UBTECH

EDUCATION

UNIT TWO TEACHER GUIDE

A Robot for Saving Wildlife

UNIT TWO TEACHER GUIDE | LESSON 1

Programming a Robot to Grab

DRIVING QUESTION

How do you program the Grabber robot to hold and release objects?

LEARNING GOALS

Students describe a hawk's body **SYSTEM** to identify **COMPONENTS**, including the structure of the hawk's beak and the **INTERACTIONS OF THOSE COMPONENTS**. Students envision the **INTERACTIONS OF SOME OF THOSE COMPONENTS**, including the hawk's beak, in terms of the function that they perform for the hawk.

Students use the structure and function of a hawk's beak to **DEFINE THE CRITERIA** for the robot program.

THINKING AS ENGINEERS, students construct, program, and test the Grabber robot to evaluate its success in meeting the **DESIGN CRITERIA** and brainstorm **IMPROVEMENTS**.

GETTING STARTED

Time Estimate

100 minutes (two 50-minute periods)

Materials for Each Group

- 1 UKIT and app interface–enabled device
- Student worksheets (pages 22–23 of this packet)

NOTE:
Make copies from the guide.

Lesson Resources

- "A Red-Shouldered Hawk" image
- "Comparing the Red-Shouldered Hawk and the Grabber Robot" table

Online Resources

https://www.audubon.org/field-guide/bird/red-shouldered-hawk
https://www.allaboutbirds.org/guide/Red-shouldered_Hawk/overview
https://www.nationalgeographic.com/animals/birds/r/red-shouldered-hawk/

Vocabulary

- talons
- beak
- grasp

BACKGROUND FOR THE TEACHER

Red-shouldered hawks hunt from perches within forests or along the edges of swamps, fields, and rivers. They use keen eyesight to spot prey. When they locate prey, the hawks launch from their perch, flying in a low dive to take their prey by surprise.

Red-shouldered hawks hunt small mammals, amphibians, reptiles, and small birds. Voles, mice, chipmunks, frogs, and toads comprise their main diet. They also eat snakes, large insects, and occasionally fish or crayfish. The features that the hawk uses to obtain food can be thought of as components in a system that work together to insure the survival of the bird.

5E LESSON PLAN

The 5E model is a five-stage sequence teachers can apply to lessons and units. Developed originally for the Biological Sciences Curriculum Study, the 5E model is supported by a growing research base and is a great fit for problem-based learning, project-based learning, and the Universal Design for Learning framework.

ENGAGE: Sparks student interest; creates a personal connection to the lesson; assesses prior knowledge

EXPLORE: Allows students to develop their own understanding of the topic

EXPLAIN: Offers students opportunities to share what they have learned and explore what it might mean

ELABORATE: Invites students to apply new knowledge and gauge the impact of that knowledge on prior understanding

EVALUATE: Provides time for students to reflect on the lesson; assesses student learning and understanding

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ENGAGE

Start with What Your Students Know: Ask students to tell what they know about how birds eat.

- What special **STRUCTURES** do birds use when eating? (Students might suggest structures such as beaks, eyes, and talons.)
- What is their **FUNCTION**? How do birds use them?
- What senses do you think birds use?
- How do you know? Where did you get the information that enabled you to answer these questions about birds?

Review the Unit Driving Question: How should a robot be designed to care for an orphaned red-shouldered hawk?

Explain that the structures of the birds that are involved in feeding may become part of a robot designed to care for an orphaned bird. **ENGINEERS IMPROVE EXISTING TECHNOLOGIES**, and in this Unit students will act as engineers to improve the function of the Grabber robot so that it can act in the place of a parent hawk.

Point out to students that they will need to learn about red-shouldered hawks and their young in order to answer the Unit's Driving Question, but their first challenge is to build and program the robot. Present the Driving Question: How do you program the Grabber robot to hold and release objects?

EXPLORE

NOTE:

Student should be in groups before they begin.

Each group should have a robot kit.

