and why should we move it there?* (Remind students they need lots of information to design a good habitat cage with exercise trail for Perri's Pet Palace and move paperclip to LEARN).
3. **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. Why do you think that no one raised their hands?* (Engineers test their toys before they sell them. Take a few student answers). ***Say:*** *Today, we are going to learn about someone who tests toys for their job. Before I read, I want you to think about why it is important to test materials, toys, or objects before you try and 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 from Leo.*

ACTIVITY – Finding new words:

4. **Introduce the book**. *Leo Cockroach… Toy Tester* **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 Leo the Cockroach, who is an engineer, and his job is to test toys before they are sold. Why would someone need to test toys before they sell them?* (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 good strategies like using pictures and context to help you think about what they might mean.*

Leo Cockroach…Toy Tester

6. **Reading the story.** Remember to use some of the things that help their development:
   a. **Teach new vocabulary at the point of contact**
   b. Target the comprehension skill – main ideas from informational text
   c. Encourage higher-level thinking and comprehension monitoring by pausing for "teacher think alouds" and asking questions about the text.

CLOSURE:

7. **Whole class summary**. To help students understand that it is important to be testing toys and materials before you use or sell your design, ask the students these questions:
   - What did Leo do as a job?
   - Do you think that Leo's job was important?
   - Did his boss think that his job was important?
   - Why did Leo decide to leave the toy company?

   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 a toy did not work after it was tested?* (guide students to talk about redesigning the toy to make it work and introduce failure as part of the engineering design process)

TEACHER NOTES:

ASSESSMENT

Pre-Activity Assessment

Student discussion regarding ideas about the importance of testing.

Activity Embedded Assessment

Have students complete **Interesting Words** on their own or as a class with students raising their hand when the come to a new vocabulary word.

Post-Activity Assessment

Post reading questions.

EXTEND THE LESSON

Have students set up a toy factory in the classroom to test toys.

My Juicy Words

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

FOCUS/KEY CONCEPT

- **Science**: Living things are diverse with many different observable characteristics.
- **Science :** Natural systems have many components that interact to maintain the system.
- **Engineering:** Engineers must carefully plan their designs before they can build and test them.

STANDARDS

NGSS: K-2-ETS1-1, K-2-ETS1-2

MATERIALS

For each pair of students:

- Copies of '**flickability**' and '**stackability**' placemats (1/group)
- Set of 3D shapes (1/group)
- Copies of the Draw your Habitat and Plan Your Design – Shape Store BLM

TEACHER PREPARATION

- A large size flickability and stackability chart (on chart paper, overheard, SMART board, etc.)
- Each group should be given 5-10 of each type of 3D shape.

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

INTRODUCTION:

1. **Connect to prior knowledge. Ask:** *Who can remember what Leo's job was?* (to test the toys) *What did we learn about testing toys from Leo?* (it is very important) *Why is it important to test toys or products before you sell them?* (so they are safe and don't break)
2. **Tie to Engineering Challenge. Say:** *Today we are going to be engineers as we design a habitat trail for our hamsters. 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 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 base, but your job will be to design the trail. Because these shapes are expensive we have* ***constraints*** *for each group to follow. A constraint is something that limits how we can solve our problem.*
   - *Each group can only use 20 shapes*
   - *You cannot have more than 10 of one shape.*

   These constraints mean that you will need to carefully test the shapes to help you choose the best ones for your design.
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 paperclip 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 paperclip to LEARN)

ACTIVITY – Testing for "Stackability" and "Flickability":

4. **Individual testing for "Stackability ".** 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.)
5. **Whole class summary of "Stackability".** When students have finished their tests, complete a large version of the "stackability" chart 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.
6. **Individual testing for "Flickability".** Using the same 5-10 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 flickibility test, you will place the shape on top of the placemat and then* ***gently*** *push at the shape with your pointer finger.*

The Importance of Testing

7. **Whole class summary of "Flickability".** When students have finished their tests, complete the large "flickability" chart 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 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 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, etc.)
8. **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 with multiple entrances and tunnels used for nesting, food storage and connecting them to their dens. 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
    - Towers – The hamster can crawl up vertically in the tunnel.
    - Caps – Provides a lookout at the top of a tower
9. **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.*
10. **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 BLM Draw your exercise trail.
11. **Pair planning.** Have students work with their partner to fill out the **Plan Your Design – Shapes Store** worksheet. Remind them of the constraint of 20 shapes total and no more then 10 of each shape.

