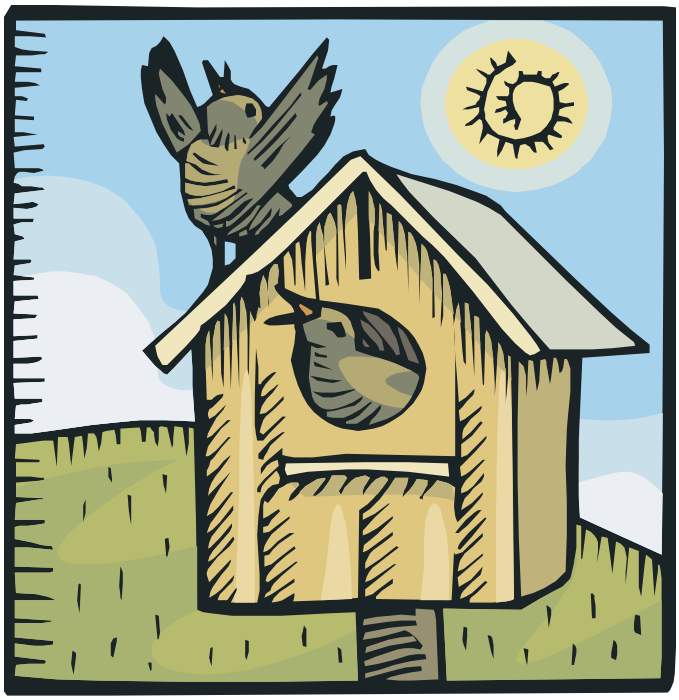


Animal House

ABOUT THIS LESSON

"Animal House" is designed to reinforce formulas and methods of determining perimeter and area through a series of activities contextualized through animal and habitat conservation. As students progress through the lesson, they will move from analyzing regular shapes to composite shapes as they move from artificial animal enclosures to wildlife refuges.

OBJECTIVES

Students will

- build a conceptual understanding of area and perimeter of rectangles.
- calculate the area and perimeter of rectangles by either counting unit squares or edges and by applying their formulas.
- apply the area and perimeter formulas to real life situations.
- calculate the area and perimeter of composite figures.

LEVEL

Grade 3 Math and Science

MODULE

Areas and Volumes

MODALITY

NMSI emphasizes using multiple representations to connect various approaches to a situation in order to increase student understanding. The lesson provides multiple strategies and models for using those representations indicated by the darkened points of the star to introduce, explore, and reinforce mathematical concepts and to enhance conceptual understanding.

P – Physical
V – Verbal
A – Analytical
N – Numerical
G – Graphical

TEACHER PAGES

COMMON CORE STATE STANDARDS FOR MATHEMATICAL CONTENT

This lesson addresses the following Common Core State Standards for Mathematical Content. The lesson requires that students recall and apply each of these standards rather than providing the initial introduction to the specific skill.

Targeted Standards

3.MD.6: Measure areas by counting unit squares (square cm, square m, square in, square ft, and improvised units). *See Activity 1: 1, 3, 5; Activity 4: 1*

3.MD.7: Relate area to the operations of multiplication and addition. *See Activity 1: 2-5*

3.MD.7a: Find the area of a rectangle with whole-number side lengths by tiling it, and show that the area is the same as would be found by multiplying the side lengths. *See Activity 1: 3, 5*

3.MD.7b: Multiply side lengths to find areas of rectangles with whole-number side lengths in the context of solving real world and mathematical problems, and represent whole-number products as rectangular areas in mathematical reasoning. *See Activity 2: 1-7*

3.MD.7c: Use tiling to show in a concrete case that the area of a rectangle with whole-number side lengths *a* and *b*+*c* is the sum of $a \times b$ and $a \times c$. Use area models to represent the distributive property in mathematical reasoning. *See Activity 1:7*

3.MD.7d: Recognize area as additive. Find areas of rectilinear figures by decomposing them into non-overlapping rectangles and adding the areas of the non-overlapping parts, applying this technique to solve real world problems. *See Activity 4: 1-6; Activity 5:1-3*

3.MD.8: Solve real world and mathematical problems involving perimeters of polygons, including finding the perimeter given the side lengths, finding an unknown side length, and exhibiting rectangles with the same perimeter and different areas or with the same area and different perimeters. *Activity 1:8-12; Activity 2:5-7; Activity 5:4*

3.AO.8: Solve two-step word problems using the four operations. Represent these problems using equations with a letter standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. *Activity 1: 8-10*

Reinforced/Applied Standards

3.MD.5: Recognize area as an attribute of plane figures and understand concepts of area measurement.

3.MD.5a: A square with side length 1 unit, called “a unit square,” is said to have “one square unit” of area, and can be used to measure area.

3.MD.5b: A plane figure which can be covered without gaps and overlaps by *n* unit squares is said to have an area of *n* square units.

3.OA.1: Interpret products of whole numbers, e.g., interpret $5x7$ as the total number of objects in 5 groups of 7 objects.

3.OA.3: Use multiplication and division within 100 to solve word problems in situations involving equal groups, arrays, and measurement quantities.

3.MD.3: Draw a scaled picture graph and a scaled bar graph to represent a data set with several categories. Solve one- and two-step "how many more" and "how many less" problems using information presented in scaled bar graphs. For example, draw a bar graph in which each square in the bar graph might represent 5 pets.

COMMON CORE STATE STANDARDS FOR MATHEMATICAL PRACTICE

These standards describe a variety of instructional practices based on processes and proficiencies that are critical for mathematics instruction. NMSI incorporates these important processes and proficiencies to help students develop knowledge and understanding and to assist them in making important connections across grade levels. This lesson allows teachers to address the following Common Core State Standards for Mathematical Practice.

MP.1: Make sense of problems and persevere in solving them.
Students will move from the conceptual building of perimeter and area to concrete models where they will apply their understanding to real world problem situations.

MP.2: Reason abstractly and quantitatively.
Students compute the area of rectangles using unit squares and determine the perimeter of rectangles by counting and then write formulas that can be used for all rectangles.

MP.4: Model with mathematics.
Students apply and use the area and perimeter formulas to solve real world problems involving rectangular and composite shapes.

MP.5: Use appropriate tools strategically.
Students use grid paper and pencil to draw multiple habitats.

MP.6: Attend to precision.
Students use precision when drawing their habitats to fit a certain area.

MP.7: Look for and make use of structure.
Students will make use of structure by discerning that using the formulas for perimeter and area are more efficient than counting each unit square or edge individually. In addition, students use multiplication to add a long series of numbers to shorten the perimeter calculation.

NEXT GENERATION SCIENCE STANDARDS

3-LS1-1 Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.

3-LS3-2 Use evidence to support the explanation that traits can be influenced by the environment.

3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

ASSESSMENTS

The following types of formative assessments are embedded in this lesson:

- Class discussions of zoos and habitats through structured reading.
- Accurate completion of tables
- Sequencing of "Life Cycle" cards
- Students interpret information from charts and graphs
- Students apply knowledge of perimeter and area to design boardwalk

MATERIALS AND RESOURCES

- Scissors
- Colored Pencils
- Card set, "Life Cycle"
- Laminated sheet, "Aerial View of Marsh Refuge"
- Sheet, "Boardwalk Pieces"
- ½ cm grid paper

TEACHING SUGGESTIONS

The goal of Activity 1 is to reinforce the formulas for area and perimeter by looking at the enclosures of three different animals in a fictional zoo. The activity begins with accessing prior knowledge about zoos from the class. The teacher will need to support this process to ensure that students who have limited knowledge of zoos through personal experience have enough information to understand the nature of zoo enclosures. There are many images and even videos online that can help students visualize what a zoo is like. The teacher may want to begin the lesson by sharing some of these computer images with the students or by having students search for zoo images on their computers. The teacher may even find resources or information regarding the closest zoo to the school and talk to students about some of the main exhibits. This is an opportunity for students to get excited, talk about their favorite animals, share stories about their experiences, and make observations about the images included with the introduction. Points of interest the teacher may want to discuss include:

- Many zoos are research centers and study ways to protect plants and animals
- Zoos usually create artificial habitats/ displays/enclosures.
- Zoos have a large variety of animals
- Each zoo is different (Teacher may ask students what different zoos they have been too and to compare and contrast them. Teachers may want to point out size and location and differences as well.)