Build Your Robot: Ask students to follow the instructions in the app interface to construct the robot. Then ask them to connect their app interface–enabled device to the robot and run the robot's sample program. Once groups have all successfully constructed and tried their robots, ask students to **DISCUSS AND COMPARE THEIR OBSERVATIONS WITH OTHERS**.

- What types of objects could the Grabber robot pick up?
- How did the commands in the robot's program affect the robot's movement?

EXPLAIN

Strike Force: Remind students that now that they have explored the robot in action, they need to begin thinking about how the robot could be improved so that it can function in a rehabilitation center. Ways that the robot could be improved may be found by studying the red-shouldered hawk.

Develop and Use a Model: Provide students with a copy of "A Red-Shouldered Hawk" or project it onto a whiteboard for the entire class to see. You may wish to introduce the image to the students with the following script:

- Imagine that you are hiking in a field near some trees and spot a red-shouldered hawk sitting very still on a branch just on the edge of the meadow. The hawk is clearly looking around. It swivels its head back and forth and stares intently at the ground below. It's lunchtime and the hawk is looking for something good to eat. The hawk is especially good at catching prey found in a meadow or around a small pond. Think about the hawk's body. What parts of the hawk make it a good hunter in this habitat?

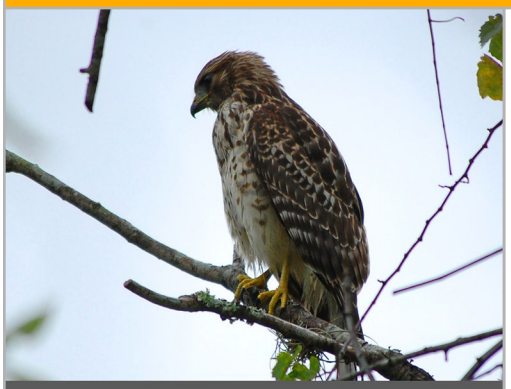
"Red Shouldered Hawk" by mbarrison.

Ask students to use the illustration as a **MODEL** of the hawk's body by adding callouts to identify the physical structures they see, such as the beak, eyes, talons, claws, feathers, and wings. Use a discussion to prompt students to think about the ways that they think the parts of the hawk work to find and grasp prey.

- How does the hawk use each **STRUCTURE**; what is its **FUNCTION**?
- How do these physical features work together, or **INTERACT**?
- Have you ever seen a hawk perched somewhere above the ground **(PATTERNS IN NATURE)**? What did you think the hawk was doing?
- How do birds like hawks catch their prey?
- What parts **(COMPONENTS)** of their bodies do they use when hunting?

Reason and Compile Evidence: Use a comparison between the hawk and the robot to prompt thinking that can support students when they develop design criteria for their robots. Ask students to compare the Grabber robot and the hawk using the table "Comparing the Red-Shouldered Hawk and the Grabber Robot."

Remind students to use their **OBSERVATIONS** of the robot as **EVIDENCE** to support their comparisons **(ARGUMENTS)**.

COMPARING THE RED-SHOULDERED HAWK AND THE GRABBER ROBOT	
 "Red Shouldered Hawk" by mbarrison.	Create a diagram of your Grabber robot.
How are the robot and the hawk the same?	How are the robot and the hawk different?

As students work to compare the robot and the hawk you may wish to use discussion questions to prompt their thinking:

- How does the **SIZE** of the Grabber robot compare to the size of the red-shouldered hawk?
- What is the **SIZE** of the robot's jaws, and how do they compare to the size of the bird's beak?
- How might the **SIZE** or shape of the bird's beak help it to grasp its prey?

ELABORATE

Investigation Plan: Ask students how birds feed their young when they are still nestlings:

- What body parts and senses do birds **USE** when feeding their young?

Identify Criteria: Explain that **ENGINEERS** use criteria to judge the success of their designs. Remind students that the Unit Driving Question is "How should a robot be designed to care for an orphaned red-shouldered hawk?"

