UBTECH

EDUCATION

BEGINNER KIT

A Robot for Saving Wildlife

INTERACTIVE TEACHER GUIDE

UBTECHEDUCATION.COM

UNIT SEQUENCE 13-19 sessions (60 minutes each)

LESSON	DRIVING QUESTION	DESCRIPTION
UNIT INTRODUCTION 1 session (60 minutes)	How could a robot be designed to care for an orphaned red-shouldered hawk?	Students think about the needs of an orphaned red-shouldered hawk. They will discuss the driving question and learn about the design challenge for the unit.
LESSON 1: PROGRAMMING A ROBOT TO GRAB 3-4 sessions (60 minutes each)	How is the Grabber robot like a red-shouldered hawk? How is it different?	After sharing their prior knowledge about birds, students build the Grabber robot and observe its movement. Students then learn about the red-shouldered hawk and compare it to the Grabber robot. These observations assist students in determining the criteria needed for a future redesign of the robot.
LESSON 2: DESIGNING A ROBOT TO GRASP PREY LIKE A HAWK 3-4 sessions (60 minutes each)	How could you modify the Grabber robot to hold and release objects that are like the food hawks eat?	Students spend time researching how the red-shouldered hawk hunts and eats its prey. They then use this information to revise their design challenge criteria before testing and redesigning the Grabber robot.
LESSON 3: DEFINING SUCCESS FOR A ROBOT DESIGN 2-3 sessions (60 minutes each)	How has your redesigned robot evolved as you have learned about red-shouldered hawks?	Students learn about the life cycle and reproduction stages of the red-shouldered hawk. Students use this information to define the design criteria of a robot that will work in a wildlife rehabilitation center.
LESSON 4: BUILDING AND SELECTING A ROBOT FOR WILDLIFE REHABILITATION 3-6 sessions (60 minutes each)	Did your redesigned robot meet the design challenge's criteria and constraints?	Students construct and test a redesigned robot based on class created criteria and constraints. They then compare similar design solutions.
UNIT WRAP-UP/ ASSESSMENT 1 session (60 minutes)	How could a robot be designed to care for an orphaned red-shouldered hawk?	Students answer the driving question using the experiences they have had throughout this unit.

LESSON 1

Programming a Robot to Grab

DRIVING QUESTION

How is the Grabber robot like a red-shouldered hawk? How is it different?

DESCRIPTION

After sharing their prior knowledge about birds, students build the Grabber robot and observe its movement. Students then learn about the red-shouldered hawk and compare it to the Grabber robot. These observations assist students in determining the criteria needed for a future redesign of the robot.

LEARNING GOALS

STUDENTS WILL:

- **IDENTIFY** structures of a bird.
- **CONSTRUCT** and **TEST** the Grabber robot using an example program.
- **COMPARE** and **CONTRAST** the Grabber robot to a red-shouldered hawk.
- **USE** the structure and function of a hawk's beak to **DEFINE** the criteria needed for a redesign of the robot.
- **BRAINSTORM** improvements to the robot.

STANDARDS
3-LS2-1
4-LS1-1
4-LS1-2
5-ESS3-1
3-5-ETS1-1

GETTING STARTED

TIME ESTIMATE

3-4 sessions (60 minutes each)

MATERIALS

- UKIT Beginner
- 1 Bluetooth-enabled device with the uKit EDU app installed

LESSON RESOURCES

- A Robot for Saving Wildlife Interactive Student Notebook
- Unit Vocabulary
- Optional:
  - "12 Excellent Wildlife Rehab Centers in the U.S."
  - "How to find a wildlife rehabilitator"
  - "What is Wildlife Rehabilitation?"

- Explore Activity
- A Red-Shouldered Hawk
- "Red Shouldered Hawk: Call Sounds & Activities"
- Comparison Table
- Engineering Design Process
- Engineering Design Log
- Engineering Design Challenge

VOCABULARY

CRITERIA	specific outcomes for a project
ENGINEERING DESIGN PROCESS	a series of steps that can be followed to solve a problem, steps can be repeated as many times as needed with improvements being made along the way (iterative process)
FUNCTION	the special purpose or activity for which a thing exists or is used
PREY	an animal that is hunted or killed by another animal for food
PROGRAM	a sequence of coded instructions that can be used by a computer or machine to complete a task
REHABILITATION CENTER	a place where injured, orphaned, or sick wild animals can be treated and cared for so that they can be released back into the wild
STRUCTURE	the manner in which something is built, arranged, or organized
SYSTEM	a regularly interacting or interdependent group of items forming a unified whole

TEACHER PREP

- Review the lesson resources listed and decide how to distribute these to students either digitally or in print, if applicable.
- Review the Evaluate section for this lesson and consider how students will be assessed. This will determine the need to print assessment materials or provide additional materials for students to record their responses.
- Ensure available devices have the uKit EDU app installed with the UKIT Beginner curriculum downloaded.
- Determine student groups of four for this unit. Ideally, students would stay in the same groups throughout this unit as they will share the same UKIT and redesign together.
- If time permits, build the Grabber robot so you know what is expected of your students. This will also allow you to better assist them as they build.