In looking at the gridded enclosures for the three animals, the students begin by counting to determine perimeter and area, then move quickly to using a formula. If students have difficulty counting the number of squares in the enclosures because of the labels, teachers should encourage students to use the other rows to help them count or students should draw in the squares. Calculating area through the formula, l x w, is introduced before perimeter, $2\times(l + w)$, because it can be arrived at through a single mathematical operation; multiplication. Additionally, in later sections this method of calculating the area of rectangles will be more useful than the perimeter formula to students, which is not applicable to composite shapes.

In Activity 2, students will have the opportunity to design a rectangular zoo enclosure. The activity opens with students selecting an animal of their choice to be donated to the zoo. They will then create different habitats for their animal using a specific area, applying the concepts of area and perimeter that were built in the first activity. Students will be given a large grid (40 x 40) and an area of 36 square units. The students will then draw three different rectangular habitats of their choosing, all with different dimensions, but an area equal to 36 square units, noting the length and width on each rectangle as $l\times w$. For example, students who draw a rectangle that is 9 units in length and 4 units wide would write 9×4 on the rectangle. The same rectangle oriented differently would have a length of 4 and width of 9 and would be identified as 4×9. Though zoos are not limited to rectangular enclosures, the lesson limits the design at this point for the sake of scaffolding. Students may note that some enclosures they have seen have curves or are composite shapes. The teacher should acknowledge that this is true and then redirect to wording in the prompts that the zoo wants this particular enclosure to be rectangular.

If orientation is considered, there are 9 different options for the habitats. If written as $l\times w$, in order of increasing length, they are:
$1\times36,\ 2\times18,\ 3\times12,\ 4\times9,\ 6\times6,$
$9\times4, 12\times3, 18\times2, 36\times1$

Once students have cut out their three rectangles the teacher will ask for someone to volunteer a rectangle and tape the rectangle to the wall. The teacher will ask if any other groups also came up with that exact rectangle, with the same length and width. Students will bring up their matching rectangles and tape them underneath the one the teacher taped, forming a column of like rectangles. The teacher will ask if any group has a different rectangle and repeat this process of displaying the rectangles from the groups until each group has displayed each of their three rectangles. The teacher should order the rectangles from left to right with increasing length. For example, if the first rectangle has length 9 and width 4 and is noted as 9×4 then the teacher should place this on the wall so that there is plenty of room to the left of that rectangle for the five 5 rectangle options with lengths less than 9. If the class does not have examples of all nine options, the teacher should leave a gap and brainstorm with students about any other options that exist. The display on the wall will show the frequency of each option in the room and the teacher should have at least one cut-out of each of the nine options ready to tape to the wall in the brainstorming session so that new ideas do not have to be drawn and cut on the spot. Remember to use the commutative property, for example, $1 \times 36 = 36$ and $36 \times 1 = 36$ are two rectangles with different lengths and widths but both having an area of 36 square units. In the activity, students are told the use the number of squares "across" as the length and the number of squares "down" as the width. This is an arbitrary decision and either could be identified as the length or width. Students may want to discuss this fact.

In question 5, students will complete a table that contains both the area and perimeter of all nine possible rectangular habitats. The teacher may want to provide a large copy of the chart to be completed as part of the entire class discussion and have students transfer the answers to their papers. This chart will provide a reference to compare rectangles that have an equal area, but unequal perimeters. The students will develop a sense that the length and width of a rectangle are not only dimensions, but are also considered factors when using them to multiply to calculate the area. Teachers may want to use question 7 as an extension to test if all ***square*** habitats have a perimeter less than ***non-square*** rectangular habitats with an equal area.

The activity concludes with students choosing a layout for their animal and taking into consideration the animal's needs in the interior design of the enclosure. Depending on the animal, the rectangle options towards the center of the display on the wall will usually be more suitable than the ones with very small lengths or widths. Question 9 provides examples of features that the students should include in their aerial view, or blueprint. Note that food is not included as the zookeepers attend to the animal's dietary needs and can bring food into the enclosure as needed. The last question, asking students to visualize the front of the display allows students to use their imagination. The goal of the question is to reinforce the zoo context and have students adjust their viewing angle while being attentive to matching the features appropriately with the top view.

The teacher should read aloud, or ask for students to read, stopping regularly to model interactive reading skills like marking the text, annotating, and diagramming. Although three specific endangered birds are discussed in the text, the teacher can find supporting pictures and information regarding birds that can be spotted in the local area.

In Activity 3, students read a passage that transitions the topic of animal conservation from

zoos to refuges. Prior to reading the passage the teacher should display the images of the woodlands, coastal prairie, and marsh one at a time. For each picture, students should begin by making observations about what they see. The teacher will then ask students to think of the types of animals that they would expect to find there. Students should be able to justify or account for their suggestions, and they should be encouraged to think of creatures big and small.

There are four bold-faced words indicating vocabulary that students will need support to define and understand. The word "mimic" means to "copy" and students may be familiar with examples of mimicry such as parrots who can mimic sounds or walking stick bugs that mimic the appearance of twigs. Students should use information from the text to help them understand "conservation," "restoration," and "endangered" in this context. The idea of "conservation" may be more challenging, as animal conservation may seem very different than something like water conservation, which they may be more familiar with. In both cases, "conservation" indicates a desire to save.

The last paragraph of text describes some physical characteristics of the birds. Having color photos ready to display will help students make the connection between the text and the animal. This is specifically important for the Attwater's prairie chicken, as the sentence describing the air sacks is lengthy and is well supported by an image.

At the conclusion of the text, students should have enough information to correctly match up the golden-cheeked warbler, Attwater's prairie chicken, and the whooping crane with the respective images of the Balcones woodlands, coastal prairie, and marsh. The teacher should engage the students in citing evidence from the text and/or photographs to support the matching activity.

By Activity 4, students should know two ways to determine the area of a rectangle: counting squares and using the formulas: $A = l \times w$. Activity 4 has students extend and apply these techniques to calculate the area of shapes composed of two or more rectangles (composite figures). The area of these shapes can be counted, or the students can calculate them by adding the area of the composing rectangles. The area can also be calculated by determining the area of a large rectangle and subtracting out the area of missing or "cutout" rectangles. Teachers can use **Refuge A** or another shape of their choosing to guide students through the process of calculating area by adding or subtracting the area of the smaller rectangles. The teacher may also choose to challenge the students to use subtraction when determining the area of one of the irregular shaped refuges.

In questions 6 and 7, students are given a scenario for the reintroduction of Attwater's prairie chickens into the refuge from the captive breeding program at the Houston Zoo. Students will look at a data table to see how the population of wild Attwater's prairie chickens in the refuge has changed over the course of 10 years. They will see that growth is not consistent, and there is even a decline in birds from 2004 to 2006. The teacher should encourage students to think of factors that might affect these numbers while reinforcing that the refuge has helped to overall increase the population of these birds. Factors may include the life-span of adult birds, years of harsh weather, food shortages, and predation.

Students are also asked to account for the difference, as shown in the bar graph, in body mass for an average captive female bird and an average wild female bird. Students should note that wild birds are slightly less massive than captive birds. Reasoning should include the idea

that captive birds do not have to compete or work as hard for food compared to wild birds.

In Activity 5, students put all of their skills together to subtract the area of a composite shape from the area of the larger composite shape that it is inside. Having students consider the "viewable" area of a marsh refuge after a boardwalk has been constructed contextualizes the math. In Question 2, students are asked to consider the perimeter of the boardwalk to reinforce that the perimeter formula, $2(l + w)$, does not apply to the composite shape. Instead students must total the lengths of all sides.

Questions 5-8 require the use of the life cycle cards. It is recommended that the teacher have these cards laminated and cut prior to this activity, so that they can be stored easily for use with this lesson again. In arranging the cards for the grasshopper, frog, and whooping crane, the students should see that all three animals have unique phases of development. All three are born/hatched and then grow into a mature form. The teacher should discuss with students that after the mature form, the organism continues to age until death, and the lifespan for animals can be very different. Additionally, animals have to reach certain maturity before they can reproduce. The last card of any set (in order of development) technically precedes the first card to repeat the "life cycle" for that animal. A mature whooping crane can produce an egg, for example.