Since students are trying to design a robot to care for orphaned birds, they should think about the way a hawk feeds its young. Then they can identify structures and functions that should be included in their robot design. That list of structures and functions is a set of **DESIGN CRITERIA**. Display a copy of the "Comparing the Red-Shouldered Hawk and the Grabber Robot" list that students created to compare the Grabber robot with the hawk. Ask:

- What **STRUCTURES** would a robot need to feed a young hawk, and how do they **FUNCTION**?
- How would they work together as part of a **SYSTEM**?
- What structures or functions should be included in a robot designed to feed orphaned birds?
- Which structures or functions are already part of the robot?
- Which structures or functions do you think you might need to build to improve the robot?

Create a class list labeled "Criteria" and retain that list for reference in Lessons 2–4. You may want to add notes to indicate which criteria students see as priorities for future designs.

EVALUATE

Ask questions such as the following to evaluate students' understanding of the Lesson goals:

- Name an external structure of the hawk.
- Write a sentence to explain the function of the structure you chose.
- Write a sentence or two to explain how the Grabber robot's structures and function compare to the hawk's.

LESSON 1 SAMPLE RUBRIC

THE ANSWERS DISPLAY ...	EXCELLENT UNDERSTANDING	GOOD UNDERSTANDING	LIMITED UNDERSTANDING
The student response exhibits the following aspects:	The response identifies external structures of the hawk (i.e., beaks, talons, eyes, or wings) and accurately connects those structures to a function (i.e., tearing, holding, seeing, flying). The response identifies structures on the Grabber robot, describes the function of those structures, and makes a comparison between the robot structures and the structures of the hawk.	The response identifies structures in the robot and the hawk. The response describes the function of at least one of the structures of the hawk and of the robot. The response identifies at least one similarity or difference in the structures and functions of the hawk and the robot.	The response does not clearly describe a connection between the structures and functions of the hawk or the robot. The response does not identify either a similarity or difference between the structure and functions of the hawk and the robot.

GUIDING THE INVESTIGATION

During instruction, student performances should include more crosscutting concepts and practices than those emphasized in the below Next Generation Science Standards (NGSS) Connections table and Learning Goals. The following tables summarize the additional concepts and practices incorporated during the 5E Lesson Plan.

NGSS ELEMENTS DEVELOPED IN THIS LESSON

NGSS CONNECTIONS	
4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.	**3-5-ETS1-1** Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

ENGAGING IN ARGUMENT FROM EVIDENCE	ASKING QUESTIONS AND DEFINING PROBLEMS
Construct an argument with evidence, data, and/or a model. (4-LS1-1)	**Define a simple design problem that can be solved through the development of an object, tool,** process, or system **and includes several criteria for success** and constraints on materials, time, or cost. (3-5-ETS1-1)

LS1.A: STRUCTURE AND FUNCTION	ETS1.A: DEFINING AND DELIMITING ENGINEERING PROBLEMS
Plants and **animals have** both internal and **external structures that serve various functions in** growth, **survival**, behavior, and reproduction. (4-LS1-1)	Possible solutions to a problem are limited by available materials and resources (constraints). **The success of a designed solution is determined by considering the desired features of a solution (criteria).** Different proposals for solutions can be compared on the basis of how well each one meets the specified criteria for success or how well each takes the constraints into account. (3-5-ETS1-1)

SYSTEMS AND SYSTEM MODELS	CONNECTIONS TO ENGINEERING, TECHNOLOGY, AND APPLICATIONS OF SCIENCE INFLUENCE OF SCIENCE, ENGINEERING, AND TECHNOLOGY ON SOCIETY AND THE NATURAL WORLD
A system can be described in terms of its components and their interactions. (4-LS1-1), (4-LS1-2)	People's needs and wants change over time, as do their demands for new and improved technologies. **Engineers improve existing technologies.** (3-5-ETS1-1)

Bolded elements are intentionally developed in the Lesson; overlapping elements may be developed as well (for example, see Guiding the Investigation above).

