SN EDUCATOR GUIDE

November 12, 2016

Spider Hearing and Robot Senses

About this Issue

This educator guide focuses on how animals and robots sense and respond to the world around them. The article "Jumping spider hears distant sounds" explores how organisms can sense sound, even if they don't have eardrums. After observing certain arachnids under various conditions and recording neuron activity, researchers report that the spiders hear a specific range of airborne sound wave frequencies from at least three meters away. Like spiders and other animals, learning robots will also have to qualitatively observe the world around them and make meaning from sensory inputs. The article "Robot awakening" explores technological advances in robot sensing. The guide touches on the physics of sound, the physiology of hearing and the relationships between animals and their prey. Students can focus on a particular phenomenon of interest or examine the cross-curricular intersections that emerge from animal behavior studies. Along with a main focus on the qualitative observations of animals, this guide also includes a short section focused on how robots are being programmed to collect sensory data to effectively interact with the world around them.

Connections to Curricula

- Qualitative observations
- Predator-prey relationships
- Sound waves and vibration
- Biomimicry
- Animal behavior
- Physiology of sound perception
- Experimental design
- Coding

What's in this Guide?

- **Article-Based Observation:** These questions focus on reading and content comprehension by drawing on information found in the article "Jumping spider hears distant sounds." Questions focus on animal behavior and the nature of experimental design and modification.
- **Quest Through the Archives:** With Internet access and your school's digital access to *Science News*, your students can use this short section to explore the history of robotics as reported by *Science News* since 1922. This quest is based on the article "Robot awakening."
- **Cross-Curricular Discussion:** The majority of these questions and extension prompts connect to the article "Jumping spider hears distant sounds" and encourage students to think about how animals sense the world, as well as the nature of sound as a wave. There are many different links to additional information, simulations and other teaching tools. Engineering and experimental design concepts are embedded in the extension prompts, and the section is subdivided roughly by subdiscipline for educators who would like to focus on one particular topic area. The extension prompts are either more topic specific or more conceptually advanced. Following the questions related to the spider article, there is a section about the article "Robot awakening" that focuses on the importance of robots being able to process sensory data. Prompts encourage students to think about how they might design a

robot to complete a task, and how they might incorporate biomimicry into their robot design. Students can also explore coding at their own pace.

- **Activities:** The activities explore how animals sense and respond to their world. In "What is this animal telling me" students use their observational skills to practice cataloging and analyzing animal behavior. This is followed by "You are the animal biologist," which asks students to design their own experiments based on an animal of their choosing.

Standards Alignment

Next Generation Science	Common Core
Waves and their Applications in Technologies for Information Transfer: HS-PS4-1, HS-PS4-3	ELA Standards: Reading Informational Text (RI): 1, 2, 7
From Molecules to Organisms: Structures and Processes: HS-LS1-2	ELA Standards: Writing (W): 2, 3, 6, 9
Ecosystems: Interactions, Energy and Dynamics: HS-LS2-2, HS-LS2-7, HS-LS2-8	ELA Standards: Speaking and Listening (SL): 1, 6
Earth and Human Activity: HS-ESS3-6	ELA Standards: Reading for Literacy in Science and Technical Subjects (RST): 1, 2, 4, 8, 9
Engineering Design: HS-ETS1-3	ELA Standards: Writing Literacy in History/Social Studies and Science and Technical Subjects (WHST): 2, 4, 6, 7, 9