In the last question, students are asked to create a food chain. To help scaffold this, the teacher could specifically ask, "Looking at the three animals here, what does the grasshopper eat? What does the frog eat? What could eat the frog?" Starting with "grass" the teacher would model the creation of a food chain by drawing an arrow pointing to the word "grasshopper." The next arrow would point from "grasshopper" to "frog" from which an arrow would point to "whooping crane." In middle grades, students will learn that organisms that get their energy by eating other organisms are called heterotrophs. Those organisms that feed exclusively on other animals are called carnivores. Food chains are a way of diagramming how the energy moves up through an ecosystem. Arrows are used to symbolize the movement of energy from organism to another. Technically the whooping crane also eats grasshoppers, and a curved arrow could be drawn pointing from "grasshopper" to "whooping crane." The result would be a food **web** and not a food **chain**. In grade 3, it is sufficient that the students understand that some animals eat other animals and some animals eat plants.

The lesson concludes with a Design Challenge and an Extension opportunity. The design challenge asks students to design their own boardwalk on a laminated aerial view of a marsh habitat. They manipulate pieces of boardwalk to create an area for people to walk on and view the refuge. Due to the number of small pieces, students can cut out their own boardwalk pieces if the teacher has decided not to have them pre-cut and/or laminated. Cost is introduced as a consideration in the challenge and students are again asked to apply what they know of area and perimeter.

Refuges are educational, and placards are often placed on paths or boardwalks to provide information regarding geology, history, and/or biology of the area. The extension provides a literacy opportunity for students to write information about other living things that can be found in marsh habitats that can be displayed for visitors to the refuge.

NMSI CONTENT PROGRESSION CHART

In the spirit of NMSI's goal to connect mathematics across grade levels, a Content Progression Chart for each module demonstrates how specific skills build and develop from third grade through pre-calculus in an accelerated program that enables students to take college-level courses in high school, using a faster pace to compress content. In this sequence, Grades 6, 7, 8, and Algebra 1 are compacted into three courses. Grade 6 includes all of the Grade 6 content and some of the content from Grade 7, Grade 7 contains the remainder of the Grade 7 content and some of the content from Grade 8, and Algebra 1 includes the remainder of the content from Grade 8 and all of the Algebra 1 content.

The complete Content Progression Chart for this module is provided on our website and at the beginning of the training manual. This portion of the chart illustrates how the skills included in this particular lesson develop as students advance through this accelerated course sequence.

3rd Grade Skills/ Objectives	4th Grade Skills/ Objectives	5th Grade Skills/ Objectives	6th Grade Skills/ Objectives	7th Grade Skills/ Objectives	Algebra 1 Skills/ Objectives	Geometry Skills/ Objectives	Algebra 2 Skills/ Objectives	Pre-Calculus Skills/Objectives	AP Calculus Skills/Objectives
Write the formula for the area of a rectangle using a variable for the missing length or width.	Isolate the variable for length or width in the formula for area of a rectangle.	Isolate the variable for length or width in the formulas for area and perimeter of a rectangle.	Solve literal equations (perimeter, area, and volume).	Solve literal equations (perimeter, area, and volume).	Solve literal equations (perimeter, area, and volume).	Solve literal equations (perimeter, area, and volume).	Solve literal equations (perimeter, area, and volume).	Solve literal equations (perimeter, area, and volume).	Solve and use literal equations in real life and mathematical applications.
In a problem-solving situation with a real-world application, determine the area of rectangles and rectilinear figures with whole number side lengths by counting unit squares or multiplying side lengths.	In a problem-solving situation with a real-world application, determine the area of rectangles and rectilinear figures where one side is a fraction and one side is a whole number or a fraction. (Computations involving addition and subtraction of fractions are limited to like denominators.)	In a problem-solving situation with a real-world application, determine the area of rectangles and rectilinear figures with fractional and decimal side lengths. (These situations can include calculating area of rectangles on the coordinate plane.)	In a problem-solving situation with a real-world application, determine the area of rectangles, triangles, and composite figures with fractional and decimal side lengths. (These situations can include calculating area of rectangles and triangles on the coordinate plane.)	Given 3 or 4 coordinate points that form a triangle or a rectangle with one side on a horizontal line and one side on a vertical line, calculate the area of the figure.	Calculate the area of a triangle, rectangle, trapezoid, or composite of these three figures formed by linear equations and/or determine the equations of the lines that bound the figure.	Calculate the area of a triangle, rectangle, trapezoid, circle, or composite of these figures formed by linear equations or equations of circles and/or determine the equations of the lines and circles that bound the figure.	Calculate the area of a triangle, rectangle, trapezoid, circle, or composite of these figures formed by linear equations, linear inequalities, or conic equations and/or determine the equations of the lines and circles that bound the figure.	Calculate the area of a triangle, rectangle, trapezoid, circle, or composite of these figures formed by linear equations, linear inequalities, or conic equations and/or determine the equations of the lines and circles that bound the figure.	Calculate the area between curves.

Animal House

Activity 1 – Introducing Area and Perimeter

Have you ever been to a zoo or seen one in a movie or show? Close your eyes and imagine being there and walking around. What would you see?

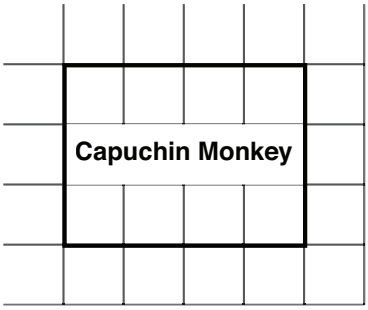
People enjoy watching the animals in their enclosures. Zoos are also places where scientists and animal caretakers study animals and their behaviors. They can protect animals that are endangered and help them increase their numbers.

Look at the picture of an exhibit called “Giants of the Savannah” at the Dallas Zoo in Texas.

- Do you see any animals you recognize?
- What are some of the features of the enclosure?
- What kinds of things would the zoo need to consider when designing an enclosure for animals?

A new zoo is opening near you and we can't wait for you to meet some of the family! This zoo is planning separate enclosures for playful capuchin monkeys, extremely social meerkats, and the solitary red panda.

1. The area (*A*) of the capuchin monkey enclosure is measured as 12 square units. We can prove this measurement by counting the number of square units inside of the shape. How many squares do you count inside the capuchin monkey enclosure?



_____ square units

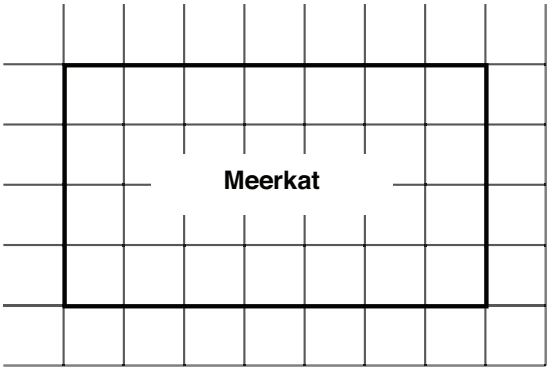
2. What is another way to determine the area? Remember, it is an array.

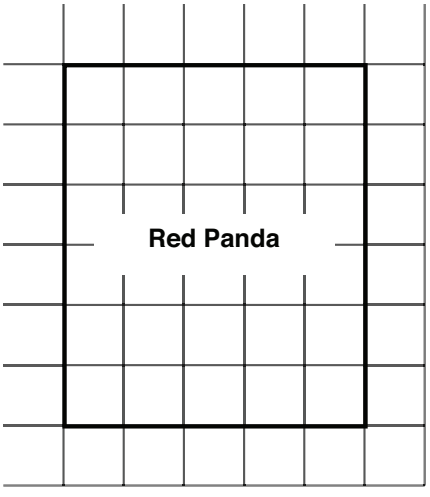
3. The capuchin monkey enclosure has a length (*l*) of 4 units and a width (*w*) of 3 units. What mathematical operation makes the following number sentences true for the enclosure?

