Bay Area Scientists in Schools
Presentation Plan

Lesson Name _____ Biological Inspired Robotics

Presenter(s) ___ Electrical Engineering Graduate Student Association Outreach @ UC Berkeley ___

Grade Level ___ K—5 targeting standards in 3. Can be slightly altered to be taught at a 6-8 level. ___

Standards Connection(s) ___ Biological inspiration in robotics design. Introduction to robotics. ___

Teaser:
Where are all the robots? TV, movies and the Internet would have us believe that robots that look like people should be here, now, doing everyday tasks like our laundry. But we don't see that in reality: in fact the "robots" most people think of don't exist because of the huge challenges of getting robots to do even simple tasks. In this module we have students modify vibrating "bug" toy robots to follow walls like real insects to foster a discussion about what robots are and what they can do. The robots provide a conceptual bridge highlighting connections between disparate science disciplines.

Objective: *As a result of your lesson, what will students learn? What will they be able to do?*
The students will develop a precise definition of robotics: "Something that is programmable, can take in sensory input, and can do work in the real world". They'll understand some of the basic tasks of robotic navigation, and how morphology (shape of animals) helps them perform particular tasks. They'll also learn how studying the natural world is connected to topics like robotics engineering.

Vocabulary/Definitions:
3 – 6 important (new) words
Robotics, bio-inspiration, mechanical adaptation, programmable, Inputs (ex. visual input, auditory input, human input),

Materials:
What will you bring with you?
Mini-robots, wires for modifying the robots, presentation material (projector required).

What should students have ready (pencils, paper, scissors)?
Heavy books or small boxes to build obstacles for the robots to navigate.

Classroom Set-up:
Student grouping, Power/Water, A/V, Light/Dark, set-up/clean-up time needed
Students should be in small groups of 1-3 with their desks pushed together. This provides a large surface for the mini-robots to run around and fosters a little collaboration/competition between teams striving to accomplish the wall-following task. A laptop projector is very useful.

Classroom Visit

1. Personal Introduction: _____5___ Minutes

Who are you? What do you want to share with students and why? How will you connect this with students' interests and experiences?

We'll introduce ourselves as engineers from Berkeley, talk about what we do as scientists and also talk a little bit about where we come from to help establish a more personal connection.

Topic Introduction: _____10____ Minutes

What questions will you ask to learn from students? Big Idea(s), vocabulary, assessing prior knowledge…

This module starts with a discussion of how students understand robots, and what is right and wrong about those ideas. In particular, we invite students to define robots themselves by coming up with examples ("Is a hammer a robot?" "Is Google a robot?"). This discussion is often pretty far reaching, because people are pretty excited about robotics, so plenty of time has been budgeted.

2. Learning Experience(s): ___30-40_ Minutes

What will you do, what will kids do? Demonstrations, hands-on activities, images, games, discussion, writing, measuring… Describe in order, including instructions to kids.

After this, mini-robots are introduced and a series of tasks for the mini-robots is set out. For instance, tie wire around a robots head to make it follow a wall on its left side, even around corners. Each student is given a mini-robot and a length of wire to experiment with while we circulate in the room and have one-on-one design discussions. There are many tasks available if students finish quickly.

3. Wrap-up: Sharing Experiences _____10___ Minutes

Putting the pieces together – how will students share learning, experience, build vocabulary?

Another class discussion at the end of class allows students to share what design principles they learned, what was challenging about the task. This is compared to state-of-the-art research, using videos if time.

4. Connections & Close: _____5____ Minutes

What else might kids relate this to from their real-life experience? How can they learn more?

Remind students to notice how form relates to function, both in the design of artificial objects as well as the number and shape of limbs and size of animals seen in nature.

Total 50 – 60 Minutes

Follow-up – After Presentation

Students pick an example of form relating to function. Examples abound around the house (pets, kitchen utensils) and outside (bugs; birds; construction equipment). They then write a note explaining that form and function of their object or animal. The project can be expanded to include researching animal adaptions. Particularly, classifying adaptations as *mechanical* (arising passively from form) or *behavioral* (arising from active decision-making).

List or attach *examples of activities, websites, connections for additional learning.*

Our website (http://www.eecs.berkeley.edu/~eegsa/or) has the robotics material we've produced. We purchase our robots from http://www.hexbug.com/nano/. Several TED talks (e.g. http://www.ted.com/talks/robert_full_on_animal_movement.html) discuss related themes.

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