I Will Survive! - An Engineering Design Challenge

Resource ID#: 31248 Primary Type: Lesson Plan

This Engineering Design Challenge is intended to help fifth grade students apply the concept of how changes in an ecosystem can affect the survival of an animal species. Some suggested background building lessons are included, but it is not intended as an initial introduction to this benchmark.

Subject(s): English Language Arts, Science

Grade Level(s): 5

Intended Audience: Educators

Suggested Technology: Document Camera, Computer for Presenter, Internet Connection, LCD Projector, Adobe Flash Player

Instructional Time: 5 Hour(s)

Resource supports reading in content area: Yes

Freely Available: Yes

Keywords: Adaptations, Ecosystem, engineering design challenge, engineering, EDC, Engineering Design Challenge

Instructional Component Type(s): Lesson Plan, Problem-Solving Task, Assessment , Text Resource

Resource Collection: CPALMS Lesson Plan Development Initiative

ATTACHMENTS

engineer_design_challenge_process_final.pdf
engineering_design_rubric_bps.doc

LESSON CONTENT

Lesson Plan Template: Guided or Open Inquiry

Learning Objectives: What will students know and be able to do as a result of this lesson?

Students will:

- identify changes in an ecosystem that can affect the survival of an animal species.
- identify characteristics in an animal species that allow them to adapt to changes in an ecosystem.
- identify the basic needs of animals. (food, water, shelter, air)
- complete an engineering design challenge demonstrating an "animal's" structure that can function in a changed ecosystem.
- explain that when the environment changes, differences between individuals allow some plants and animals to survive and reproduce while others die or move to new locations.

Prior Knowledge: What prior knowledge should students have for this lesson?

Prior knowledge of habitats or ecosystems, structural and behavioral adaptations, human influences, and natural impacts to ecosystems is necessary. This could be assessed through the Formative Assessment activity and is also reviewed in the introduction.

Guiding Questions: What are the guiding questions for this lesson?

1. How do the diverse characteristics of different animals make them more likely to survive after a change in their ecosystem?
2. Which adaptations are the most critical to the survival of a species?
3. How critical are conservation efforts to an animal species' survival?
4. What should humans do to minimize their negative impacts on ecosystems?

Introduction: How will the teacher inform students of the intent of the lesson? How will students understand or develop an investigable question?

Day 1:

- To introduce the lesson, have students view a video or read an article about effects of natural disasters, climate change, or human impact on diverse animal species in their ecosystems. As they view or read, students should look for changes in the ecosystem and their impacts on the animal species. Listed below are two examples linked to National Geographic, one article and one video showing the effects of melting ice on the polar bear population:
  - Polar Bears Listed as Threatened
  - http://video.nationalgeographic.com/video/environment/threats-to-animals-environment/polar-bears/ (This video is about 3 minutes long. Download in advance so you can play past the 30 second advertisement before showing to students.)
- Next read a teacher selected non-fiction text that focuses on an animal species that is struggling to survive due to changes in its Ecosystem. Selected text may come from a science textbook or a magazine such as National Geographic. Click on the link below: National Geographic Pathfinder Edition Jan-Feb 2013

Changes in Ecosystem	Effects on Polar Bears

- Have students create a chart or other graphic organizer to record their information from additional readings in their science notebook. Changes in Ecosystem Effects on Polar Bears
- Ask the students to look back through the text to find information about the changes in the polar bear's ecosystem and record their evidence on the chart in their science notebook. Discuss student responses.
- Next, ask the students to look for information in the text about how the changes are impacting polar bears and record their evidence on the chart in their science notebook. Discuss student responses.
- Turn and Talk - Have students reflect with a partner upon what they have learned and record their thoughts in their science notebooks. Have students share their views in a class discussion.

