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| **Lesson Title:** Animal Engineering | |  |
| **Grade Level:** 5th | **Quarter:** 4th |
| **Standards:**  **Science:**  S5L1. Students will classify organisms into groups and relate how they determined the groups with how and why scientists use classification.  a. Demonstrate how animals are sorted into groups (vertebrate and invertebrate) and how vertebrates are sorted into groups (fish, amphibian, reptile, bird, and mammal).  **Math:**  **MCC5.NBT.5** Fluently multiply multi-digit whole numbers using the standard algorithm.  **MCC5.NBT.7** Add, subtract, multiply and divide decimals to hundredths, using decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. | | |
| **Lesson Essential Question:**  How can I use my knowledge of the classification system for living things to engineer an entirely new living creature? | **Vocabulary:**  Classification  Vertebrate  Invertebrate  Kingdom  Phylum  Class | |
| **Lesson Materials:**  Paper core tubes from wrapping paper, paper towels, toilet paper  Cardboard  Cardstock  Lids  Plastic bottles and/or jars  Pipe Cleaners  Metal cans of assorted sizes  Craft sticks and wooden dowels  Toothpicks  Bubble wrap  Wax paper  Plastic wrap  Aluminum foil  Styrofoam  Paint  Construction Paper  Markers and/or colored pencils  Glue and/or Tape  Fake Fur and feathers  Assorted fabrics | **Lesson Assessment:**  Completed animal model with reference card  Competed Student Journal  Completed budget sheet- attached  Student participation | |
| **STEM Challenge Overview:**  Students will be animal designers for a biotechnology engineering firm which creates new animals for various clients. | | |
| **Teacher Background:**  Students should have been introduced to basic information about classification systems prior to this activity.  A reference chart for the vertebrate and non-vertebrate phyla, with the classes for each phylum and key information for each is attached below. *This chart could easily be used for an introductory lesson prior to this one, by blanking out key information and requiring students to do research to complete the chart.*  The project is designed to use readily available, inexpensive recycled materials; however it is certainly an option to encourage students to bring in materials which might enhance the animal models, such as fake fur and feathers.  Students will manage an “engineering budget” of $500; the teacher will need to assign prices to the various items in the materials “warehouse”. | | |
| **INSTRUCTION** | | |
| 1. **Ask/Engage 15-30 min.** | | |
| Display the pictures of mystery animals and the taxonomical chart (all attached below) or use your own choices.  Show the Prezi to engage students in activity.  Ask students to discuss with their thinking partner or elbow partner how they might go about classifying the creatures in the pictures. After 2-3 students have shared their thoughts, tell students about their challenge, as follows:  **Challenge:**  The Amazing BioTech Engineering Company has hired a group of expert animal designers, to develop a new animal for one of its clients, the Astonishing Safari Company. Astonishing Safari Company is known around the world for its exciting animal collection which can only be viewed on very expensive tours at their parks in select locations on different continents.  The group’s task is to create an animal which does not fit into the traditional classification chart for living things, because it combines characteristics from the different phyla (Vertebrate and Non-vertebrate) or classes within a phylum (for example: reptile and bird). Since Amazing BioTech Engineering Company needs to put a lot of money into research and development for future projects, they have provided each group with a budget for creature creation. | | |
| 1. **Imagine/Brainstorm – 30-40 min.** | | |
| Each creative engineering group will be presenting an animal model to the company. Each group will determine what dominant or recessive traits their animal will have. The brainstormed drawings should contain as many details as possible, with labels or written explanations to help others understand the thinking. Generate a list of possible materials that would be needed for the ideas, along with a rough estimate of the cost.  **Criteria:**  1. Must be created as a model and have a unique name  2. Must combine characteristics of more than one class from vertebrate and/or invertebrate phyla  3. Must have at least 2 movable parts  4. Must be accompanied by a reference card which provides the animal’s name; describes the habitat in which it lives and how it would function there (for example, large rocks or sandy expanses where it can sun itself because it’s cold-blooded or lots of vegetation to make nests if it is an egg-layer which incubates its eggs); features of the animal (wings, scales, etc.); whether it is an herbivore, carnivore or omnivore, its types of preferred food and methods for obtaining those foods; how it moves about and ways it defends itself  **Constraints:**  1. Must be created from available materials  2. Must keep within $500 budget for constructing the animal; cost accounting sheet will be submitted as part of the final project | | |
| 1. **Plan/Design – 30-45 min.** | | |
| Students will present their ideas to members of their engineering teams.  Teams should be composed of 4 engineers:  *Engineering Manager/Reference*- the Card Creator  *Finance Manager*- manages the budget and completes the budget sheet  *Design Engineer*- draws the final plan  *Materials Manager/Timekeeper*- draws up the materials list, get the materials and keep the team on track regarding time.  Each person in the group must help build the model and is responsible for completion of his/her own Student Journal.  Each team should collaboratively discuss the ideas, then come up with a plan for a final design. Although it is best if the team can achieve consensus on the plan, the Engineering Manager has the final say on the plan. After the plan has been agreed upon, the final plan should be drawn, a materials list created, and all costs should be listed on the budget sheet. | | |
| 1. **Create / Test – 45 min.** | | |
| Engineering teams will build their animal models according to their design plans*.* | | |
| 1. **Evaluate/Improve (**and repeat Steps 1-5) **- 20 min.** | | |
| Each team should evaluate their design. Did the animal model meet the established criteria? Did the final design match the planned design? If not, why? Did the team stay within the budget? How would the team improve their design. | | |
| 1. **Museum – End of the day** | | |
| Engineering teams will present their animals to visitors. Please create a scheduled time for all 5th grade classes to present their animals.  Partner classes would be ideal.  Example: Mr. McGee’s class will present to Ms. Evatt’s class at 1:00 and then switch at 1:15.  Presenters should use their writing as a guide to talk about their animals. They can create brochures, trifolds, prezi’s, etc. Have fun with it! Teach the kids to be a docent. Have fancy napkins and punch if you want! | | |