CLOSURE:

12. **Whole class summary.** Discuss the attributes of the shapes and why students chose specific shapes. **Ask:** *Today, we had a chance to test some of the materials that we are going to use in our trail designs. 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?*

TEACHER NOTES:

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

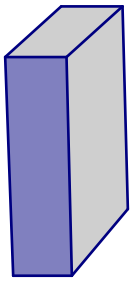
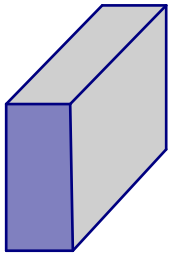
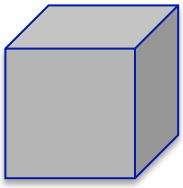
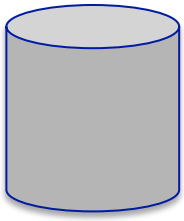
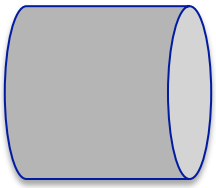
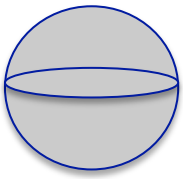
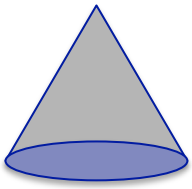
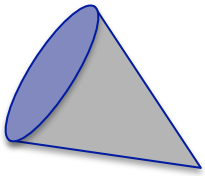
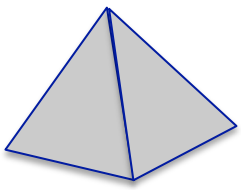
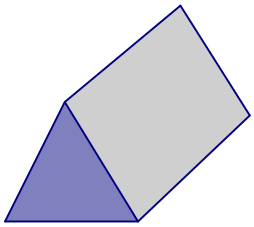
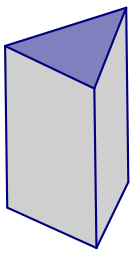
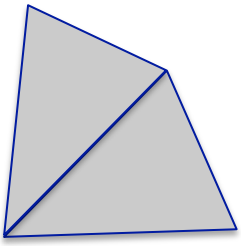
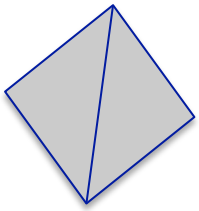
Part 1: Looking at what students have learned about the characteristics/attributes of three-dimensional shapes through a class discussion of their testing results.

Part 2: Looking at what students have learned about the characteristics/attributes of three-dimensional shapes through a class discussion of which shapes they are planning to use.

EXTEND THE LESSON

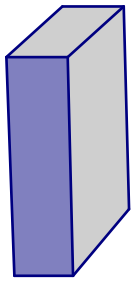
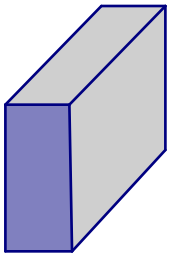
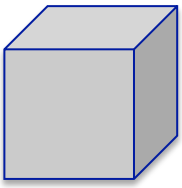
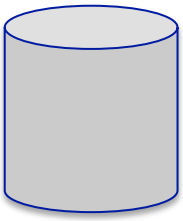
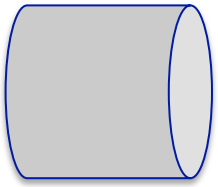
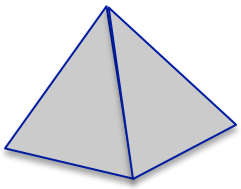
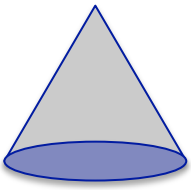
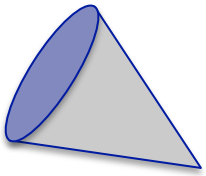
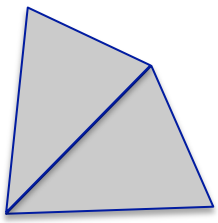
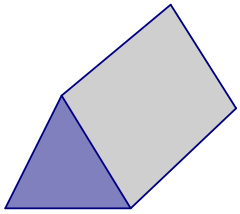
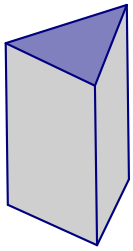
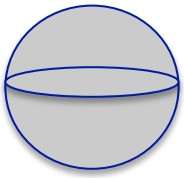
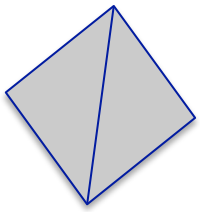
Test your materials: “Stackability”

