NAEP Technology and Engineering Literacy (TEL) Task:

Iguana Habitat

Internet access via Chrome or Firefox : https://www.nationsreportcard.gov/tel_2014/#tasks/iguana

Overview: In the Iguana Habitat task, students help troubleshoot and fix the habitat for a classroom iguana named "Iggy." Students first learn about iguanas and their basic needs, and then they work through the task to determine how best to fix Iggy's wire mesh cage/habitat.

Uses:

- Instructional
- Formative Assessment
- STEM
- Blended Learning

Grade level: Middle school through high school (dependent upon objective), NAEP TEL grade 8

TEL's Iguana Habitat Assessment Targets: Combination of content areas and practices are used to classify the types of reasoning and thinking expected of eighth-grade students to show their ability to understand and apply technology and engineering knowledge and skills in a variety of problem-solving contexts.

- Content Classification**: Design and Systems** focuses on the nature of technology and the processes used to develop technologies, as well as basic principles for dealing with everyday technologies.
- Practice Classification: **Developing Solutions and Achieving Goals** refers to students' systematic use of technological knowledge, tools, and skills to solve problem and achieve goals presented in realistic contexts.

Design and Systems & Developing Solutions and Achieving Goals: Assessment Targets

- Predict the consequences of design decisions
- Troubleshoot a malfunctioning device or system
- Analyze as an initial step in design or troubleshooting
- Design a device or system to address a need
- Understand and use models to solve engineering and design problems

Ohio Standards:

Science:

- Life Science Grade 7: Cycles of Matter and Flow of Energy-- In any biome, the number, growth and survival of organisms and populations depend on biotic and abiotic factors.
- Physical Science Grade 7 Conservation of Mass and Energy—Energy can be transformed or transferred but is never lost.

Technology:

Design and Technology Strand (Grade 6-8)

Topic 1: Define and describe technology, including its core concepts of systems, resources, requirements, processes, controls, optimization and trade-offs.

- Analyze how tools, materials and processes are used to alter the natural and human-designed worlds.
- Define and categorize the requirements of a design as either criteria or constraints.
  (This task focuses on design criteria. The task could be extended by the teacher to include consideration of constraints, e.g., having a budget.)
- Explain how optimization is the process of making a product as fully functional and effective as possible.

Topic 2: Identify a problem and use an engineering design process to solve the problem.

- Apply a complete design process to solve an identified individual or community problem: research, develop, test, evaluate and present several possible solutions, and redesign to improve the solution
- Explain how innovation is the process of modifying an existing system or system element(s) to improve it.
- Consider multiple factors, including criteria and constraints, (e.g. research, cost, time, materials, feedback, safety, etc.) to justify decisions when developing products and systems to solve problems.
  (As the task is currently structured, "multiple factors" include different design criteria. The teacher could extend the task to fully address other factors included in this content statement.)
- Identify and explain why effective designs develop from non-linear, flexible application of the design process.

Topic 3: Demonstrate that solutions to complex problems require collaboration, interdisciplinary understanding, and systems thinking.

- Evaluate the effectiveness of the group's collaboration during the engineering design process and the contribution of the varying roles. *(If task is restructured as a collaboration….)*
- Deconstruct a system into its component parts and describe how they interrelate.

Topic 4: Evaluate designs using functional, aesthetic and creative elements.

- Examine the progression of a product to identify how the functional, aesthetic and creative elements were applied. *(Functional and creative elements apply to this task.)*

Required Materials

Digital device with internet access and use Chrome or Firefox:

https://www.nationsreportcard.gov/tel_2014/#tasks/iguana

- scroll down to "Take this task" on right or scroll to the bottom

Iguana Habitat Directions for student answers

Instructional Strategy – scenario based task/simulation

Prerequisite knowledge:

- Understanding of what animals needs to live or what resources living things need, especially animals.
- Understanding living and nonliving factors in a system
- Coldblooded vs. warm-blooded

- Nocturnal vs. diurnal
- Concept that animals may behave differently in a captive setting vs. a regular external ecosystem

Skills/knowledge introduced

- Changes in habitat affect the organisms in that habitat, learn about resources available to organism in a captive setting which are different than an external ecosystem and relate those to both settings and how it affects the organisms.
- Learning about the flow of energy in a system between the nonliving and living components. Also, how that energy flow affects the organisms in the system.
- Science and Engineering practices identified above; including citing evidence in an argument.
- Scientists use technology to model possible outcomes.

