Design a Zoo

Lesson Setup

Real-World Context	Possible Math Tools
Students divide into groups, and each group designs a zoo: it must have more than one exhibit, and students must consider multiple sources of cost. Students may brainstorm one of many different modeling problems: • How much should we charge for admittance? • How could we reduce an outstanding cost? • How can we design a profitable zoo with limited space? • If we went on a field trip to the zoo, could we learn which exhibits are popular? Which one is the best investment?	6 – 8 students: Data analysis, linear functions, data extrapolation

Possible Learning Objectives:

Students estimate the cost of their zoo, both initially and after some amount of time (e.g. one week, one year) They should collect data on which exhibits are most popular, either by surveying the class or taking a field trip. Using one or more metrics, students hypothesize how their zoo can be improved, and present on their work.

Cross-curricular Connections:

This lesson goes well with a field trip to the zoo, encouraging students to think quantitatively during the trip.

Materials List:

At minimum, only paper and pencils are required. Grid paper, stickers, and other tools may be helpful.

Additional Notes:

Regardless of the variation you chose, be aware that design tasks are prone to non-mathematical solutions. To combat this, limit student choices in the design phase and be clear about what questions the model is answering. Are you trying to minimize the cost of the zoo? Determine the most popular exhibits?

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Anticipate:

Where might students go with the provided context?

These questions are adapted from the GAIMME report – Guidelines for Assessment and Instruction in Mathematical Modeling Education. You can freely download the report here: http://www.siam.org/reports/gaimme.php.

What questions might students ask to **define a focused problem** from the broader real-world context?	What sort of costs might be associated with a zoo exhibit? For example: cost of the animals, food, cleanup, maintenance, animal care (physical and mental), land, building the habitat, hiring staff, etc. How are these costs paid? Are they one-time payments, or do they have to be paid regularly?
What **information** might students need, and who will provide/find that information?	The students may estimate the cost of different exhibits, and survey the class to determine their popularity. This should take very little time: surveys may be passed around while students are working. Alternately, this information can be gathered at an actual zoo—before the trip, students should plan how to collect data.
What **vocabulary** should students learn before they begin the task?	Revenue, profit, (initial/daily) cost
What **assumptions or generalizations** might students make using the information they have?	Students may focus only on the costs they think are biggest—for example, they might assume that feeding the animals is much more expensive than maintenance. They might also assume that costs and revenues stay constant over time. To make the modeling simpler, students may assume a simple relation between the popularity of an exhibit and the space which should be devoted to it.
What **mathematical tools** might your students gravitate towards?	When planning the exhibits, it is easy to measure their area by counting unit squares. Higher grades might be required to use larger grids, or non-rectangular exhibits, to make use of geometry.
Which parts of the modeling process should happen in **small groups** and which with the **whole class**?	Each group should estimate the cost of their exhibits, and survey the rest of the class to estimate popularity of each exhibit. The whole class should conduct the initial brainstorming, imagining possible costs and revenues.
How will students **record** their ideas? In what format will they **present**?	Each group presents the design and layout of their zoo, either with a poster or a slide. They explain how they found the cost of their exhibits, and why their zoo is efficient. They should also present on any other topic of focus (e.g. how many people have to visit each day? Are the more expensive exhibits the most popular?)