1. How many can you put on top of each other before it falls? 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?		

Test your materials: “Flickability”

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

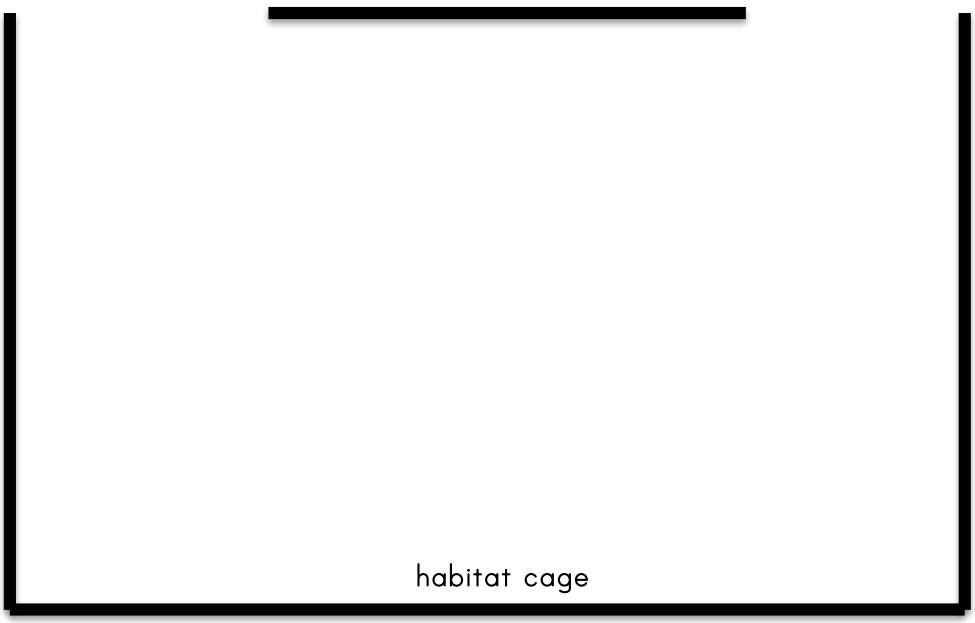
	slides falls over rolls		slides falls over rolls		slides falls over rolls
	slides falls over rolls		slides falls over rolls		slides falls over rolls
	slides falls over rolls		slides falls over rolls		slides falls over rolls
	slides falls over rolls		slides falls over rolls		slides falls over rolls
	slides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

Draw Your Habitat Cage and Exercise Trail

back

left

right



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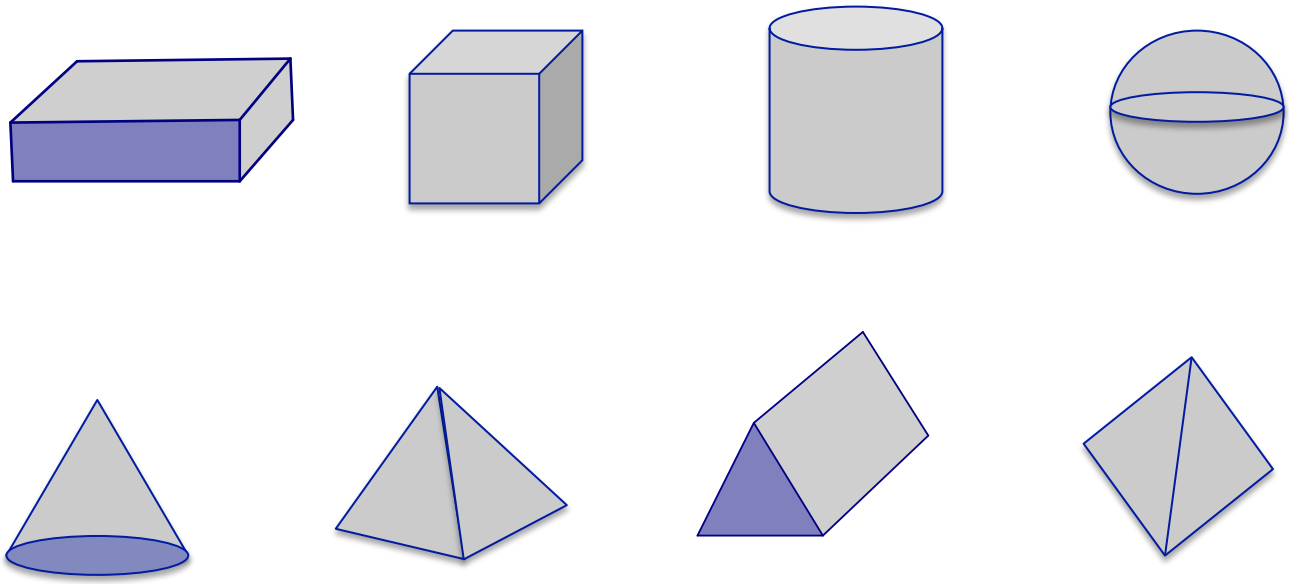
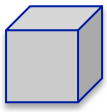
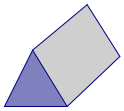
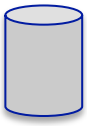
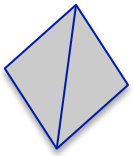
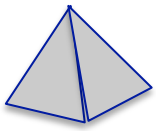
Part 1: Plan Your Design - Shape Store