Vocabulary: habitat, adapted, digest, vegetarian, humidity, dehydrated, relevant, nocturnal, diurnal, coldblooded (ectothermic), warm-blooded (endothermic)

Methodology

Introduction:

1. Teacher give overview of the scenario.
2. Have students brainstorm/list ideas of what an ideal iguana habitat would be/what animals need to live. (Method: students work individually/pairs/groups)
3. Students share and teacher record ideas.
4. Teacher covers any missing prior knowledge (example: what nonliving and living items are and how they can interact with organisms, or how energy enters and exits the system).
5. Students give any additional ideas.
6. Discuss with students how to fill out scenario questions using complete sentences/ incorporating all ideas into complete statements, i.e. not just stating "Yes it needs heat" but expounding on the ideas and using evidence to answer the questions.

Activity:

1. Students complete simulation and record answers on task handout. Print out or copy response results after task. (**Note**: nothing will be saved from the simulation
2. Teacher monitor and stress writing an effective justification/argument using evidence especially question two and eight.
3. Dependent upon objective, teacher score/go over with class.
   Primary follow-up is to discuss questions and task with class.

Extensions: (format-discussion or written response)

1. Students evaluate what else they could have done to improve the habitat.
2. Address whatever else might be missing in the captive setting vs. an external ecosystem: possible predator/prey, changes in the ecosystem.
3. How a captive animal ecosystem is different from an external ecosystem.
4. Food webs and information about the external ecosystem of an iguana and other organisms.
5. Ecosystems factors such as population dynamics, food chains, producers vs. consumers vs. decomposers and functioning/roles/dependency in an ecosystem.
6. Ohio endangered species and ecosystems https://www.fws.gov/midwest/endangered/lists/ohio-spp.html

Mathematics

- Cage is too cold: students take measurements on floor and under ceiling, doing several measurements and in different places in room.

  Use mathematics to identify average temperature on the floor and under the ceiling thus students discover that warm air rises.

  6.SP.2 Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.

  6.SP.3 Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.

  6.SP.4 Display numerical data in plots on a number line, including dot plots (line plots), histograms, and box plots.

  6.SP.5 Summarize numerical data sets in relation to their context.

  a. Report the number of observations.

  b. Describe the nature of the attribute under investigation, including how it was measured and its units of measurement.

  c. Find the quantitative measures of center (median and/or mean) for a numerical data set and recognize that this value summarizes the data set with a single number. Interpret mean as an equal or fair share. Find measures of variability (range and interquartile range) as well as informally describe the shape and the presence of clusters, gaps, peaks, and outliers in a distribution.

  d. Choose the measures of center and variability, based on the shape of the data distribution and the context in which the data were gathered.

- Students could calculate the volume of different boxes and see if the volume makes a difference.

  6.G.2 Find the volume of a right rectangular prism with fractional edge lengths by packing it with unit cubes of the appropriate unit fraction edge lengths, and show that the volume is the same as would be found by multiplying the edge lengths of the prism. Apply the formulas $V = lwh$ and $V = Bh$ to find volumes of right rectangular prisms with fractional edge lengths in the context of solving real-world and mathematical problems.

G.GMD.6 When figures are similar, understand and apply the fact that when a figure is scaled by a factor *k*, the effect on lengths, area, and volume is that they are multiplied by *k, k^2* and *k^3*, respectively.

- Using a meter, students check how much electricity different heat lamps consume and calculate the cost to run each one.

  7.RP.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units.

  7.RP.3 Use proportional relationships to solve multistep ratio and percent problems.

  7.EE.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

- Using a water mister of sorts, students measure how much water is consumed in one hour and then calculate the volume of the water container determining the number of days before the container need to be refilled.

  8.EE.5 Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways.

  8.F.1 Understand that a function is a rule that assigns to each input exactly one output. The graph of a function is the set of ordered pairs consisting of an input and the corresponding output.

  8.F.2 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables or by verbal descriptions).

  8.F.4 Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description or a relationship or from two (x,y) values, including reading these from a table or from a graph. Interpreting the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values.

  8.SP.3 Use the equation of a linear model to solve problems in the context of bivariate measurement data, interpreting the slope and intercept.

  <u>General student activities:</u>

  - Analyze similarities and differences between procedures or solutions.
  - Cite evidence and develop a logical argument for concepts or solutions.
  - Describe or compare/contrast solution methods.
  - Generalize a pattern.
  - Gather, analyze and evaluate information to draw a conclusion.
  - Make basic inferences or logical predictions from data/observations.
  - Recall, observe & recognize facts, principles, properties.