Engineering Animal Enrichments

Companion Lesson to X-STEM All Access Episode "Wild About Animals"

Grade/ Grade Band: Middle and High School	**Topic:** Engineering Design

Brief Lesson Description: Students will learn about the characteristics of an effective animal enrichment in a zoo. They will then develop a prototype of an enrichment to make the life of an animal at a zoo more engaging and present their idea to others.

Performance Expectation(s):

HS ETS 1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

MS ETS 1-4: Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Specific Learning Outcomes:

Students will be able to….
-Explain what animal enrichment is and how it enhances the lives of zoo animals.
-Design a prototype to explain animal enrichment using common classroom items.
-Develop a test to determine the effectiveness of the animal enrichment
-Predict how it would enhance the animal experience at the zoo.
-Present you solution to others for feedback.

Narrative / Background Information

Prior Student Knowledge:

Elementary students are often familiar with zoos and how they meet the needs (shelter, food, and health) of various animals. As they move into middle school and high school, students develop understanding of ecological roles of animals as well. This lesson will help students to consider the quality of life of zoo animals and how engineering can improve this.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Designing Solutions: Design a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria and trade-off considerations. (HS-ETS1-2) **Developing and Using Models:** Develop a model to generate data to test ideas about designed systems including those representing inputs and outputs. (MS-ETS1-4)	**ETS 1.B: Developing Possible Solutions** A solution needs to be tested, and then modified on the basis of the test results in order to improve it. (MS-ETS1-4) Models of all kinds are important for testing solutions. (MS-ETS1-4) **ETS 1.C: Optimizing the Design Solution** Criteria may need to be broken down into simpler ones that can be approached systemically and decisions about the priority of certain criteria over others (trade-offs) may be needed. (HS-ETS1-2) The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)	**N/A to selected standards**

Possible Preconceptions/Misconceptions:

Common misconceptions that students have about zoos may include:
-Animals are neglected
-Animals do not have enough space
-Animals are trained to do tricks like those in circuses
-Animals are taken from the wild
-Zoos are purely for human entertainment.

To learn more about these misconceptions visit this article!

LESSON PLAN – 5-E Model

ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:

Students will begin this lesson by answering the following prompts:

- *Have you ever been to a zoo?*
- *If so, what was your favorite part of visiting?*
- *If not, what do you think a visit to the zoo would be like?*

After students have a few minutes to consider these questions, have them share in groups and then discuss as a class. Explain that many of us visited zoos as children, but that zoos do important work to help us protect wildlife and biodiversity.

Show the XSTEM video "WIld about Animals with Jordan Veasley". His portion of the video ends at 21:58

After the video, ask students to share:

- *one thing that they learned*
- *one thing that they were surprised by*
- *one thing they are left wondering.*

EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:

Explain to students that today we will be engineering animal enrichments for animals in the zoo. Place students in groups of 4. Assign each student a website below and ask them to spend ~10 minutes exploring the following websites to answer the question, "What is animal enrichment? Give 3 or more examples of animal enrichment" Tell them that they need to be prepared to share with their team.

Website 1: Smithsonian National Zoo and & Conservation Biology Institute Animal Enrichment
Website 2: Wild Welfare Enrichment & Animal Welfare
Website 3: Animal Behavior College The Importance of Enrichment in Zoo Wildlife Habitation Facilities
Website 4: Toronto Zoo Animal Enrichment

Have students share their findings with their teams. Then, as a class, discuss the following three questions:

- *What is animal enrichment?*
- *What problem(s) does animal enrichment solve for the animals living in the zoo?*
- *Do you think all animals are provided enrichment? Why or Why not?*

EXPLAIN: Concepts Explained and Vocabulary Defined:

Explain to students that today we will become engineers tasked with developing animal enrichment for animals at the zoo. Then, show the following video that explains the Engineering design process to the students.

Explain to students that today they will start by defining the problem, investigating the animal that they are going to create an enrichment for and brainstorm possible solutions.

Hand students the Activity Sheet and have them read/review the Problem statement and criteria and constraints. Ask students what clarifying questions they have. The most common one will be what materials are available to use for the enrichment. This is up to you as the instructor, but suggest materials include:

-Popsicle sticks	-Rubber Bands	-Masking Tape
-Card Board	-Paper/Styrofoam Cups	-Duct Tape
-Hot Glue	-Construction Paper	-Any other readily available materials you commonly use
-Masking Tape	-Aluminum Foil	
-String	-Card Stock	

Next, students need to read the passage about the ball python and complete the data table about their needs in the student activity sheet. In a group, students may be assigned roles based on the three categories: Habitat, Diet, and Health.