Day 2:

- Show a video clip or photo of an animal species that has been able to adapt to a changing ecosystem such as the walking catfish in Florida. http://education.nationalgeographic.com/education/multimedia/walking-catfish/?ar_a=1&ar_r=999 (Article "Walking Catfish")
- Discuss the impacts that changes in an ecosystem can have on animals with questions such as:
  - Should animals be removed from their natural habitats and put in zoos so that they will survive?
  - Should humans do more to protect animals from ecosystem change?
- Tell the students that they are about to join an expedition of scientists and explorers whose mission is to discover how an animal species has survived after a natural disaster. Break the students into teacher-selected teams and explain that each expedition will explore different ecosystems such as Grasslands, Tundra, Taiga, Tropical Rain Forest, Marine, or Desert. Student groups may choose their ecosystem or the teacher may assign an ecosystem to each group.
- Students may have done a companion lesson (availableonCPALMS) Amazing Adaptations, where each discovery team "discovered" (created) a new animal species that included the following:
  - Habitat: include a map showing the location of the discovery, details about the climate, and the challenges this habitat presents.
  - The adaptations that ensure its basic needs of food, water, shelter, air, and predation are met.
  - Predators , prey, and symbiotic relationships.
  - A colored illustration of the animal with the structural adaptations labeled.
  - Name of the animal and a rationale for the name. If students have not participated in that lesson, the teacher may direct students to research existing animals that live in their assigned ecosystem to find the information listed above.

Investigate: What will the teacher do to give students an opportunity to develop, try, revise, and implement their own methods to gather data?

Day 3:

- Introduce that an engineer is a special type of scientist. Ask students what they know about engineers and the work they do. Clarify what engineers do and tell students that they will be engineers in this design challenge. In this lesson, students will take an idea or drawing and design a moving part for their animal or will make sure that their animal's structure can function in a changed ecosystem (*i.e.* wings will support the animal so it can fly to a new ecosystem; tail legs that will allow it to walk instead of swim; webbed feet for swimming in a flooded ecosystem). The teacher may give the students a scenario such as a forest fire, pollution such as an oil spill, or a disaster such as a hurricane. The teacher should have multiple resources such as animal photos, cards, books, and video clips available to help students who are struggling come up with ideas. For some groups, teachers may lead students with questions such as:
  - "What physical features/adaptations allow your animal to survive in its ecosystem?"
  - "What physical features/adaptations does this animal have on its body that helps it to move?"
  - "How would the ecosystem change after the natural disaster?"
  - "What would your animal need in order to adapt to these changes?"
  - "Can you think of another structure that could help this animal be better adapted to the changed ecosystem?"
- Explain the Engineer/Design Challenge Process graphic (attached). Phase 1. Explain that we are now in Phase 1: "Identifying the Problem." In this stage, engineers identify the problem or challenge and any things they need to consider when they design their solution. The challenge will be to change the animal they made in a previous lesson (Amazing Adaptations) using a Styrofoam egg as the main body that included a moving part as a structural adaptation so that it could survive in a new or altered ecosystem. (If they have not previously designed an animal species, they can create one now. Student groups will first create an animal species that

has adaptations which allow it to survive in its ecosystem. They should illustrate and label the adaptations.) Then each student group will create the animal species as described above. Students will then alter their animal species prototype to adapt to the changes in its ecosystem.
- Brainstorm possible solutions. Put students into their explorer teams and allow time for them to discuss, brainstorm and draw their plans and designs in their science notebooks.
- Have explorer teams create a materials wish list or display possible materials for them to choose as building materials. The teacher should ask students questions such as those listed in the Feedback to Students Assessment section as they work through these steps.
- Teams should submit their designs and materials list to the teacher. *It will be important for the teacher to review these science notebook entries to support student success, while allowing room for trials and revisions.

Day 4:

- Design and build a working model or prototype. Once they have a plan approved by the teacher, they will build a model of their design (altered animal species) to test it. This model is called a "prototype."

Analyze: How will the teacher help students determine a way to represent, analyze, and interpret the data they collect?