$4 \square 3 = 12$

$l \square w = A$

4. Look at the other two enclosures. Complete the data table. Prove the area by counting the squares.

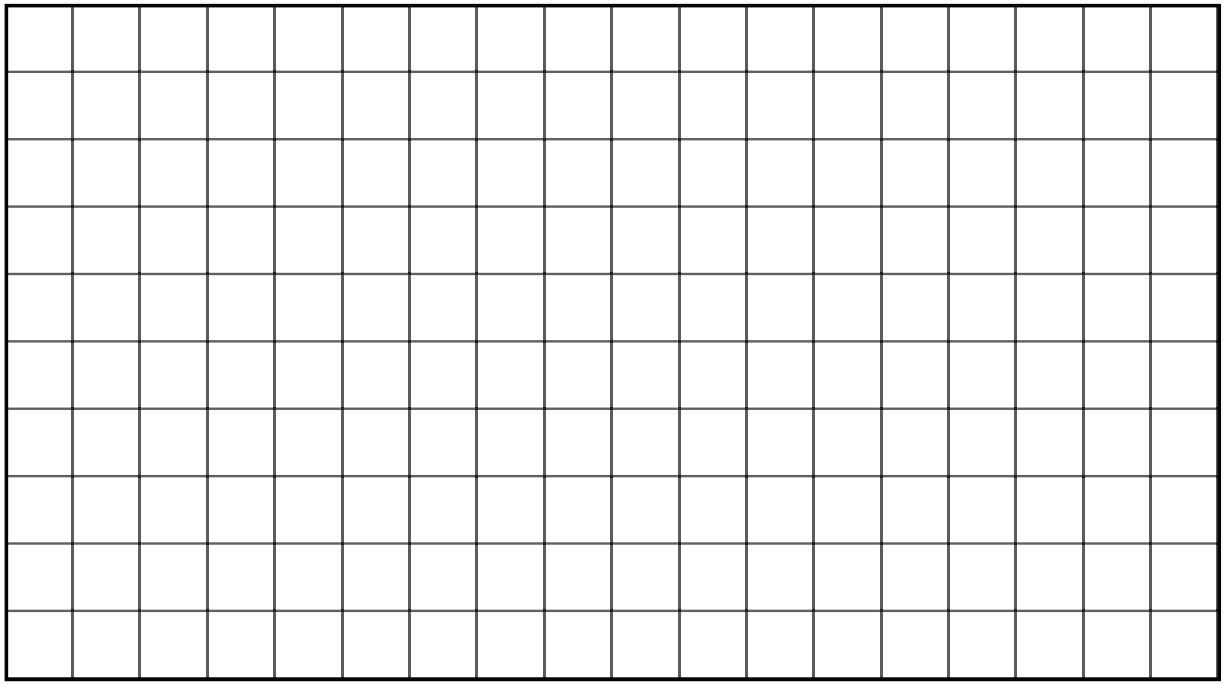




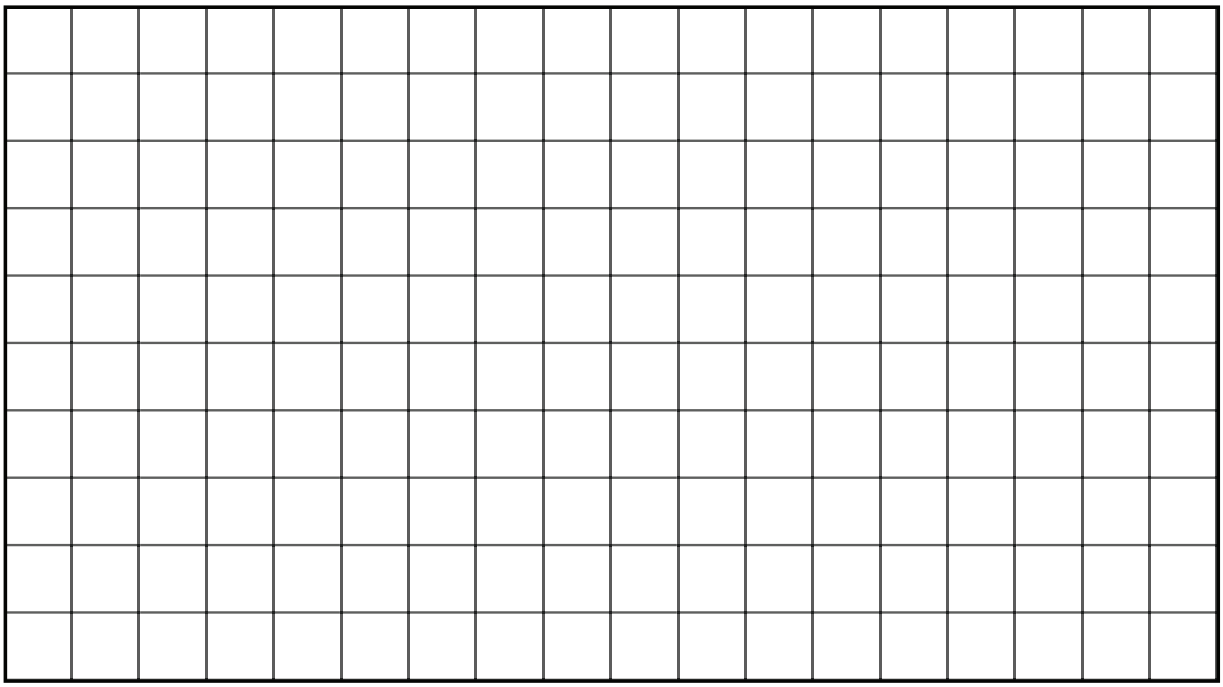
	Length (*l*) units	Width (*w*) units	Process	Area (*A*) sq. units
Meerkat Enclosure				
Red Panda Enclosure				

5. Is the process between length, width, and area the same as it was for the enclosure for the capuchin monkey? Write number sentences to support your answer.

6. Draw your own rectangle on a new grid. Write a number sentence showing that the calculation for area is the same as the counted number of squares.



7. The zoo has decided to increase the area for the Red Panda by extending the length from 5 to 8 units. Draw a rectangle on the grid provided to show the new enclosure.



a. Write an expression that can be used to determine the original area.

_____ × _____

b. Write an expression that can be used to determine the additional area.

_____ × _____

c. Add your two expressions together to show an expression for the total area.

_____ × _____ + _____ × _____

d. What is the total area?

e. Now, let's think about a different way to do the same problem. Write an expression to show the entire length of the new enclosure.

$$(\_\_\_\_ + \_\_\_\_)$$

f. Write an expression to show the entire area of the new enclosure.

$$(\_\_\_\_ + \_\_\_\_) \times \_\_\_\_$$

g. What is the total area?

h. Compare your answer in (d) with your answer in (g).

8. The perimeter (P) of the capuchin monkey enclosure is measured as 14 units. We can verify this measurement by counting the sides of the squares that outline the shape. How many units do you count along the sides of the capuchin monkey enclosure? __ units

9. For the capuchin monkey enclosure, which is 4 by 3, the perimeter would be

$$4+3+4+3$$

Let's group the numbers. The parentheses show the numbers we are grouping together for length (l) and the numbers we are grouping together for width (w).

$$(4+4)+(3+3)$$

a. Now, let's rewrite the expression using multiplication.

$$2\times\_\_\_+2\times\_\_\_$$

b. Since both the 4 and the 3 are multiplied by 2, we can rewrite again.

$$2\times(\_\_\_+\_\_\_)$$

10. For a rectangle whose length is l and whose width is w, the perimeter would be

$$l+w+l+w$$

Let's group the "like terms," in other words, group the letters that are the same.

$$(l+l)+(w+w)$$

a. Now, let's rewrite the expression using multiplication.

$$2\times\_\_\_+2\times\_\_\_$$

b. Since both the l and the w are multiplied by 2, we can rewrite again.

$$2\times(\_\_\_+\_\_\_)$$

11. Look at the other enclosures. Complete the data table. Determine the perimeter.

Enclosure	Length (*l*) units	Width (*w*) units	Process	Perimeter (*P*) units
Meerkat			$2 \times (\_\_\_ + \_\_\_)$	
Red Panda				

12. Look at the rectangle you drew. Write a number sentence showing that the calculation for perimeter is the same as the number of sides of the squares that outline the shape.

Activity 2: Designing a Zoo Enclosure

You get to pick an animal for the zoo! The zoo will need to create a new enclosure for this animal. The zoo has agreed to set aside 36 square meters for the **rectangular** animal habitat.