Finally have students work collaboratively to brainstorm 3 or more ideas for animal enrichments for the ball python. As they generate their ideas, they should be able to explain how they will enhance the life of the species. Have students show you their completed activity sheets (part 1-3) before allowing them to move on to the elaborate portion of the lesson.

ELABORATE: Applications and Extensions:
Students will construct a prototype of their animal enrichment. This is meant to be a rapid prototyping activity–the purpose of their prototype is to show an idea for feedback rather than be a working model. Set a clear time constraint for this activity–the suggested time frame is 30 minutes.

After students build their prototype, they should create a diagram of their idea that shows the important structures, functions, and dimensions of their design.

They will then consider how they would test the success of their design by creating a test for use with the Ball Python. Before students do this, make it clear that animal testing must undergo a rigorous process to ensure the safety of animals, so for this lesson we are only proposing how it would be conducted in a zoo under the supervision of a zookeeper.

EVALUATE:

Formative Monitoring (Questioning / Discussion):
Questions throughout lesson plan in italics, Student Hand Out

Summative Assessment (Quiz / Project / Report):
Students will present their design solutions to the class using a 2 minute elevator pitch. They will use their physical prototypes to show their idea and should address the following information:
-how your prototype would work
-how you anticipate it would improve the life of a ball python
-how you would test it with animals.

As students listen to others' presentations, they should provide one area of strength and one area for growth in their design. An easy way to do this is to provide students index cards or post notes to write on and hand to groups as they finish. This feedback will be used by students in the Elaborate further portion of the lesson. You may have all students listen to one another's presentations–OR–you can have groups pair up and present to each other to limit the class time needed.

Student presentations can be graded using the following rubric:

Exceeds Standard	Meets Standard	Does Not Meet Standard
Meets all required elements and extends to further research/evidence to prove the viability of the solution.	Student Presentation Includes: -Prototype that shows the concept of the animal enrichment -How the prototype would work -The anticipated impact on the life of a ball python -How the prototype would be tested with animals	Missing required elements -or- has errors in the presentation that show material is not understand

Elaborate Further / Reflect: Enrichment:
After receiving feedback from other students, groups should complete part 6 (redesign) of the activity sheet. This will allow them to consider their feedback and think about how their design can be improved. If time allows, they can represent their revised idea to the group that they originally presented to.

SOCIAL EMOTIONAL LEARNING ACTIVITY

Social Awareness: Demonstrating Empathy and Compassion or Understanding the influences of organizations and systems on behavior

In today's video, Jordan Veasley discussed the benefits of volunteering in preparing for his future. But what other benefits does volunteering have? Students today will explore the idea of volunteering and determine the benefits for themselves and others for these activities.

Start the lesson by asking students to define what it means to volunteer. Then, ask them to create a list of activities that they have volunteered in their lives.

Next, show the following video: Volunteering: The Beneficial Side Effect Ted X Talk
As they watch the video, have students create a list of the benefits of volunteering for both the volunteers and the organizations that they help. Discuss as a class following the video.

Provide students an opportunity to research local ways to volunteer. Possible starting points include volunteermatch.com, unitedway.org, or dosomething.org

Alternatively, after watching the video, you can provide students an opportunity to volunteer for local animal related organizations including

humane societies, animal sanctuaries, or local zoos.

INTERDISCIPLINARY CONNECTIONS/IDEAS

ELA: Have students read this article and use the provided resources to have a debate on the question, "Are animal Zoos Good or Bad for Animals?

CTE: With students in child care/teaching pathways, create a lesson to teach younger students about how zoos help promote biodiversity of species.

Geography: Research and explore zoos around the world. How are they similar? different?

Materials Required for This Lesson/Activity	
Quantity	**Description**
10-12 per group	Popsicle Sticks
1 sheet per group	Cardboard
1 per group -or- multiple to be shared by class	Hot Glue Gun with Glue
1 length per group	String
4-6 per group	Rubber Bands
2 per group	Paper or Styrofoam Cups
2-4 sheets per group	Construction Paper and/or Cardstock
1 length per group	Aluminum Foil
Class Set	Cutting Tools (such as scissors, box cutters, or craft knives)
Class Set	Masking/Duct Tape for students to access

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