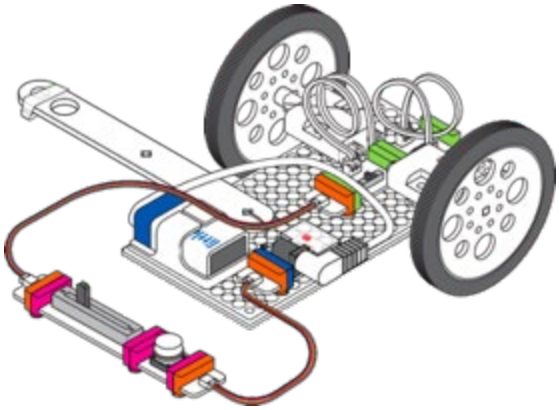
littleBits education

LESSON

Busy Bees



Overview

In this lesson, students will:

- Use a model to demonstrate the relationship between insects and plant reproduction in nature.
- Use littleBits to engineer a self-propelled robotic bee to address the effects of a declining honeybee population.

THE CHALLENGE

Design your own robotic Beebot that can transfer pollen from one flower to another.

Lesson Tags

BUSY BEES

GRADE LEVEL:

Elementary (grade 4)

SUBJECTS:

Science, technology, engineering

DIFFICULTY:

Beginner

DURATION:

60 minutes

PREREQUISITE KNOWLEDGE:

- littleBits basics
- Basic understanding of pollinators and plant reproduction

Supplies

Bits:

- STEAM Student Set (power, button, slide dimmer, 2 DC motors, 2 wires, battery and cable, battery clip, mechanical arm, 2 wheels, 2 magnet shoes and mounting board)

Tools Used:

- Pen/pencil
- Scissors
- Tape
- Markers
- Twist tie

Other Materials:

- 3 inch bar magnet
- 6-8 small paper clips
- Paper, cut to 5” x 7”

Description

LESSON OUTLINE:

INTRO: Introduce the lesson prompt and assess students’ current knowledge.

CREATE: Groups of 2-3 students start to build their Beebot inventions.

PLAY: Students test their prototypes to make sure that it works and then test out their pollination model.

REMIX: Consider how the model would need to change for non-flowering plants.

SHARE: Share out ideas.

ASSESSMENT STRATEGIES:

FORMATIVE ASSESSMENT Circulate the classroom as students work, assessing their use of the Bits, teamwork, and any other relevant skills you wish to focus on. Depending on students' level of experience, you might look for students putting Bits together backwards (e.g. trying to force them together and not aligning the right sides and getting a magnetic snap), students not adding a power source etc.

SUMMATIVE ASSESSMENT Students should complete the student handout. You may choose whether this is an individual or group submission.

Standards

NGSS

4-LS-1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

CPALMS

SC.4.L.16.1 Identify processes of sexual reproduction in flowering plants, including pollination, fertilization (seed production), seed dispersal, and germination.

SC.4.L.16.4 Compare and contrast the major stages in the life cycles of Florida plants and animals, such as those that undergo incomplete and complete metamorphosis, and flowering and nonflowering seed-bearing plants.

Vocabulary

Pollinator Stamen Pistil

Resources

ATTACHMENTS

Busy Bees: Student Handout

SUPPORTING LINKS

National Geographic: Tiny, Robotic Bees Could Change the World

National Resource Defense Council, 8 Ways to Attract Bees

TIPS & TRICKS

#1:Keep an eye on the clock, and where students are at. Some students will want to spend too much time in the Create stage, and some students will try to speed through it.

#2: We occasionally update our Bits and accessories, so some of the names and images included in the student handout may look different from those in your STEAM Student Set. Use your Invention Guide from within your Kit to support students with the parts that they have accessible to them. Use a rubber band or glue dots if you don't have a battery clip in your Kit. The invention will function the same!

PACING (60 mins)

Prep + Setup

Intro (10 mins)

Create (20 mins)

Play (10 mins)

Remix (10 mins)

Share (5 mins)

Close (5 mins)

Instructional Steps

Step 1: SETUP

DURATION: 10 minutes (prior to class)

This lesson can be done individually or in small groups (2-3 students). Each group will need one STEAM Student Set and a lesson handout. Set up a central location in the classroom for assorted materials and tools. Each group will need a large amount of floor space to test their robots, preferably without carpet and free from obstacles. Consider making arrangements for students to complete this challenge in a hallway, gym, or similar space.

Each group will need a power, button, slide dimmer, 2 DC motors, 2 wires, battery and cable, battery clip, mechanical arm, 2 wheels, 2 magnet shoes and mounting board. If you don't have a battery clip in your kit, use tape, glue dots or elastic bands to secure the battery to the board. Younger students can start out with just these materials, so they aren't overwhelmed and don't try to add unnecessary Bits. Older/more confident students can have access to any Bits in their Kits.

NOTES

- You should use a classroom timer or digital timer to help keep students on track.

Step 2: INTRODUCE

DURATION: 10 minutes

Discussion

Elicit student responses to gauge understanding and warm-up for the activity.

