Name: _____

Date: _____

Group Member: _____

Group Member: _____

Group Member: _____

The Filly Zoo is acquiring four of each of the following animals: elephants, lions, and cheetahs. The zoo needs to build new habitats to house their new animals. Each type of animal has different qualities that require different characteristics in their habitats. Your challenge is to design the shapes of the habitats for each type of animal to make them as happy as possible using the information below.

- Elephants are big animals, and they take up a lot of room; so they want as much area as possible within their habitat.

- Lions like to corner their prey, so they want right angle corners in their habitat to help them stalk their prey but still want as much area as possible.

- Cheetahs like to run very fast, so they want at least one side of their boundary to be as long as possible. Cheetahs are not concerned about the area of their habitat.

The zoo has allotted 20 units of fence for each habitat and the zoo keeper wants to have at least 19 units of fence used for the border of each habitat. Your challenge is to use the Graphs and Geometry application of your TI-Nspire calculator to investigate different shapes and their properties to determine which shapes are best for each type of animal in the Filly Zoo. You may use any of the shapes available in the Geometry menu of your calculator as long as you consider all of the needs of each animal.

Sketch and label your elephant habitat in the blank screen provided on the right.

Use the space below to explain why you think this shape works best for the elephants.

1.1	DEG AUTO REAL	

Sketch and label your lion habitat in the blank screen provided on the right.

Use the space below to explain why you think this shape works best for the lions.

1.1	DEG AUTO REAL	

Sketch and label your cheetah habitat in the blank screen provided on the right.

Use the space below to explain why you think this shape works best for the cheetahs.

1.1	DEG AUTO REAL	

Discussion Questions

What do you notice about the relationships between the shapes and areas of the habitats?

What patterns do you notice?

Which habitat would you most like to live in? Explain your answer.

Teacher Notes

Purpose

The purpose of this problem-solving task is to give students an opportunity to explore the areas of several geometric shapes with a fixed value for the perimeters of those shapes. This lesson should be implemented only after students have had experience with categorizing angles & triangles and calculating area & perimeter of geometric shapes. The students should also have some experience with the TI-Nspire and its geometric features.

Frameworks and Standards Referenced

This task is designed to meet the following 6th grade objectives from the 2007 Mississippi Mathematics Framework Revised:

> *MEASUREMENT*
> > *4. Apply geometric formulas and standard (English and metric) units of measurement in mathematical and real-life situations.*
> > > *b.   Calculate the perimeter and area of regular and irregular shapes using a variety of methods. (DOK 2)*
> > > *f.   Apply techniques and tools to accurately find length, area, and angle measures to appropriate levels of precision. (DOK 1)*

Before the Task

Arrange the students in groups of three or four. Instruct the students that they should read the task then discuss their strategies for achieving a solution. Each student should be responsible for their participation in the group investigation and in the class discussion of the findings. If possible, each student in a group should have a calculator for this task.

Sample Solutions

Elephants

> The habitat for the elephants could be in the shape of the circle since a circle provides the largest area possible within a given boundary length, and area is the attribute of the habitat that is most important to the elephants. For example, given a boundary length of 20 units means that the circumference of the circle is 20 units. Then the diameter is approximately 6.37 units, with a radius of 3.18 units. Thus area of the circle is 31.77 square units.

Lions

> The habitat for the lion could be in the shape of a rectangle. This shape would provide the lions with four right angles to corner their prey. A more specific example could be a rectangle with a boundary length or perimeter of 20 units that will have an area of 24 square units with sides measuring 4 and 6 units. However, a square with sides measuring 5 units will yield an area of 25 square units. Thus, to maximize the area within the lions' habitat, a square shaped habitat would work best.

Teacher Notes

Cheetahs

There are several possible solutions to the habitat for the cheetahs. Some students may think that a slender rectangle would be the best solution, but an obtuse triangle could allow the habitat to be very long and thin. Thus, offering a longer side for the cheetahs to run along than is possible with a slender rectangle. Note: If students only provide a solution using a slender rectangle, challenge them to find another solution using the other geometrical shapes available to them in the TI-Nspire menu. After finding the obtuse triangle solution, some students may create a triangle thinner than a cheetah itself. This could raise a discussion about what a reasonable solution for the cheetahs' habitat would be. Below is a screen capture of an example cheetah habitat in the shape of an obtuse triangle.
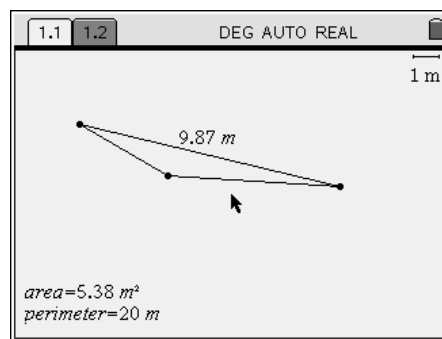
Helpful Hints for the Teacher