Circle the shapes that you want



Part 2: How many of each will you need?

Write how many of each shape you would like in the box. (You can only use 20 shapes total.)

	How many?		How many?
Rectangular Prism 		**Cone** 	
Cube 		**Triangular Prism** 	
Cylinder 		**Triangular Pyramid** 	
Sphere 		**Square Pyramid** 	

Lesson 6A

The Perfect Pet

FOCUS/KEY CONCEPT

- **Literacy:** Identify important details, that will help them to summarize the story
- **Science:** Describe how an animal's habitat should provide for the basic needs of that animal

STANDARDS

CCELA: RL.1.3

CCM: 1.G CC1.OA CC1.G

NGSS: ETS1-2

MATERIALS

- A large copy of the **Important Details** BLM (on chart paper, overheard, SMART board, etc.)
- Book: *The Perfect Pet* by Margie Palatini
- Optional: ***Important Details*** BLIM(1/student)

TEACHER PREPARATION

- Prepare chart for **Important Details sheet**

VOCABULARY

- **Engineering Design Process** A series of processes engineers go through in designing products such as background of problem, designing and implementing prototype, and evaluating and refining designed product.

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) *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?* (Hamster habitat with exercise trail.) *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? (*point to the classroom Engineering Design Process chart) *Where should we move our paperclip 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 paperclip to LEARN)

ACTIVITY – Identify important details:

4. **Introduce the book. 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? 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.*

The Perfect Pet

6. **Start Reading.** Introduce the book *The Perfect Pet* by Margie Palatini. **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** sheet. **Say:** *What were the pets Elizabeth wanted and what happened when she asked her parents to get that pet? (*Show students the **Important Details** sheet) **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 right.*

CLOSURE:

8. **Whole class summary.** After students have finished completing their **Important Detail** sheet, 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. What happened in the end of the story?* (she ended up with a pet bug, Doug). **Ask:** *Why was Doug a good fit for her?* (he didn't have too many needs – he wasn't very big, and didn't eat very much). **Ask:** *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, space).

TEACHER NOTES:

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** worksheet. 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.

Important Details

Use words or draw pictures with words.

The pet she wanted		**But it was too….**
	→	
	→	
	→	
	→	

Lesson 6B

Designing a Hamster Habitat Trail

FOCUS/KEY CONCEPT

- **Science**: Living things are diverse with many different observable characteristics
- **Science :** Natural systems have many components that interact to maintain the system
- **Engineering:** Engineers must test prototypes to be sure their designs work
- **Engineering:** Sometimes designs fail or could be made better; redesign is an important part of engineering

STANDARDS

NGSS: K-2-ETS1-1

MATERIALS

- Copies of the Build Your Habitiat BLM(1/group)
- Assorted 3D shapes
- Paper hamsters
- 2D basic needs shapes (see lesson 4)
- Engineering Checklist

TEACHER PREPARATION

- Prepare one hamster, 3D shapes, and 2D shapes for each group

VOCABULARY

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

INTRODUCTION:

