TEACHER'S GUIDE

Wild Robots

Experience Overview

TITLE	Wild Robots
AGE RANGE	9-12
SUBJECT(S)	Science
EXCHANGE TYPE	Cultural
DESCRIPTION	Hummingbirds hover, geckos use their sticky feet to climb walls, and sandfish wiggle through rubble. What do these animals and others like them have to do with robots? In this exchange, students explore how scientists study animal traits to make better robots. Students then apply STEAM skills as they design their own robots to achieve a particular purpose and navigate in their partners' local environment. Students also practice providing effective feedback to their partner classrooms throughout the design process.

Objectives

Students will...

- identify and describe physical features of two environments.
- synthesize information from multiple sources.
- select animal features that assist with mobility in selected terrain.
- apply biomimicry concepts in a robot design.
- create diagrams in planning robot models.
- ask questions and offer constructive feedback to extend learning and conversation.
- learn and develop strategies for effective communication with a global audience.

Instructional Outline and Pacing Guide

Allow one full session for students to complete each of the following activities, plus additional time as needed for them to respond to the work of their partner classes.

Welcome/Meet Your Partner Class
First Thoughts
Pick a Place
Search for Ideas
Design It
Build It
Animal Robots Revealed (2 sessions)
Final Thoughts

Note: If you have limited time, consider modifying the Experience to end after students share their diagram in Design It.

Teacher Resources

Video
"Robot Design"

Readings from Cricket Media
Extend student learning by sharing these related Cricket Media articles, found in the Teacher Resource section of this Experience.

- S1 "Robot Zoo" Ask
- S2 "Creeps, Crawls, Swims, or Flies: Robots go Wild" Odyssey
- S3 "Anatomy of a Robot" Ask
- S4 "It's in the Legs" Appleseeds
- S5 "Robots to the Rescue" Odyssey

Online Resources
- Biomimicry Institute
  http://biomimicry.org/biomimicry-examples/#.VgXEjc4XT_8
- Smithsonian
  http://www.smithsonianmag.com/science-nature/how-biomimicry-is-inspiring-human-innovation-17924040/?no-ist
- Popular Science
  http://www.popsci.com/tags/biomimicry
- Live Science
  http://www.livescience.com/28873-cool-technologies-inspired-by-nature.html

Other Materials
Simple, readily available materials for building: cardboard, plastic containers, wire, recycled parts, springs, bottle caps, etc.

STUDENT ACTIVITIES

1. Welcome

Welcome to the Wild Robots Experience!

You will begin by exploring how animals' unique traits and abilities are used to design some very unusual robots! You will also meet the partner class you will be working with.

During this Experience you will…
- exchange information about local environments with your ePals.
- discover how animal traits are used to design robots.
- plan and design a robot that incorporates animal features.

TEACHER NOTES

1. Engage students and ignite prior knowledge by asking students to share what they know about robots. (Encourage them to think beyond what they've seen on TV!) Share any interesting facts of your own, such as the development of tiny "robo-bees" by Harvard University, which may be used for search-and-rescue. (See web links for other examples.)

2. Explain that the purpose of this Experience is to learn how biomimicry is used in robot design. Explain that biomimicry means "impersonating the traits of living things." Direct students to the GC website and have them begin the Experience.

2. Meet Your Partner Class

SAY HELLO!

Introduce yourself to your partner class. Create a text or video introduction telling them
- where you live—be specific!
- two or three things about your community
- a few details about your school and class

SHARE

Post your introduction and then read or view the one created by your ePals. In what ways are your two classes the same? How are they different? Share your observations by replying to your ePals

1. Before your students write their own introduction, tell them a little about the ePals they will be working with. Then help them plan, draft, edit and post their introduction.

2. As a class, read the partner class's introduction and compare and contrast the information they shared with your own introduction. Select 4 or 5 students to post the class's comments and questions.

3. Read aloud any comments and questions posted by the partner class. Discuss answers as a class, and select students to post responses.

3. First Thoughts

VIEW

Let's get started! Watch this short video about designing robots with animal traits. Then share your reactions with your classmates.

READ AND DISCUSS

Read the article "Robot Zoo." Discuss with your classmates all of the ways scientists incorporated animal features in their robots. What was the reason behind each choice?

SHARE

Choose the animal robot from the article that you liked the most or thought was the most unusual or innovative. Post your choices and your reasons for your partner class. Then read and discuss the choices made by your ePals.

1. Engage students in the Experience by viewing the Robot Design video with your class. Tell them that they may be making a video just like it!
2. Share "Robot Zoo" as a focus article. Lead the class in the follow-up discussion, or allow them to talk about the article in pairs or small groups.
3. For the "Share" activity, you may wish to have your class vote on the one or two best robots from the article, and post only those as a class. Be sure to check with you partner teacher to make sure he or she uses the same approach.
4. As a closing discussion, ask students what type of animal traits might be useful in designing a robot that lives in different environments such as the mountains, ocean, grasslands, beach, desert, and city.

4. Pick a Place

You will be designing a robot for an environment described by your partner class and choosing an environment for them to study. So look around and really think about where you live!

CREATE

Create a class video, slide presentation, or text entry that includes the following:

- A description of your local environment (ocean, river, grasslands, mountain, desert, urban, etc.). If there is a lot of variety, feel free to describe more than one area.
- Photos or links to images of your local environment.
- Some of the challenges traveling in this environment.