**Mystery Animals, where do they belong to?**



**Pangolin**



**Hummingbird Hawk-Moth**



Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Animal Engineeering STEM Challenge

5th Grade

**Challenge**: The Amazing BioTech Engineering Company has hired your group of expert animal designers, to develop a new animal for one of its clients, the Astonishing Safari Company. The company is known around the world for its exciting animal collection which can only be viewed on very expensive tours at their parks in select locations on different continents. Your task is to create an animal which does not fit into the traditional classification chart for living things, because it combines characteristics from the different phyla (Vertebrate and Non-vertebrate) or classes within a phylum (for example: reptile and bird). Since Amazing BioTech Engineering Company needs to put a lot of money into research and development for future projects, they have provided you with a budget for your creation and you will be required to account for all your expenses.

**Criteria:**

1. Must be created as a model and have a unique name

2. Must combine characteristics from all 8 categories

3. Must have at least 2 movable parts

4. Must be accompanied by a reference card which provides the animal’s name; describes the habitat in which it lives and how it would function there (for example, large rocks or sandy expanses where it can sun itself because it’s cold-blooded or lots of vegetation to make nests if it is an egg-layer which incubates its eggs); features of the animal (wings, scales, etc.); whether it is an herbivore, carnivore or omnivore, its types of preferred food and methods for obtaining those foods; how it moves about and ways it defends itself

**Constraints:**

1. Must be created from available materials

2. Must follow the guidelines from the coin toss activity

3. Must keep within $500 budget for constructing the animal; cost accounting sheet will be submitted as part of the final project

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| 1. **Body Covering** |  |
| 1. **Backbones** |  |
| 1. **Number of Limbs** |  |
| 1. **Wings** |  |
| 1. **Eye Color** |  |
| 1. **Offspring** |  |
| 1. **Teeth Shape** |  |
| 1. **Body Color** |  |
| 1. **Diet** |  |
| 1. **Free Choice: Adaptation** | **List your three choices below and circle your trait**   1. **2. 3.** |

**Materials:**

1. **ASK / ENGAGE:** What is the problem you are being asked to solve?

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1. **IMAGINE/BRAINSTORM:** What are some possible solutions to the problem that you are trying to solve? After you brainstorm, draw and label your ideas below.

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| **Idea #1** | **Idea #2** |

1. **PLAN/DESIGN:** Share your ideas with your group and collaborate to decide on a final design plan. Draw your team’s design below and make a list of the materials that you will need to complete your design.

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| **Team Design Plan** | **Materials List** |

1. **CREATE/TEST**: Use your Final Design Plan to create and build your solution. Test your design. Did it work? Why or Why not?

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1. **EVALUATE/IMPROVE:**  How well did your design work? Did your solution solve the problem within the given constraints?

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How can you improve your design? How can you make it better? Draw and label your improved design below.

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| **Improved Design Plan** |

**Names: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Project Accounting Sheet for Animal Engineering**

**$500 Budget**

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| **New Animal** | | | |  |
| **Material** | **Cost for 1** | **# Needed** | **Total** |  |
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