1. **Tie to Engineering Challenge**: **Ask:** *Who can remember what problem we are trying to solve?* (Ex: create a habitat trail, for our hamsters that is like the tunnels they dig to will keep them happy and healthy and we can only use 20 shapes). **Say:** *I want you to listen as I read the design challenge again and I want you to think about the problem that we are trying to solve.* Read challenge to students. **Say:** *You will be using your knowledge of animals, animal habitats and shapes to help you design a home or habitat that your hamster could live in. Remember this habitat should provide all of the basic needs to keep your hamster happy and healthy. Hamsters like to dig tunnels which is what you have been asked to help design. Everyone will receive the same rectangular base or "den", but your job will be to design the trail portion of the habitat. However, because these shapes are expensive and we can only afford for each group to use 20 shapes, and no more than 10 of one shape. This is why we tested the shapes before, so we have a good idea about how well they will work in building our designs.* **Say:** *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. Are you ready to build some habitats?*
2. **Identify where they are in the engineering design process.** Try ***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 paperclip and why should we move it there? (*move paperclip to TRY)

ACTIVITY – Build and test hamster habitats:

3. **Discuss basic needs criteria**. **Say:** *You just told me that we are going to make a habitat for our pet hamster and we remember that 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, 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.*

Designing a Hamster Habitat Trail

4. **Discuss escaping criteria.** *We also provide our hamster with a habitat that is similar to their natural habitat. Remember we discussed how hamsters are excellent diggers and like to make burrows with multiple entrances and make tunnels to nest in, for food storage also use the tunnels to connect them 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 and with that we want to make sure that our hamster can't escape. To test this, 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. Is it good if your hamster can escape?*
5. **Build habitats.** Have the students start on their design using the information they gathered from their 4B exercise and the shapes they planned to use in section 4B.
6. **Test habitats. (Test)** As a class, move paperclips to Test. To make sure their habitat meets those constraints, 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), and
    - Counting the total number of 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.
7. **Share habitat designs.** Have students share their habitat design with others while reminding them that they want to pay attention to other student's design because they might get ideas that they want to try in their redesign. This is where the pictures are helpful, because 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 needs are met.
8. **Redesign habitats. (Decide)** As a class, move paperclips to Decide. Allow students time for the redesign of their habitat to make it even better. 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.

CLOSURE:

9. **Share final design**. If time allows, have students share with their classmates the design they ultimately chose and why they chose that design.

TEACHER NOTES:

ASSESSMENT

Pre-Activity Assessment

Review the hamster topic map and the basic needs chart from the very 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