SHARE

Post your description, and then read or view the one created by your ePals. What questions do you have about what they've sent? Post those questions below.

1. Help students identify and define the features and challenges of their environment. Students in an urban area might focus on the tall buildings or dangerous traffic. Students who live near the ocean could focus on nearby sand dunes or the ocean itself.
2. After students have decided what environments or landscapes they will describe, work with them to create an outline or storyboard that captures the details they will share and the visuals they will use to accompany those details. You might want students to work in small groups to present an environment within your location, and then combine all work into one presentation.
3. Guide students in analyzing and responding to the description they receive from their partner class.

5. Search for Ideas

THINK AND DISCUSS

- As a class, review the main features of your ePals' environment as they described it. What challenges would it present?
- Form a Robot Design Team with some of your classmates. Choose one of the environments described by your ePals to build a robot for. Think: What could a robot do in that environment people can't? Choose a purpose for your robot.
- Discuss what animal features could be built into your robot to help it navigate in the partner team's local environment and achieve the purpose you chose.

SHARE

Post your ideas about the animal features you would include in your robot. Explain why you chose the ones you did.

RESPOND

Respond to your ePals' ideas by explaining any characteristics of your local environment that might have been missed or misunderstood.

1. Help group students into design teams. Explain that they will work in these groups to design and build their robots.

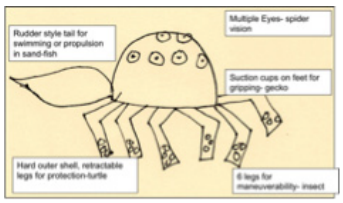
2. Allow the teams to begin the discussions in this activity. Move from group to group to offer help or advice as needed.

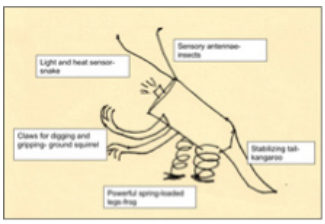
   Optional: Distribute or display articles from the Resources section to help students gather additional ideas. Consider having groups of students read one of the articles and report to the class what they have learned about animal robots and biomimicry.

3. Suggest to students that they post the ideas for their robot using the following format:
   - Robot Name
   - Purpose
   - Environment
   - Features

6. Design It

PLAN





- Review the ideas you came up with in the first two activities. Work with your Design Team to create a rough sketch of what the robot might look like.
- Share your sketch with other groups and discuss ideas for improving your plan.
- Make a final version of the diagram. Label it with the animal features you included, along with brief explanations of its purpose and how it will work.

1. Tell students that today they will be creating a diagram of their robot. Explain that a diagram is like a blueprint for designers and should include labels and other specifications to illustrate the different important parts of the robot.

2. Before students review the partner class's plans, discuss the kind of feedback and questions that are most helpful. Break students into small groups to compose questions and feedback responses.

3. Guide students in reviewing the comments and questions from their ePals discuss how to use the comments to make design additions or changes.

6. Design It *cont.*

SHARE

Take a photo or scan your robot diagram and upload it to share with your ePals. Review your partner class's plans. Post questions and offer suggestions to help your partners clarify or improve their ideas. Make revisions to your own plans based on the feedback you receive.

7. Build It

CREATE AND CONSTRUCT

Use the robot design diagram you completed in the previous step to create a model of your robot with available materials. The model does not actually need to work, but it should show others what the pieces and parts look like.

SHARE

Summarize your model-building experience for your partner class. Post details about the following

- The materials you used
- The design and construction challenges
- Solutions you found, or changes you made to your original plans

When you receive your partner class's summaries, see if there are any ideas you could use, or if they used building materials you hadn't thought of.

1. Provide a collection of recycled and craft materials for model building. Items such as cardboard, pipe cleaners, corks, springs, cups, and cans. Students will also need ways to fasten parts together, so provide wire, glue, staplers, and tape.
2. Direct teams to create one model together and work collaboratively to combine the best ideas and assembly solutions for their final robot.
3. Hold a mini "Robot Fair." Have groups put their models on display and then take a tour of the entire "exhibit."
4. Tour the exhibit yourself, asking each group questions about their robot. Use the model and their responses as a kind of informal assessment of what they have learned.

8. Animal Robots Revealed

BRAINSTORM Now that your design is complete, how will you share your invention with others? As a team, decide how to show and explain the special features of your robot and how it "works" to solve the challenge in your ePals' environment.

CREATE Work with your Design Team to plan and create your presentation. Remember to include:

- name of your robot
- how you used animal mimicry in the design
- how you designed it to navigate in your ePals' environment
- what features help the robot complete its task

SHARE Share your robot presentations with your partner class. Then spend some time carefully studying your partner class's robots. Post your responses, telling

- what you like about each design
- what you learned from your partners' creations.

1. Consider brainstorming as a class to come up with a list of presentation ideas for students to choose from. Some ideas might include:
   - narrated video where students describe and demonstrate their robot
   - slideshow (narrated or with text/ labels)
   - Photos of a poster and model display
   - Stop animation using robot models
2. Help students self-assess their presentation plans to make sure they are including the important features of their robots as shown in the checklist.

9. Final Thoughts

SHARE With your classmates, discuss what you want to keep learning about this topic. Post your ideas for your ePals and remember to thank your ePals for sharing the Experience with you!

1. Take time to review the Experience and for students to assess what they learned about robots from their participation, as well as what else they would like to learn about this topic.