- Gather the explorer teams together and tell them that they are moving into Phase 2: "Testing." Refer to the Engineer/Design Challenge Process graphic. Explain that engineers test their structures to collect data, analyze it, and observe how effective they are. A student group may add wings to their animal species prototype so that it can relocate. Student groups would need to be sure that the wings could support the structure so that it could glide.
- Once the first test is completed, each team will "Analyze their data/results" and discuss as a group; what is working in their model and what might need to be changed. Students should also review the Engineering Design Evaluation Process Rubric so that they clearly understand how they will be graded on the assignment. Students will revise their plans as needed. The student groups should then meet with the teacher to demonstrate how their design meets the requirements. The teacher will give feedback and the group should implement any necessary changes. After "Modifying," they will test again, continuing the "test-analyze-modify" cycle until they feel their "solution is complete and a final model is achieved."
- Each group will also prepare a presentation with the purpose of informing the other groups about how their animal had to adapt to survive in its changed ecosystem. The presentation should explain how the design meets the engineering design requirements as well.

Closure: What will the teacher do to bring the lesson to a close? How will the students make sense of the investigation?

Day 5:

- Gather the student teams together and tell them that they are moving into Phase 3: "Presentation." Refer to the Engineering Design Challenge Process Graphic (attached). Explain that meeting together to discuss the designs and test results is an important part of the engineering process. Ask teams to present their team's plans, tests, modifications, and results to the class. Students may need to be reminded of the importance of this conference and that actively listening to each group's information is a critical part of the activity.
- Distribute a presentation response form to the students. This could be something as simple as a chart with the following headings. Animal, Ecosystem, Changes to the Ecosystem, Adaptations, and Impact on Survival. Under each heading, the students would list the information that each group presented.
- Say, "We will have a question and answer period. After each presentation you will all have an opportunity to ask questions." Prompt or encourage students to ask questions such as:
  - What evidence/data do you have that indicates that your design was effective?
  - What inspired your design for your animal species?
  - Why did you choose these adaptations for this animal?
  - What problems did you need to solve and how did you solve them?
  - How and why did you modify your prototype?
- Each group should present the changes to their animal species, using both the model and the presentation they prepared. Allow time between each presentation for students to add their thoughts to the presentation response form.
- Collect the presentation response forms to assess individual student understanding of environment changes on animals, and that differences between individuals allow some plants and animals to survive and reproduce while others die or move to new locations.
- Use the Engineering Design Process Evaluation Rubric to assess the Engineer/Design Challenge Process and the Speaking and Listening Standards.
- Students will either respond to one of the guiding questions in their science notebook or they will reflect on their learning with a prompt such as, "I used to think_____, but now I know_____."
- Review the Engineer Design Challenge Process through class discussion. Do students understand each phase and how the process helps engineers solve challenges and create the best designs they can.

Summative Assessment

Use the attached Engineering Design Process Evaluation Rubric to evaluate each student's performance during the Design Challenge portion of this lesson.

Formative Assessment

Before the lesson, the teacher will distribute a collection of photos with a variety of animals in varying ecosystems. (I use the All About Animals Photo Library, but you may also access free photos at Bing images.)

To assess prior knowledge of ecosystems and how animals meet their basic needs, ask the students:

- "Can you identify the ecosystem that this animal lives in?"
- "What basic needs have to be met for this animal to survive?"
- "Where does the animal belong in the food web or food chain of this ecosystem?"

Assess student knowledge of structural or behavioral adaptations by asking:

- "Can you observe anything on the animal's body that could help it survive in its habitat?"
- "Do you know of any behavior that could help this animal survive?"

Ask students:

- "What kind of natural disasters could cause major changes to ecosystems?"
- "What kind of things could humans do to damage ecosystems?"

The teacher will use this information to assess the instructional needs to develop appropriate background knowledge needed for this lesson and to create student cooperative groups for the lesson. The teacher may choose to create mixed groups of students who have various degrees of understanding regarding ecosystems, impacts of changes to ecosystems, and adaptations of plants and animals so that stronger students can support students who have less knowledge of these aspects of life science. Another approach would be to build groups of students with the same level of understanding so that students with a stronger understanding could work together to challenge and enrich their group, while the teacher could give more time and support to the students with a weaker understanding. The teacher may also

take into consideration students' strengths, keeping multiple intelligences in mind so that each group is comprised of students that are strong in each design area.