  Note: *Students will continue to use the Grabber robot in the remaining lessons. To save on time, the robot should be kept intact until students are directed to redesign it in Lesson 4.*

5E LESSON PLAN

ENGAGE

In this unit, students are going to learn about the habitat, life cycle, and feeding habits of the red-shouldered hawk. They are then going to use this information to redesign a robot that could take the place of a parent hawk, if needed, in a rehabilitation center.

Ask the students if they have ever seen a baby bird on its own, maybe in its nest or outside of the nest. Do they think the baby bird can survive on its own in the early stages of life? What are things that the parents do for the babies until they are on their own? What would happen to a baby bird if the parents were no longer around?

Explain to students that in some situations, animals can be taken to **REHABILITATION CENTERS** to be taken care of until they are able to take care of themselves. Take some time to share information about rehabilitation centers in your area. You can also refer to this list of centers across the U.S., find centers relevant to your state through The Humane Society of the United States, or share information from the National Wildlife Rehabilitators Association resource.

If time permits, have students work collaboratively in groups to gather information that explains the work of wildlife rehabilitators. Suggest that they begin with the Humane Society website to learn about the wildlife rescue organizations in their state. Have them identify and share their sources of information with the class. Ask questions such as the following to guide students' research:

- How do wildlife centers help orphaned birds?
- What is the goal of the treatment they provide?
- How do wildlife centers treat animals so that they can be released back into the wild?
- What do wildlife rehabilitators feed orphaned hawks?

Share with students that birds have many internal and external **STRUCTURES** that **FUNCTION** to support its survival, growth, behavior, and reproduction. These structures work together as a **SYSTEM** to keep the bird alive.

Gauge what students know about how birds eat using the following questions:

- What special structures do birds use when eating? Students might suggest structures such as beaks, eyes, and talons.
- What is the function of each of those structures? How do birds use them?
- What senses do you think birds use?
- How do these senses help the birds?

Review the unit's driving question and the design challenge with students:

- "How could a robot be designed to care for an orphaned red-shouldered hawk?"
- **The Challenge:** You have been contacted by the Flying High Bird Rehabilitation Center. The center has a red-shouldered hawk nestling that needs to be fed before it can be returned to the wild. The center wants to use a robot that will mimic the appearance and behavior of a parent bird. How would you design a robot to meet this need?

Share with students that the various structures of the bird that are involved in feeding will need to be considered in their robot designs.

You can also point out that engineers work to 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.

Tell students that while they will need to learn about red-shouldered hawks and their young in order to answer the unit's driving question, their first challenge is to build and program the Grabber robot.

EXPLORE

Split students into groups of four, ensuring that each group has a UKIT Beginner set and a copy of the Explore Activity resource. Walk students through how to open the uKit EDU app, select the UKIT Beginner curriculum, and find the Grabber robot. Show students the features of the building environment shown on the Intro to uKit EDU App resource. When students feel comfortable with the app, direct them to follow the build instructions to construct the robot.

Note: *When students work in groups to build the robot, you might find it useful to assign different roles to the group's members. For example, one member could gather the parts needed for this build, one could build the base, and another could build the grabber portion. Still another could be responsible for programming the robot.*

Assigning roles ensures 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 objects with it.

Show students how to connect their device to the robot and run the robot's example **PROGRAM**. Refer to the Connecting Your Device and Accessing an Example Program resource for instructions on how to do this.

Once groups have all successfully constructed their robots and seen it in action, ask students to discuss and compare their observations with others using the following questions:

- What types of objects do you think the Grabber robot could pick up?
- Is there anything about the robot or the environment that could affect what it could pick up?
- Can you explain the blocks used in the example program?
- How did the commands in the robot's program affect the robot's movement?

EXPLAIN

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 as a stand-in for a parent hawk. Ways that the robot could be improved may be found by studying the red-shouldered hawk.