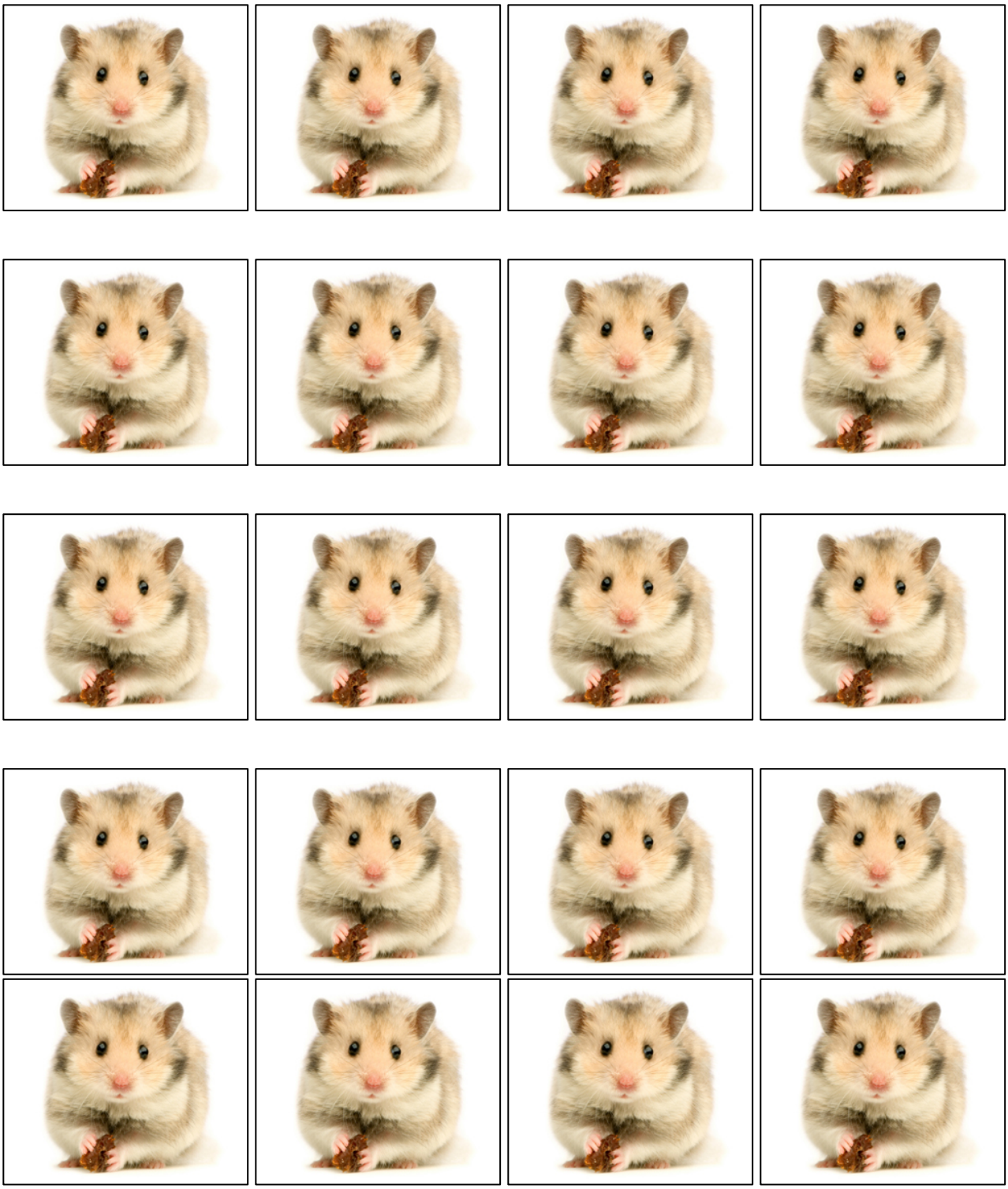
Oral assessment done by the teacher using an oral checklist, (engr design checklist) which has students identify where and how their habitat meets the basic needs requirement, how many shapes they used, and what improvements they have made/would like to make to their habitat.

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.

EXTEND THE LESSON

PictureSTEM: Designing Hamster Habitats



Habitat Cage and Exercise Trail Mat

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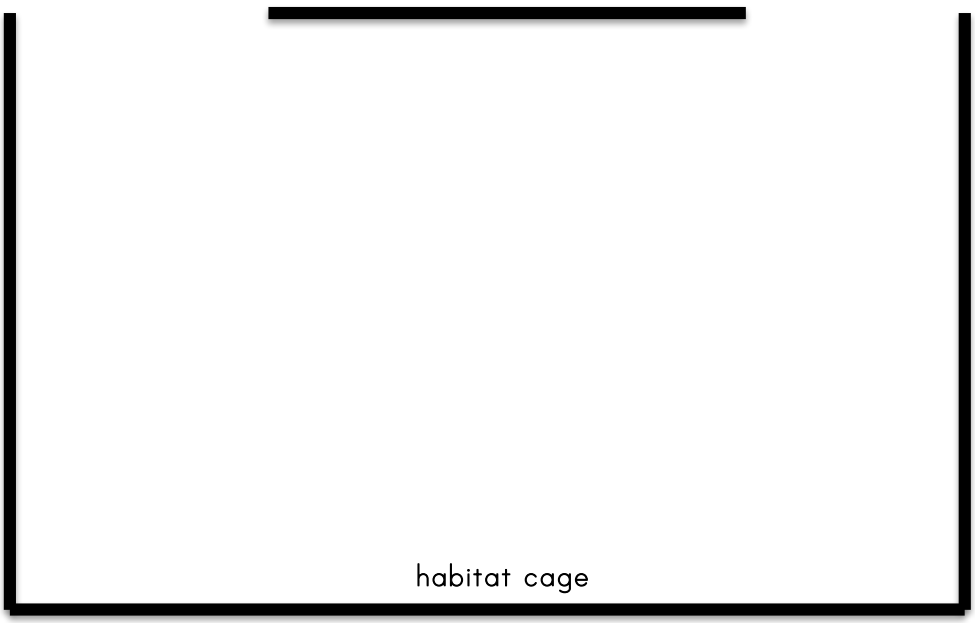

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