Dancing Birds: Science

Lesson At-A-Glance

Lesson Overview

The students will expand on and reinforce learning from the existing **We**Do™ Activity Pack by investigating various simple machines that work together to make the Dancing Birds spin. The students will take this knowledge into their community, find examples of simple machines, and explore the ways in which they are used in daily life.

Learning Outcomes

- Define and discuss *work* using grade-appropriate scientific terms.
- Demonstrate understanding that simple machines have been invented as tools and techniques (ways of doing something) to solve problems.
- Identify and classify simple machines (pulleys, gears, wheel and axles) that are being used in everyday life.

LEGO® Education WeDo™ Materials

- Completed LEGO® Dancing Birds model
- "Make It Work" worksheet
- Dancing Birds Science Rubric
- "Dancing Birds Elements Inventory" tracking sheet
- "My Program" tracking sheet
- LEGO Education **We**Do Software

Cross-Curricular Connections

- Literacy
- Visual Arts

Suggested Other Materials

- Large poster paper
- Magic markers
- Clipboards (for students to use as they search for simple machines around the school)

Suggested LEGO Elements

- LEGO Education **We**Do Construction Set 979580
- LEGO Sceneries Set 779385 (optional)
- Assorted LEGO bricks (optional)

Suggested Programming Blocks Used

- Start
- Motor Power

Estimated Completion Time

(2.25 hours + Extension)

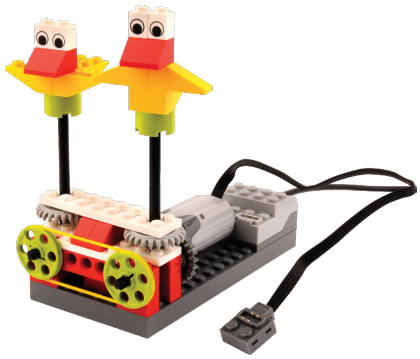
- Part 1: 30 minutes
- Part 2: 30 minutes
- Part 3: 45 minutes
- Part 4: 30 minutes

Student Organization

- Part 1: Small groups, Class
- Part 2: Partners
- Part 3: Partners, Individual, Class
- Part 4: Partners, Individual

Assessment Suggestions

- Completed "Make It Work" worksheet
- Reflective journal entry
- Interview about the experience



Vocabulary

- force
- diameter
- machine
- wheel
- work
- motion
- gear
- axle
- belt
- pulley

Connect (Part 1 – 30 minutes)

Divide the class into groups of three to four students.

Have the students create a "graffiti wall" of all the words, ideas, or images they associate with the word *work*. Post several pieces of paper on the walls around the room, each with the word *WORK* written in large capital letters at the center of the page.

Have each group line up at their piece of paper and take turns, one after the other, stepping forward to write an idea before passing the marker to the next individual in line.

Tell the students that they will have five minutes to add as many ideas, words, or images to the wall as they can. Only one student may use the marker at a time, but other students in line may contribute suggestions if the student with the marker needs some help.

When the time is up, have each group share their ideas of work with the class. After each group presents, go to the graffiti wall and circle any contributions that may be associated with the scientific concept of work (when force moves an object). *Force* is another word for power or energy.

Guiding Questions:

- What do all of the circled ideas have in common?

Tell the class that today they will be learning about the scientific definition of *work*, which is different from the general way we think about work in everyday life. In science, work does not mean a job you do to make money, nor does it mean the activities you do in class to learn something new.

Provide the scientific definition of *work* and have the students stand up at their desks to act out different types of scientific work.

Guiding Questions:

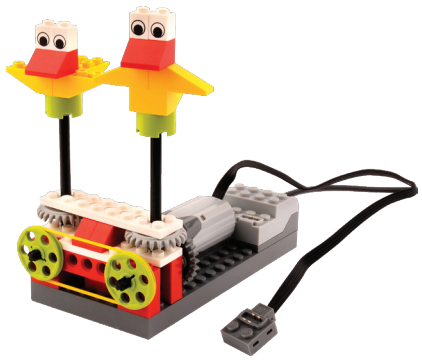
- Think about the scientific meaning of work.
- Work is when force moves an object. What actions do you think force includes? (push and pull).
- What is an example of this kind of work that we do every day? (e.g., pick up a book, push open a door, use force to brush your teeth by pushing and pulling a toothbrush)

As ideas are presented, act out the motions of the activities that could be defined as work and highlight the reasons why these actions can be included in the scientific definition of the word.

Hints:

- Define key vocabulary on a large piece of poster paper for future reference.
- This activity can also be completed by a group of students as a mind map either on the floor or at a group of desks.
- The graffiti wall is also a great way to review vocabulary and content knowledge in all subject areas.
- Other important word definitions to mention are *position* (the place where an object is) and *motion* (another word for movement).

Construct (Part 2 – 30 minutes)



Tell the students that today they will be learning about simple machines (tools to make work easier by using less force). They will be using their Dancing Birds model to learn about three similar types of simple machines.

Divide the class into pairs. Give each pair time to assemble their Dancing Birds model and walk them step-by-step through the basic Dancing Birds program. Observe the model on a low speed and discuss the questions below as a class.

Discussion Questions:

- What is the work being done on this model? (The birds are rotating or moving around in a circle.)
- Where is the force coming from? (The computer is providing the energy and using the motor to move the parts.)
- Where does motion happen on the Dancing Birds model?
- Which LEGO® elements on the model are moving? (Gears, wheels, axles of different sizes, and the belt are moving.)

Have the students shut down the **We**Do™ software and remove the hub and motor from the model.

Guiding Questions:

- Now that we have taken away the force (from the computer and the motor), how can we make our Dancing Birds work?
- Is there another way we can use force to make the model move?
- Is there something in the **We**Do Elements Set that can help us?