1. What animal will you donate?

2. Use the centimeter grids provided to design **3** habitat options, each with different lengths and widths. Each square represents 1 square meter. Label each rectangle with the length and width, $l \times w$. Use the number of squares "across" as the length and the number of squares "down" as width. For example, a rectangle that has 9 squares across and 4 squares down would be identified as 9×4. You can cut and tape a rectangle together if it does not fit on the grid.

3. List the equations that can be used to model the area of the three rectangular habitats you designed.

4. Cut out the three rectangles you made and follow your teacher's instructions for sharing your work with the class. After the class discussion, draw the different rectangles in the space below. Label each with the length and width.

5. Determine the length and width of each of the possible rectangular habitats with an area of 36 square meters. Record the measurements in the table. List the side lengths in numerical order. Write the corresponding widths below the lengths. For each of the rectangular habitats, calculate the perimeter. Write the number sentence for the process in the table provided.

Rectangle	a	b	c	d	e	f	g	h	i
Length, *l*, in units									
Width, *w*, in units									
Area, *A*, in square units	36								
Perimeter, *P*, in units									

Rectangle	Perimeter Number Sentence
a	
b	
c	
d	
e	
f	
g	
h	
i	

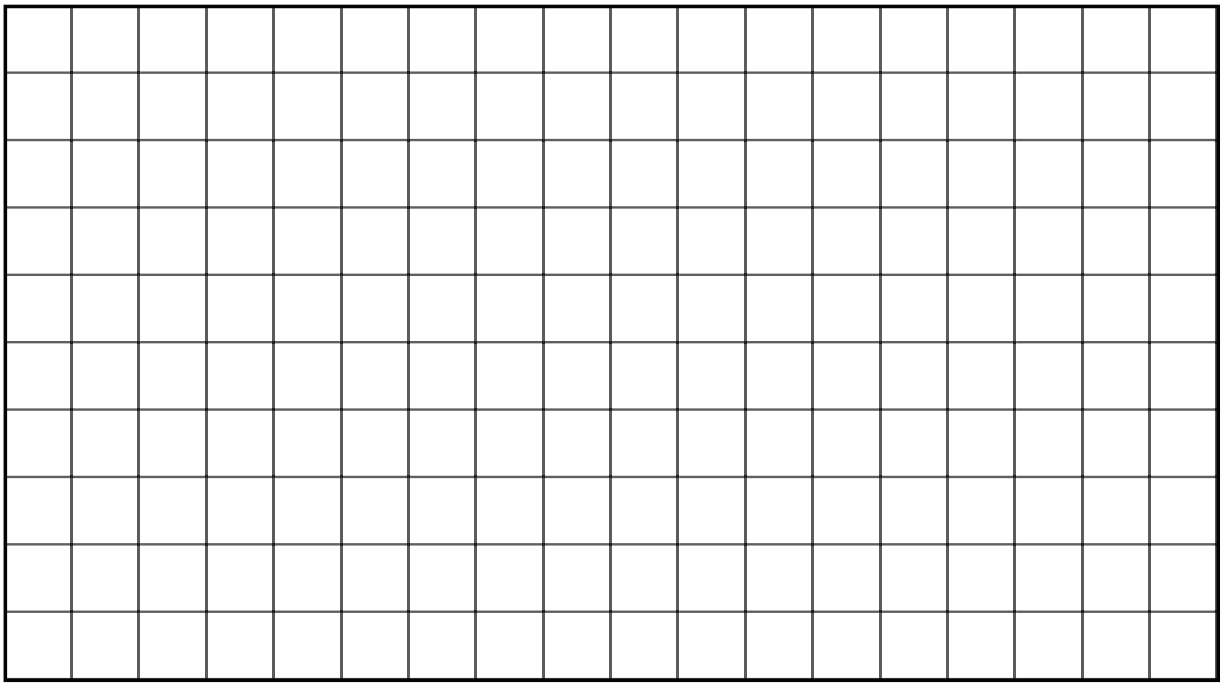
6. The length and widths of the rectangles are also called the factors of 36. Complete the list of factors in numerical order.

   1, 2, _____, _____, _____, _____, _____, _____, 36

7. For an area of 36 square units, what is the length and width of the rectangle with the smallest perimeter? What is the best description for the shape of this figure?

8. What do you know about the animal you have chosen to donate to the zoo? What does it eat? What is its natural habitat? Is it grassy? Are there many trees? What are some sources of water for your animal?

9. Choose one of the 9 habitat designs and draw it on the grid provided. Pretend you are high above the habitat looking down. Draw the placement of the following items.
   a. Water source(s)
   b. Plant life
   c. Shelter
   d. Landforms (such as rocks)



10. Pretend you are visitor and you walk up to the front of your animal habitat. If you could take a picture of this display, what would you see? Make a drawing in the space provided showing what you would see in the picture you took. Be sure to include your animal.

Activity 3: Habitats

Read and interact with the passage below.

Have you watched the wildlife in your yard? If you have a bird feeder, you might have noticed that different birds like to eat different seeds. You might have also seen how birds behave. Some birds can be found in groups, like the common grackle. The grackle can **mimic** other birds by sounding like them. Other birds, like the cardinal, like to travel alone or in pairs. If you one day become a scientist who studies birds, you will be an ornithologist. John James Audubon is a famous ornithologist who lived over 150 years ago

Audubon produced the book Birds of America. His book shows over 700 species of North American birds. It is one of the greatest examples of book art. The Audubon Society is named for him. The Audubon Society is dedicated to the **conservation** of bird populations. They protect birds' homes and food supplies. In addition, the society is committed to the **restoration** of areas hurt by human activity or natural disaster.

The Audubon Society also educates the public about **endangered** and threatened bird species. The golden-cheeked warbler, Attwater's prairie chicken, and the whooping crane are endangered.

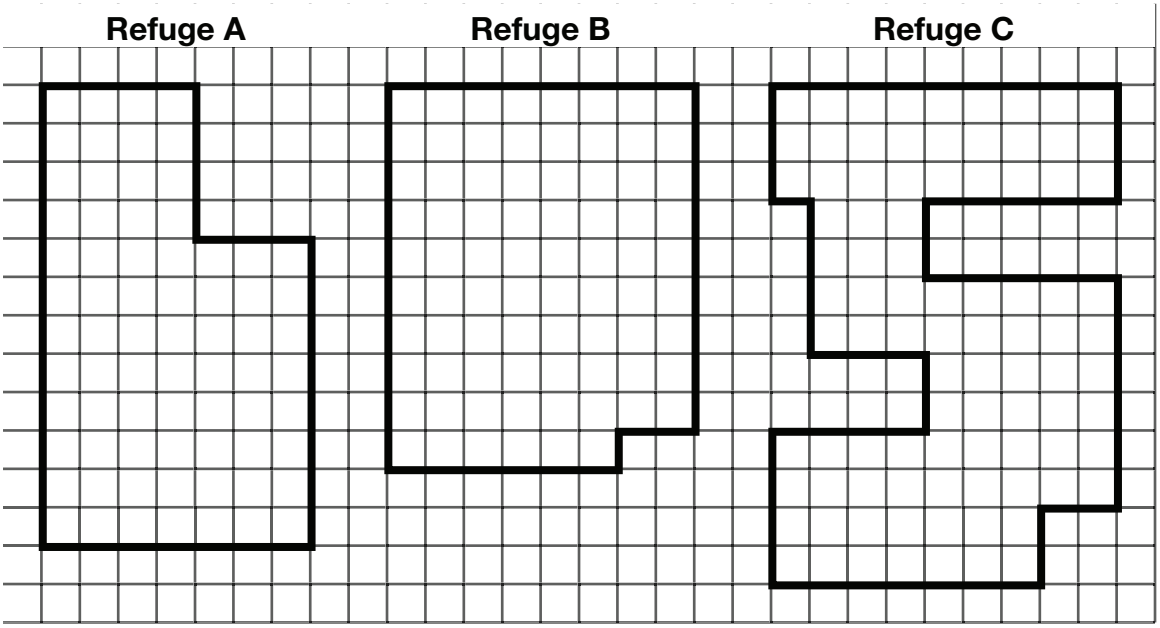
- The *golden-cheeked warbler* is a small songbird. They have yellow coloring on their cheeks. They only nest in Texas woodlands. They build their nests out of bark and spider webs.
- The *Attwater's prairie chicken* is a chicken-like bird. The males have an orange air sac on their necks that is used for attracting mates. The prairie chicken prefers to live in the prairie.
- *The whooping crane* likes to eat small fish, snails, and aquatic plants. They use their long, slender legs to wade through marshland. Their thin bills help them dig for food in the mud.