For this activity, it is helpful to be in "plane geometry view". To get to this view, open a new graphing window, then go to "Menu", then "View", then "Plane Geometry View" (see below).
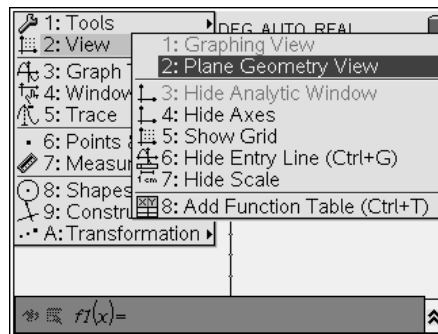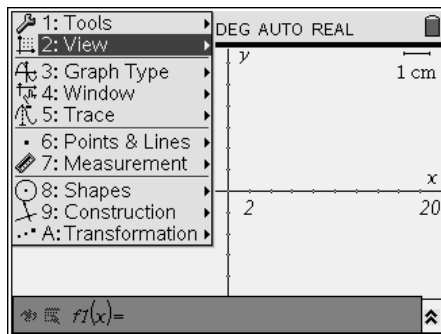

The students will need to construct their shapes by selecting "Menu", selecting "Shapes", and then selecting the shape that they want to construct. This method of constructing will allow them to measure the perimeter and area of the shape more easily than if the shapes are constructed using line segments. It will also allow these measurements to update automatically as the students manipulate their shapes to arrive at their solutions.

Teacher Notes

Once the students have constructed their shapes, they can change the attributes of their shapes by performing dilations or by grabbing a vertex of their shape with the hand feature and manipulating the shape manually.

It is helpful for the students to create area and perimeter measurements, using the TI-Nspire, that will allow them to monitor these values as they manipulate their shapes.

The default measurement unit for the TI-Nspire is set to *cm*. This can be changed by double clicking on the scale in the top right hand corner of the screen and typing in the new desired scale. For example, the scale given in the cheetah example below has been changed to meters by replacing the "*cm*" with "*m*" in the scale. Similarly, you can also change the number in the scale. See the following example:
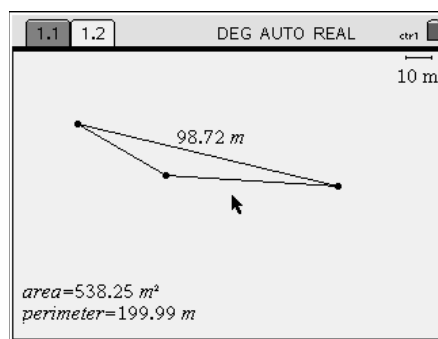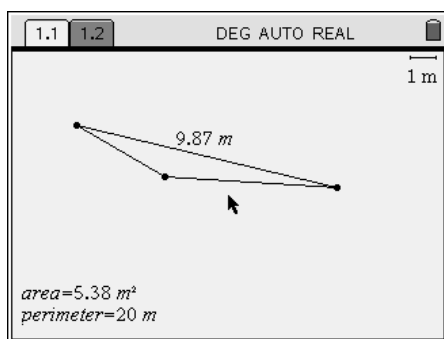
These pictures are of the same construction but the scale in the picture on the right has been changed to "10 *m*". This feature can provide your students with more flexibility as they try to decide what a reasonable scale is for the units in their solutions. Also, note that the length measurements have changed by a factor of ten. This may facilitate discussion regarding how the problem may have now changed or if the original constraints of 20 units were reasonable. The accompanying student handout provides a box in which students should sketch their habitats. However, you may also choose to use the TI-Nspire's document saving and sharing features to evaluate their work and share their ideas with their classmates.

References

Mississippi Department of Education (2007). *2007 Mississippi mathematics framework revised*. Jackson, MS: Author.