USING ADDITIONAL SCIENCE AND ENGINEERING PRACTICES*

SCIENCE AND ENGINEERING PRACTICE (SEP)	USE IN THIS LESSON (IN ADDITION TO THOSE LISTED ABOVE)
Developing and Using Models	Ask students to use the graphic as a **MODEL** of the hawk's body by adding callouts to identify physical structures they see, such as the beak, eyes, talons, claws, feathers, and wings.
	Suggest that this idea might be useful in a later Lesson when the students are **DESIGNING A MODEL** of the hawk to feed its young.
Planning and Carrying Out Investigations	Once groups have all successfully constructed and tried their robots, ask students to **DISCUSS AND COMPARE THEIR OBSERVATIONS WITH OTHERS**.
	Have students **MAKE CAREFUL OBSERVATIONS** and list them in a chart with the heading "Alike and Different."
	Ask them to review their lists and **SEEK IDEAS AND INFORMATION FROM OTHERS** about what features a robot would need to have to grab and hold the prey, so they can feed their young.
Obtaining, Evaluating, and Communicating Information	Use follow-up questions to prompt students to **SHARE THEIR SCIENTIFIC UNDERSTANDING** of how hawks hunt for food.

USING ADDITIONAL CROSSCUTTING CONCEPTS*

CROSSCUTTING CONCEPT (CCC)	USE IN THIS LESSON (IN ADDITION TO THOSE LISTED ABOVE)
Patterns	Have you ever seen a hawk sitting on a fencepost on the side of the road **(PATTERNS IN NATURE)**? What do you think the hawk is looking for as it sits on the post?
Scale, Proportion, and Quantity	How does the **SIZE** of the Grabber robot compare to the size of the red-shouldered hawk?
	What is the **SIZE** of the robot's jaws, and how do they compare to the size of the bird's beak?
	How might the **SIZE** or shape of the bird's beak help it to grasp its prey?
Systems and System Models	How do birds like hawks catch their prey? What parts **(COMPONENTS)** of their bodies do they use when hunting?
	How would they work together as part of a **SYSTEM**?
Structure and Function	What special **STRUCTURES** do birds use when eating? (Students might suggest structures such as beaks, eyes, and talons.)
	What is their **FUNCTION**? How do they use them?
	How does the hawk use each **STRUCTURE**; what is its **FUNCTION**?
	What body parts and senses do birds **USE** when feeding their young?

* See Appendixes F and G of the NGSS, 2013.

Organizing Group Work: When students work in groups to build the robot (there are usually four to a group), you might find it useful to assign different roles to the group's members. For example, one member could assemble the parts needed, one could build the body of the hawk, and another could build the jaws. Still another could be responsible for programming the robot. In this way, everyone has a defined role to play with specific responsibilities to the investigation and to their group members. However, all students should be involved in trying the robot and have experience with grabbing, holding, and releasing things with it.

NAME _____ DATE _____

DRIVING QUESTION

How do you program the Grabber robot to hold and release objects?

INTRODUCTION

Each different type of bird feeds itself in its own way. Robins hop around the lawn and dig up worms. Chickens peck the ground for seeds and insects. Pelicans dive into ocean waters to catch fish. In this Lesson, you will think about the ways red-shouldered hawks capture their prey. You will also program a robot to grab things like a hawk.

SAFETY REMINDERS

Be sure to keep your Grabber robot away from your face.

MATERIALS LIST

- UKIT and app interface–enabled device

ACTIVITY PROCEDURE

1. Discuss with your class what you know about how hawks hunt for their food. Then work in groups to construct a robot that grasps objects like a hawk grabbing its prey.
2. To construct the robot, follow your teacher's directions to open the app. Then follow the directions in the app to construct the Grabber robot.
3. Try to make the Grabber robot grab three objects.
4. Follow your teacher's directions to compare how the robot and the hawk are alike and different.

NAME _____ DATE _____

DATA TABLE

COMPARING THE RED-SHOULDERED HAWK AND THE GRABBER ROBOT	
 "Red Shouldered Hawk" by mbarrison.	Create a diagram of your Grabber robot.
How are the robot and the hawk the same?	How are the robot and the hawk different?