Look at the images of the habitats your teacher has provided. Match each of the three birds to the habitat to which they belong.

Activity 4: Wildlife Refuges

Zoos are not the only way to protect endangered animals. We can protect wildlife by creating wildlife refuges. A wildlife refuge is a piece of land where animals can live in their natural habitat. Wildlife refuges are much larger than zoo enclosures. They are often not simple rectangles.

This drawing maps the area of three different coastal prairie refuges. Use the drawing to help you answer the questions that follow.



1. Determine the area, square units, of **Refuge A** by counting squares.

2. Another way we can determine the area of **Refuge A** is by using the area formula.
   a. Divide the shape of **Refuge A** into smaller rectangles.
   b. Label the length and width of the small rectangles.

c. Calculate the area of each of the smaller rectangles using the length and width.

d. Add these areas together to compare the calculated area of **Refuge A** with the counted area.

3. If we examine **Refuge A**, you might notice that it looks like a large rectangle with a smaller rectangle cut out of it. Can we use the area of these two rectangles to determine the area of **Refuge A**? Would you need to add or subtract these two rectangles? Determine the area of **Refuge A** using this alternate method.

4. Compose two number sentences, one for the way area was calculated in step 2 and one for step 3.

5. Calculate the perimeter of **Refuge A** by counting all the sides.

6. Calculate the area of the two additional refuges using each of the methods for area and then calculate perimeter. Use the space provided to show your work.

7. The Houston Zoo has a program for the Attwater's prairie chicken. The birds reproduce and grow up in a protected environment. When they are old enough, they are released into the wild.

   In 2000, the Houston Zoo agreed to reintroduce 15 birds to the coastal prairie. Every two years, scientists counted the Attwater's prairie chicken population in that area.

   The table below shows the data from the refuge over a ten-year period.

Population of Reintroduced Birds During 2000-2010

Year	2000	2002	2004	2006	2008	2010
Bird Pop.	15	16	28	25	31	37

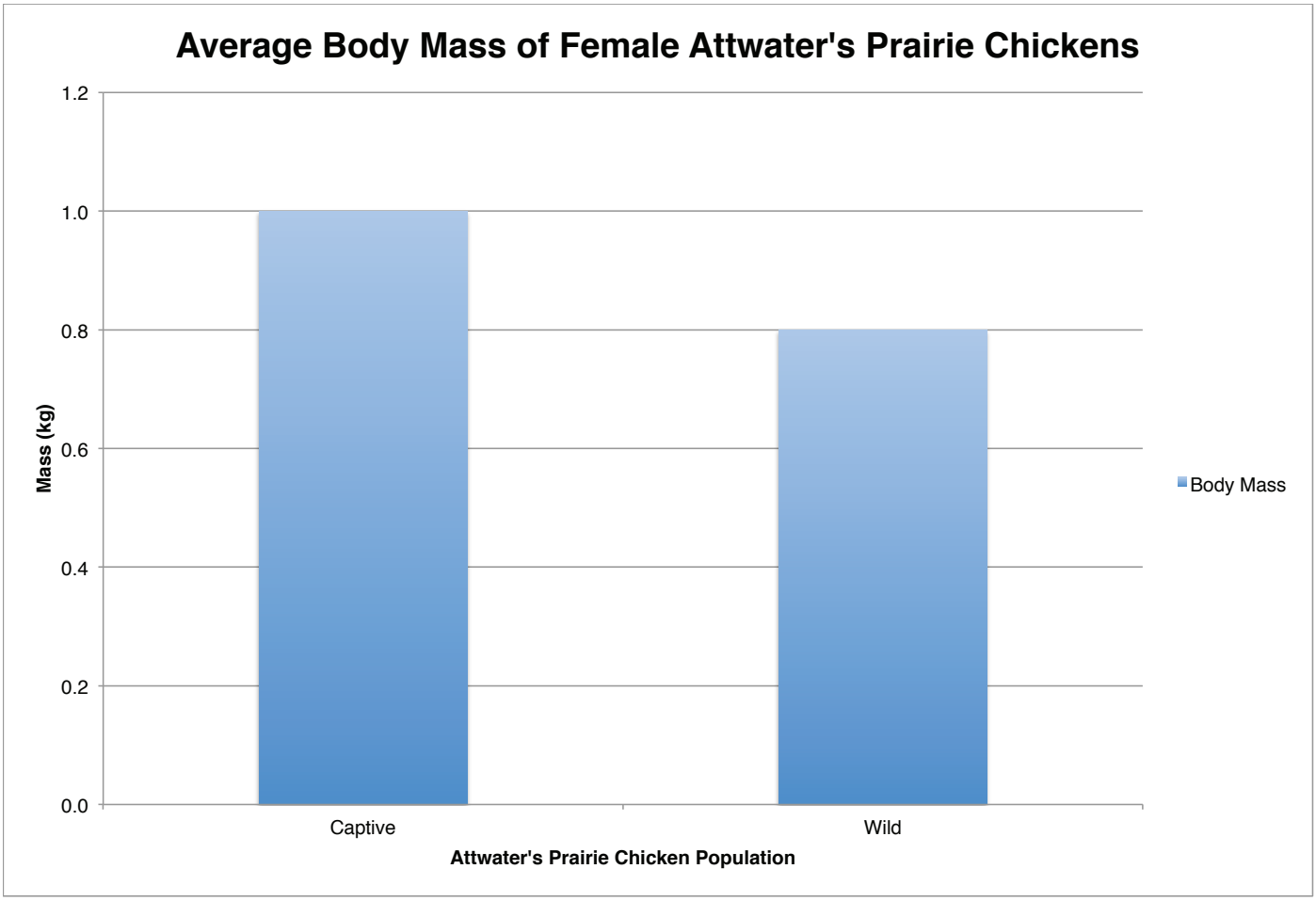
   a. What can you say about the success of the refuge based on the evidence?

   b. Do the numbers change in the same way each time the population is counted?

   c. What factors might make it difficult to predict an exact count of birds for 2012?

8. Scientists wanted to compare the masses of wild and captive Attwater Prairie Chickens. They took the masses of 15 adult female chickens in captivity at the Houston Zoo. They collected data on the masses of 15 adult female birds at the refuge in 2010. The graph below shows the results.

   Each bar represents the average mass of the 15 birds tested in each group.



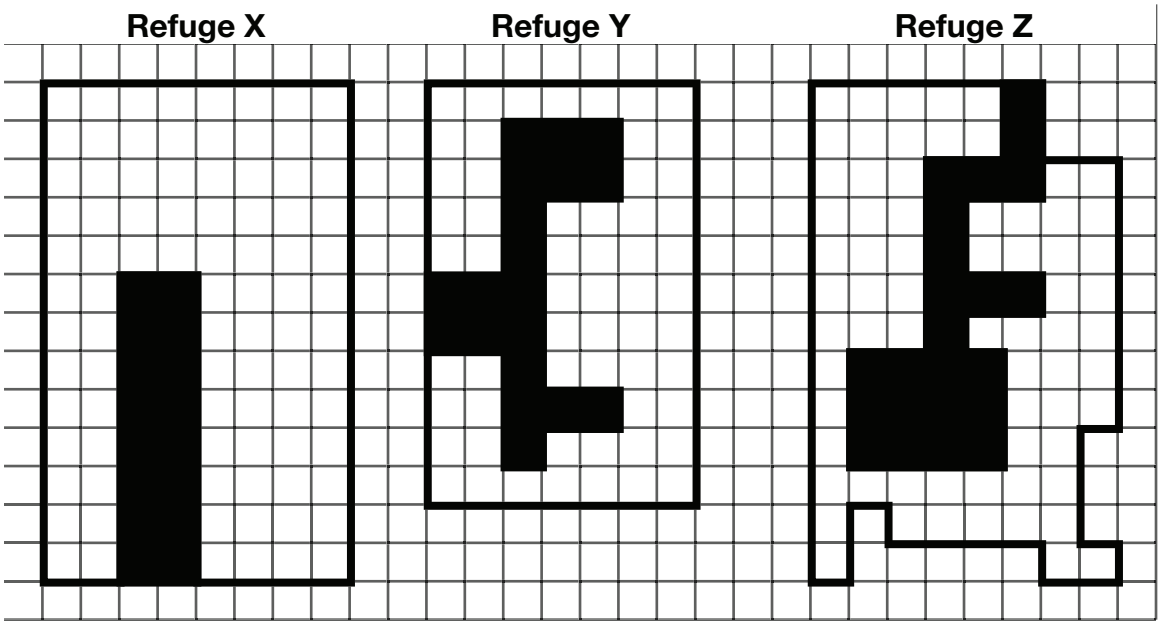
   a. Based on the graph, do captive or wild birds have a greater mass?

   b. Give reasons for why this difference in bird mass exists.