Feedback to Students

During the Engineering Challenge portion of the lesson, students will be given constant feedback with formative questioning. Questions will be geared toward helping the students understand the concepts and how to apply their knowledge to successfully complete the challenge. The teacher will listen to their answers for a rational explanation of their plans and ideas.

The teacher will ask questions such as:

- Does your design include an adaptation that allows your animal to survive?
- How does this adaptation enable the animal to adapt to environmental changes?
- What will hold your animal (prototype) together? (toothpicks, paper clips, glue, tape, pins.)
- What materials are you using to make your animal (prototype) strong enough so that it doesn't break when it moves?
- How will this material make your animal (prototype) move as you intend?

As students bring the teacher their initial plans and test results during the Design Challenge portion they will be asked:

- Is your design or modification able to function as you had planned?
- Do you need to change any materials or the design to make it work as planned?
- Does your animal (prototype) meet the requirements of the challenge?

After the students have tested their animal they will be asked:

- Did your adaptation work the way you had planned?
- What would you change or add to make your animal (prototype) better?
- Did you follow your design?

Misconceptions should be addressed throughout the lesson as they arise. For example, teachers should remind students that adaptations do not occur in a short period of time and that animals do not make an intentional decision to change. For example, a long haired animal doesn't decide that the climate is too hot and start growing shorter hair the next week. Biological adaptation involves genetic variation that allows some individual animals to survive in a changed environment. The animals that survive pass on their genes to their offspring, which increases the next generation's chances of survival.

ACCOMMODATIONS & RECOMMENDATIONS

Accommodations:

- Students with emerging writing skills could respond orally to the presentation response form or could draw labeled pictures to show learning in their science notebook.
- Collaborative groups can help with student strengths and weaknesses by providing additional support for struggling students.

Extensions:

Teachers can extend this lesson model through the addition of plants and how they could adapt to an altered ecosystem.

Suggested Technology: Document Camera, Computer for Presenter, Internet Connection, LCD Projector, Adobe Flash Player

Special Materials Needed:

Materials for student use:

- Fabric or photos simulating different ecosystems or habitats
- Collection of plastic animals or photos of various animals and their adaptations
- Paper and art supplies for illustrations of the new animal species
- Science notebooks and colored pencils
- Animal species requirements list created by teacher
- Construction paper, clay, plastic wrap, wire, chenille sticks, toothpicks, paper clips, faux fur scraps, foam, felt, feathers, wiggly eyes, and other easily found objects, glue, sewing pins, or other materials to attach objects to the Styrofoam egg.
- Styrofoam egg or ball for each group
- Presentation response forms

Materials for teacher use:

- Teacher copy of a teacher selected non-fiction text about an animal facing the challenges of a changing ecosystem. One source for these articles is National Geographic Explorer Magazines which can be found at the following link: National Geographic Pathfinder Edition Jan-Feb 2013 Teachers should choose the archive tab to view articles. Click guide to view digital editions of the student book.
- Engineering Design Process Evaluation Rubric (attached)
- Engineer/Design Challenge Process graphic (attached)

Further Recommendations:

This is a companion lesson for Amazing Adaptations. It is not necessary to teach Amazing Adaptations first, but that lesson will help develop prior knowledge.

SOURCE AND ACCESS INFORMATION

Contributed by: Elizabeth Faulkner

Name of Author/Source: Elizabeth Faulkner
District/Organization of Contributor(s): Brevard
Is this Resource freely Available? Yes
Access Privileges: Public
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Related Standards

Name	Description
LAFS.5.RI.3.7:	Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
LAFS.5.SL.1.1:	Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on *grade 5 topics and texts*, building on others' ideas and expressing their own clearly. a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion. b. Follow agreed-upon rules for discussions and carry out assigned roles. c. Pose and respond to specific questions by making comments that contribute to the discussion and elaborate on the remarks of others. d. Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.
LAFS.5.SL.2.4:	Report on a topic or text or present an opinion, sequencing ideas logically and using appropriate facts and relevant, descriptive details to support main ideas or themes; speak clearly at an understandable pace.
SC.5.L.15.1:	Describe how, when the environment changes, differences between individuals allow some plants and animals to survive and reproduce while others die or move to new locations.