Provide students with a copy of A Red-Shouldered Hawk or project it for the entire class to see. Ask students what details they can point out just by looking at the picture. The following script can be read while students look at the image:

"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?"

Additionally, you could share this video showing the red-shouldered hawk in daily life. Ask students to share their observations of the birds. Can they see how structures of the bird function? Can they see the birds using their senses?

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 the function of each of those?
- How do these physical features work together, or interact?
- What internal structures do birds use in addition to their external structures to eat, hunt, fly, etc.?
- Have you ever seen a hawk perched somewhere above the ground? What did you think the hawk was doing?
- How do birds like hawks catch their prey?
- What parts of their bodies do they use when hunting?

Ask students to compare the Grabber robot and the hawk using this Comparison Table. Remind students to use their observations of the robot as evidence to support their comparisons.

As students work to compare the robot and the hawk you may wish to use discussion questions such as these:

- How does the size of the Grabber robot compare to the size of the red-shouldered hawk?
- What structure of the hawk is the Grabber robot most like? Students should mention the talons/claws or beak. The remaining questions can be asked for both structures.
- 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

Explain that engineers use **CRITERIA** to judge the success of their designs. These designs are often created through the use of a cyclical/iterative process like the **ENGINEERING DESIGN PROCESS**. Show students this engineering design loop and discuss the steps shown. The Engineering Design Log might also be useful for students as they work through this unit.

Share the Engineering Design Challenge resource and remind students of the unit's driving question, "How should a robot be designed to care for an orphaned red-shouldered hawk?", so they can add it to the resource as their focus for the design challenge.

Display a copy of the Comparison Table resource that students used earlier in the lesson. Ask the following questions:

- 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 of criteria for the design challenge based on what students have learned in this lesson and retain it for reference in the remaining lessons. You may want to add notes to indicate which criteria students see as priorities for future designs.

While the Engineering Design Challenge resource has a place for students to add in this information, you might want them to hold off until Lesson 2 as they will revise the criteria upon further research of the animal.

EVALUATE

Use the following to evaluate student's understanding of concepts covered in this lesson:

- 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.

Informal Assessment Ideas

- Observation
  - Student groups built and successfully tested the Grabber robot.
  - Students were active participants during the hands-on activities and contributed to all class or group discussions.
- Self-Assessment Rubric
  - Ask students to rate the following:
    - Participation in discussions and activities
    - Understanding of science content
    - Confidence level building the Grabber robot
    - Understanding of the example code and the uKit EDU app

Formal Assessment Ideas

- Written Response Rubric
  - Score written responses to questions posed in this lesson using a rubric. Consider focusing on the driving question, science content, and/or learning goals for this lesson.
- Lesson 1 Rubric
  - Use the linked rubric to determine student understanding of the concepts covered in this lesson.

DIFFERENTIATION

SIMPLIFY THIS LESSON

- Create the criteria for the design challenge prior to teaching this lesson.
- Vocabulary can be presented and taught prior to teaching the lesson.

TAKE THIS LESSON TO THE NEXT LEVEL

- Have students with block-coding experience create their own program as opposed to using the example one provided.

CROSS-CURRICULAR EXTENSIONS

MATH/CODING

- Spend time looking at the example program and what numbers are involved in the blocks that are used. Are there limits to be considered?

SCIENCE

- Additional content could be added to cover additional concepts such as but not limited to: flight, speed, height, environment, gravity, and food chains.

STANDARDS

NGSS STANDARD	DESCRIPTION	LESSON(S) COVERED 1	2	3	4
3-LS2-1	Construct an argument that some animals form groups that help members survive.	X			
4-LS1-1	Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.	X	X		
4-LS1-2	Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.	X		X	
5-ESS3-1	Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.	X		X	
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.	X	X	X	X
3-PS2-1	Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.		X		
3-PS2-2	Make observations and/or measurements of an object's motion to provide evidence that a pattern can be used to predict future motion.		X		
3-LS4-3	Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.		X		
5-LS2-1	Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.		X		
5-PS2-1	Support an argument that the gravitational force exerted by Earth on objects is directed down.		X		
3-5-ETS1-3	Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.		X		X
3-5-ETS1-2	Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.		X	X	X
3-LS1-1	Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, and death.			X	
3-LS3-2	Use evidence to support the explanation that traits can be influenced by the environment.			X	
3-LS4-2	Use evidence to construct an explanation for how the variations in characteristics among individuals of the same species may provide advantages in surviving, finding mates, and reproducing.			X	