Activity 5: Boardwalk in Marshland

The whooping crane is an endangered species of bird that lives in marshland. Marshland is a type of wetland. It can be muddy and walking through the marsh can be difficult. One way to view and study the animal life in a marshland refuge is to use a raised pathway called a boardwalk. A boardwalk is like a deck or bridge and is often made of wood. It is built so that it is above the marsh.

This drawing maps the area of three different marsh refuges. The boardwalks are indicated in black. Use the drawing to help you answer the questions that follow.



1. Determine the area of the habitat not covered by the boardwalk (the unshaded portion) for each of the refuges. Clearly show your work.

2. If you walk along the outside edges of the boardwalk that touch **Refuge X**, how many units would you have traveled? Is there any edge of the boardwalk you would not have traveled? If so, what is the length of that portion?

3. Calculate the total length of the walk along the edges of the boardwalks for **Refuge Y** and **Refuge Z**.

4. Every morning an ornithologist walks the perimeter of one of the refuges to monitor bird activity. If the scientist walks 240 units in a 5 day week, at which refuge was she?

5. In early summer at this Wisconsin refuge, an ornithologist notices tiny whooping crane hatchlings. Her field journal shows drawings of cranes over the first year of their lives, much like those on the cards you have. Arrange the cards in a way that shows how a whooping crane develops. Describe how you made your decision.

6. The marshland is not just home to the whooping crane, but also to the grasshopper and the frog. Arrange the cards for the grasshopper and frog to show how these organisms grow.

7. A cycle is something that repeats. The life cycle of an animal shows how the animal grows from birth to fully grown. Why is it called a cycle?

8. Use the adult whooping crane, grasshopper, and frog to complete the food chain below.

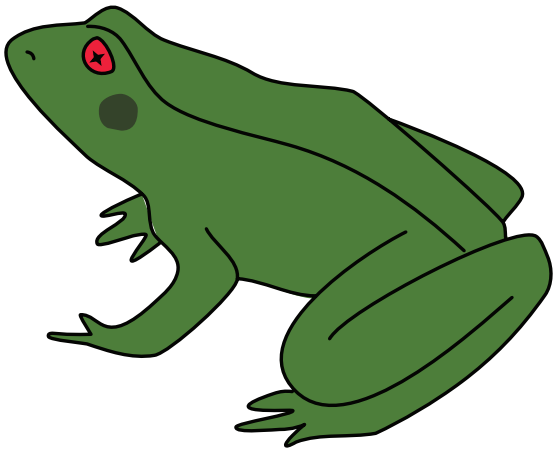
grass → _____ → _____ → _____

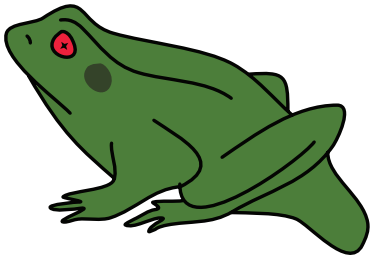
Design Challenge:
Your teacher has provided an aerial view of a marsh habitat that will become a refuge. The "X" marks where the visitor's center will be on the edge of the marsh. The green on the map looks like land, but it is really tall grasses rising above the water line. You cannot walk around the marsh, which is why you need to help! Visitors and scientists want to see more of the habitat than they could from the visitor's center. Use your boardwalk pieces to design a boardwalk for this refuge. Each piece of boardwalk costs $50, so you will need to say how much money your completed boardwalk will cost for materials. It is hard to see the plants and animals living underneath a boardwalk. State the total area of your boardwalk and the viewable area of the refuge. If a visitor walked around the edge of your boardwalk how far would the visitor walk if each square on the grid is 1 square meter?

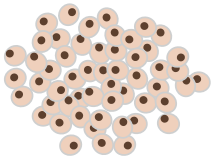
Extension: Research other living organisms in the marsh habitat. Create an informational plaque that could go along the boardwalk so visitors can learn about the habitat as they view the refuge.

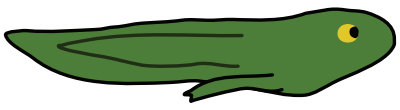
Animal House - Activity 2: Designing a Zoo Enclosure