1. Begin by asking students to describe the relationship between honeybees and flowers. How are they connected?
    a. Answers may include: Bees transfer pollen from the stamen to a pistil so that seeds will form and grow new flowers. In turn, the flowers make nectar that feeds the bees.
2. Many farmers and orchard owners are facing declining populations of honeybees. Using what you know about flowers and bees, what do you predict might happen to their crops and orchards?
    a. Answers include: With fewer honeybees, flowers will have fewer pollinators and therefore the crops and orchards will produce fewer seeds. This will result in fewer fruits and vegetables, perhaps leading to food shortages and higher grocery prices.
    b. FACILITATOR TIP: If students are interested in the declining population of honeybees suggest that they find out why the population is declining and share out a presentation in class!
3. Explain that scientists have engineered robotic bees that fly in groups to pollinate flowers. These robots are used in areas that are suffering from a lack of pollinating insects, or where the conditions are hazardous to the health of insects.

Introduce the Challenge

Explain that they'll use littleBits and the littleBits Invention Cycle to create a model of a robotic "Beebot" that can transfer pollen from one flower to another (pollination), thereby allowing new seeds to grow and produce fruit. The activity will be broken up into the following steps:

CREATE: Build your model following the directions given.

PLAY: Test your circuit to see how well it works and then test out their pollination model.

REMIX: Consider how the model would need to change for non-flowering plants.

SHARE: Share out your ideas.

Divide the class into groups of 2-3 and have them set up their workstations. Before handing out the instructions:

Writing Box #1: What features will we need to include in our pollination model if we want to show how new seeds are formed in a flowering plant?

Answers include: pollen, stamen, pistil, pollinators (the bee), flowers with brightly colored petals, nectar.

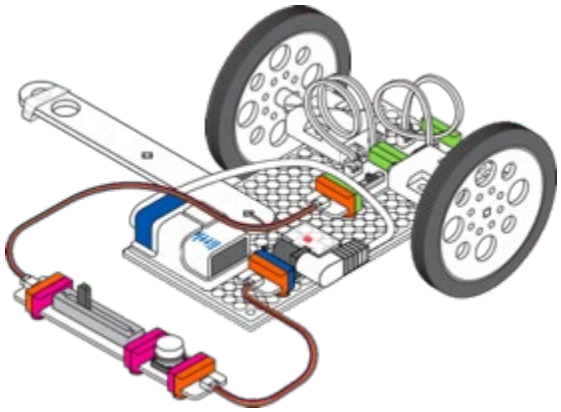
Step 3: CREATE

DURATION: 20 minutes

Students will follow the instructions and diagrams in the student handout to build their Beebots.

NOTES

- If students need a little extra help getting started, reference the Bit Index in their STEAM Student Set Invention Guide or the littleBits website to learn how specific Bits work.
- The Create phase may take more or less time, depending on the group and students' familiarity with littleBits. You may want to give students guidance on what they should do after assembling their circuit (e.g. move on to the Play phase to test their circuit), so they can self-pace.



Step 4: PLAY

DURATION: 10 minutes

Test your invention!

Power on your circuit. Push the button and move the slide dimmer. Your Beebot should move forward in a straight line. If it's moving in a circle, check to make sure that one DC motor is set to CW and the other is set to CCW.

Setting the Stage

Students will follow the directions in their handout to set up the two flower drawings. It may take a few tries for students to transfer the pollen. Make sure students are taking turns driving the Beebot.

Step 5: REMIX

DURATION: 10 mins

Writing Box #2: Ask students, “How does our model help us understand the adaptations of a honeybee? What does it tell us about the relationship between honeybees and flowering plants?” Have students sketch and label their ideas.

> Answers include: Bees have special features that help them survive. For example, a bee’s wings allow it to fly so it can find food, and our Beebot can move from flower to flower. Bees have special hairs on their legs and abdomen that attract pollen, similar to the magnetic arm of our Beebot. Our Beebot can also pick up pollen at one location and move it to another location, which helps us understand how new seeds form on flowering plants.

Writing Box #3: Imagine that we wanted to model how new seeds form in a pine tree instead of a flowering plant. Pine trees do not need help from insect pollinators, like bees, to reproduce. Instead, their seeds are carried by the wind. How would we need to change our model to help the pine trees reproduce?

> Answers include: The pollen is not carried by an insect pollinator,so our model wouldn’t need to move. Pollen from the male cone fertilizes eggs in the female cone on the same tree, so our model would need to show how pollen might be moved from one cone to another. One idea might be to use a fan in the circuit to represent the wind blowing through the pine tree.

Step 6: SHARE

DURATION: 5 mins

If time, ask students to share out their ideas from Writing Box #3.

Step 7: CLOSE

DURATION: 5 mins

Students should take apart their inventions and put away the Bits according to the diagram on theback of the Invention Guide. Students should clean up their workspace and return any usable materials/tools.

Step 8: EXTENSIONS

Consider the following invention or discussion prompts:

- Add a new feature that would help a farmer collect data on how many of his plants are being pollinated. Attach the number Bit to the second DC motor and set the Bit to “count up” mode.
- Engineer a remote Beebot that you control with a flashlight. Replace the slide dimmer + button with the light sensor Bit.
- Compete against other teams to engineer a more efficient Beebot. How could you maximize the amount of pollen that is transferred, while increasing the number of flowers that are pollinated in a given amount of time?
- Give your Beebot a body or form. Give it some character!