Animal House - Activity 5: Boardwalk in Marshland - Questions 5-8

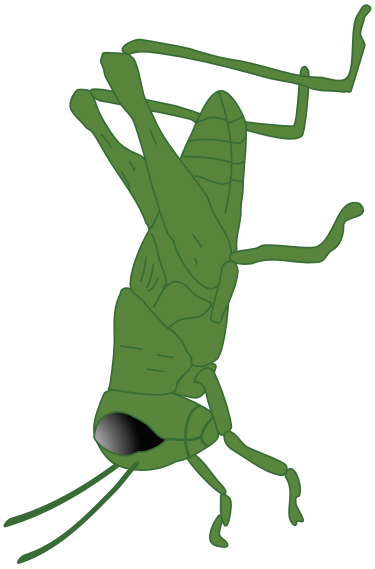


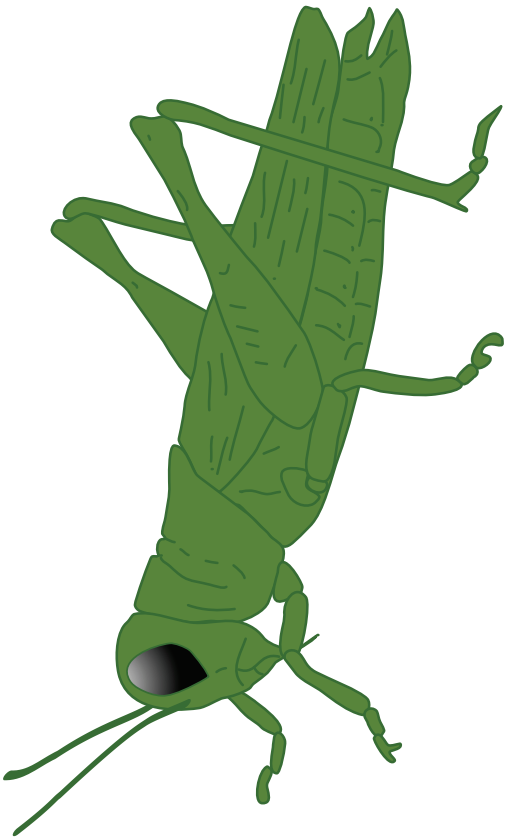




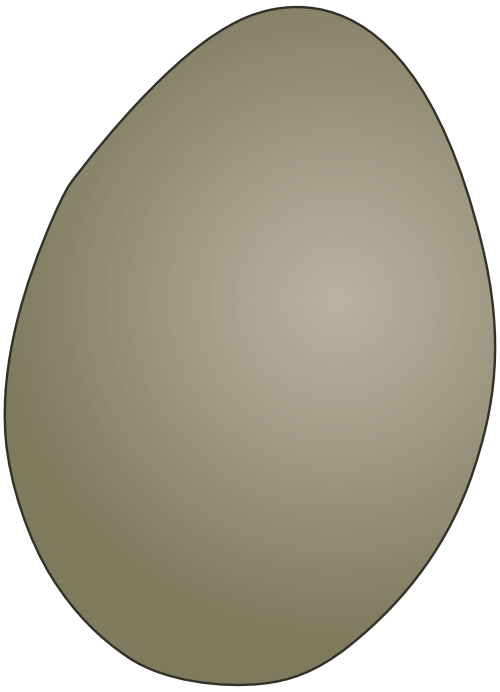


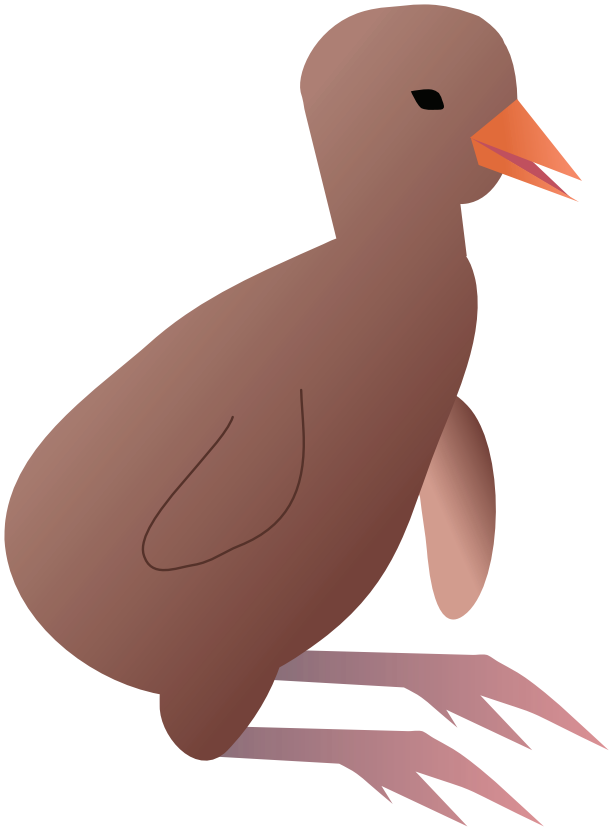
Animal House - Activity 5: Boardwalk in Marshland - Questions 5-8

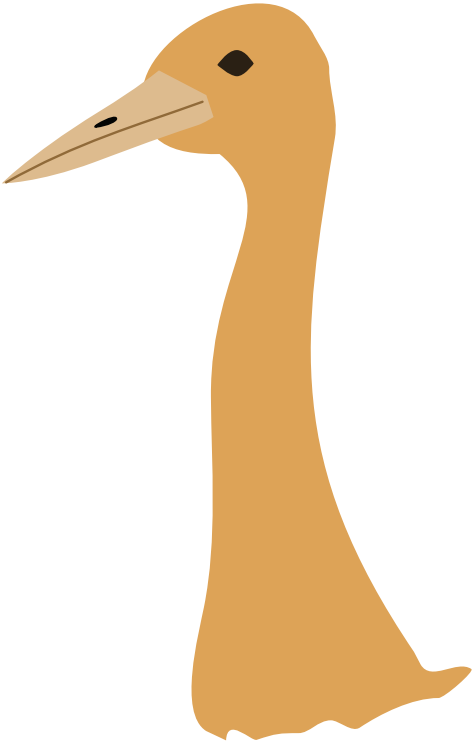


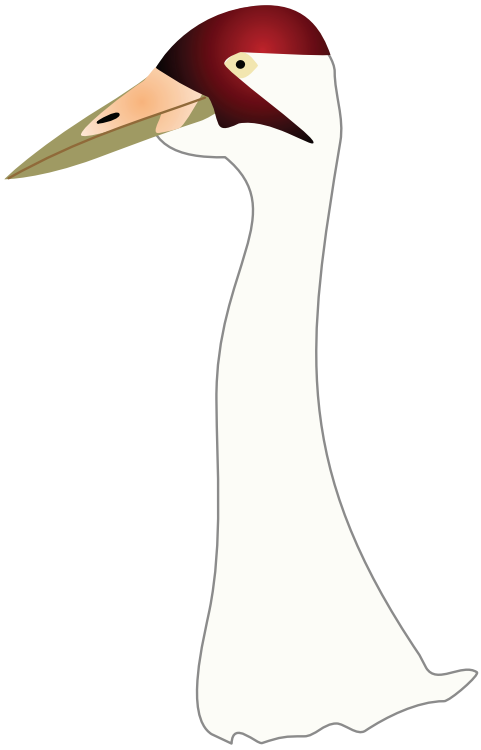


Animal House - Activity 5: Boardwalk in Marshland - Questions 5-8

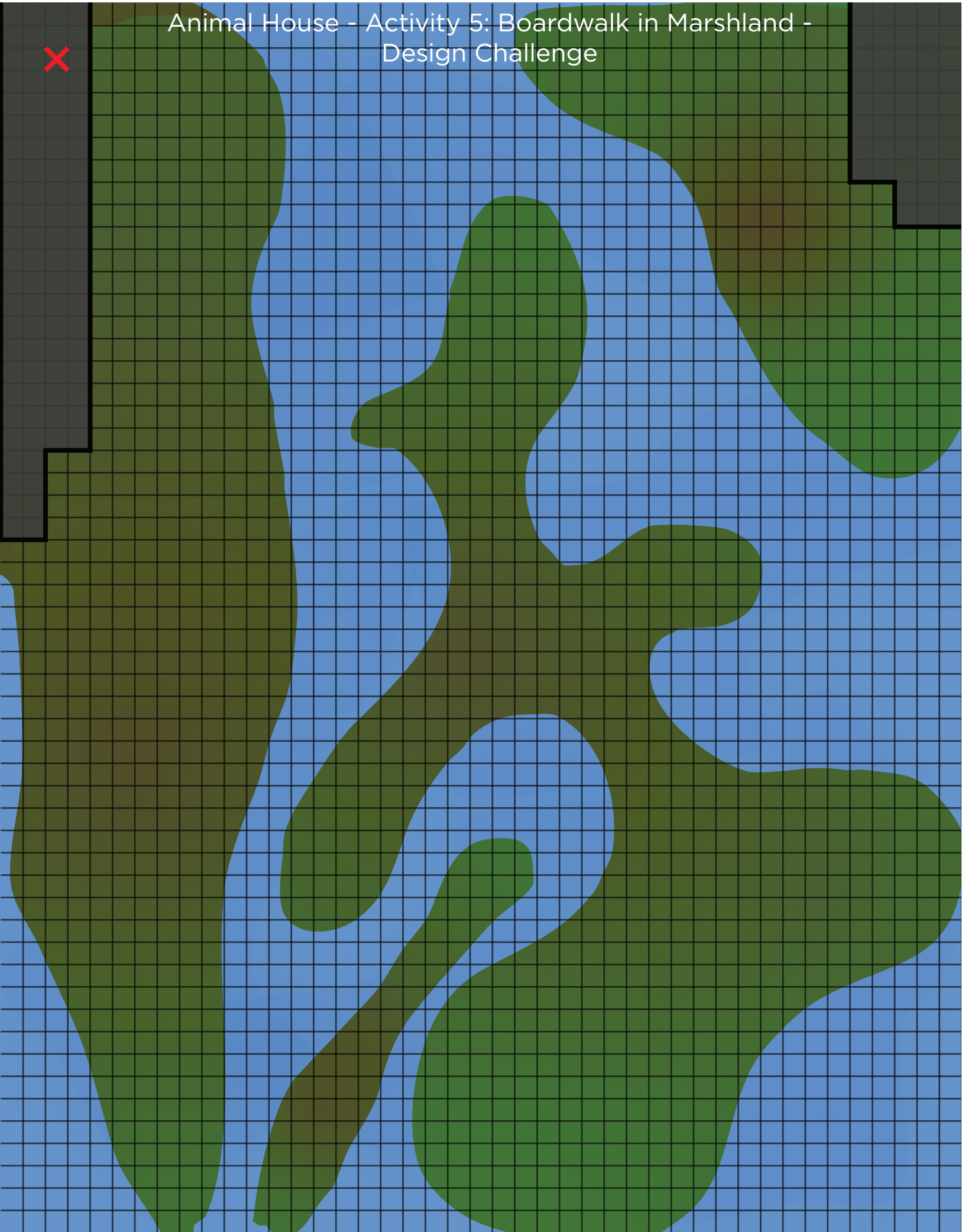








Animal House - Activity 5: Boardwalk in Marshland - Design Challenge



Animal House - Activity 5: Boardwalk in Marshland - Design Challenge