Give the students a few moments to experiment. Demonstrate how to use a gray axle or beige connector peg with axle to insert into one of the gray 24-tooth gears as a handle to push and pull, turning the gear just as the motor did.

Define the following kinds of simple machines and have students find them on the Dancing Birds model.

- Wheel and axle – a wheel connected to an axle
- Gear (modified wheel) and axle – a special kind of wheel and axle where the wheel has teeth that can mesh together with another wheel and axle with teeth
- Pulley – a special kind of wheel and axle where the wheel has a groove around its edge on/in which a belt or chain can sit to help move or change force.

Hints:

- Make sure that all students have a copy of the "Dancing Birds Elements Inventory" tracking sheet. This will help ensure that students have sufficient vocabulary to describe the elements that make up the simple machines present in the model.
- Using the manually driven version of the model allows for more control and direct manipulation of the model while examining the way it works.

Contemplate (Part 3 – 45 minutes)

Give each student a copy of the "Make It Work" worksheet. Allow students to complete the left side of the worksheet using the **We**Do™ Elements Set and itemized elements list if necessary. Circulate to prompt and redirect students as they deconstruct and observe the Dancing Birds model.

Review the elements that are used to make each example of a simple machine and demonstrate where they are and how they work on the model. Take up the left side of the worksheet and make sure that all students are using appropriate terminology and are able to select appropriate elements to create the simple machines discussed.

Tell the class that they will now be taking a mini field trip around the classroom and the common areas or grounds at their school.

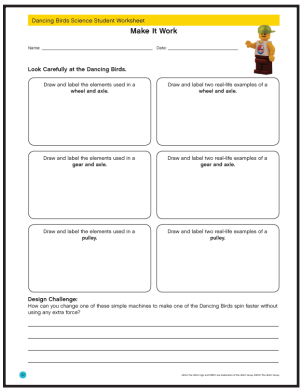
They will be hunting for examples of these simple machines in the world around them. Have the students record the examples they find in the boxes on the right side of the page using pictures and words.

When examples have been gathered, have the students return to their desks to share their discoveries as a class. Use a large piece of poster paper to record examples of wheel and axle machines, gears, and pulleys in daily life.

Hints:

- Encourage students to move the different elements and to take sections of the model apart and reassemble them while investigating the simple machines. This will help them think critically about how the elements and simple machines come together to make the model work effectively as a whole.
- If a tour of the school is not possible, a thorough examination of the classroom and out the windows should still yield several examples of simple machines in daily life. This can also be completed as a homework assignment.
- Each **We**Do Elements Set comes with an illustrated list of contents located on the opposite side of the top card.
- An illustrated and itemized list of **We**Do elements is provided in the Resources section of this activity pack.

Resources:


Dancing Birds Science Student Worksheet

Make It Work

Name _____ Date _____

Look Carefully at the Dancing Birds.

Draw and label the elements used in a **wheel and axle.**

Draw and label two real-life examples of a **wheel and axle.**

Draw and label the elements used in a **gear and axle.**

Draw and label two real-life examples of a **gear and axle.**

Draw and label the elements used in a **pulley.**

Draw and label two real-life examples of a **pulley.**

Design Challenge:
How can you change one of these simple machines to make one of the Dancing Birds spin faster without using any extra force?

"Make It Work" worksheet

Continue (Part 4 – 30 minutes)

Now that the students have learned about simple machines in their daily lives, tell them it is time to think like an engineer and see if they can improve a complex machine (the Dancing Birds model) by making changes to one of the simple machines of which it is made.

Read the Design Challenge at the bottom of the "Make It Work" worksheet out loud to the class. Tell them they will have 15 minutes with a partner to try to solve the design problem by changing the model. Design challenge clues can be given as required.

Design Challenge Clues:

- No new elements need to be added to the model.
- No programming is necessary.
- The motor and the hub stay in the **We**Do™ Elements Set box.
- One element needs to be removed from the model altogether.
- One element needs to be removed from the model and then put back on.

Demonstrate how the model can be changed. Discuss and demonstrate how changing the size of the pulley makes one bird turn faster without changing the amount of force used to push and pull the handle on the gear.

Tell the students that engineers solve these kinds of problems every day. They think of ways to work better using less energy (or force). For example, this helps more complex machines like bicycles work better while using less force. A bicycle uses all three of these simple machines to work. Gears, with a chain used like a belt on a pulley, will help make biking up a hill easier.

Prompt the students to think carefully about the Dancing Birds model.

Guiding Questions:

- What is the work that this machine does?
- Which kinds of simple machines work together to do this?
- This machine makes the birds spin in a circle. Many inventors and engineers take something that already exists and use it to make another job easier to do. Can you think of another job this model can do?

Brainstorm possible inventions using the technology/simple machines in this model to make another job easier to do (e.g., roast hot dogs or marshmallows by rotating them easily). Write a reflective journal about how this model would make that possible. Describe how the simple machines would work together to do this. Is this an invention that would work in real life, or would different materials or elements make it work better?

Extension Activities:

- Collect images from magazines, newspapers, photos, Web sites, and so forth, and create simple machine (levers, pulleys, wheels and axles, inclined planes, wedges, and so forth) collages. (30 minutes)
- Using the **We**Do Elements Set and the Sceneries Set, create a simple machine that will help move an eraser from one side of a desk to another (e.g., a wheelbarrow, a catapult, a sled on a pulley). Explain, in written or verbal form, how the simple machine helps do the work. (30 minutes)
- Research and present information about an invention that uses a simple machine and how it changed life at the time it was developed. For example, discuss how catapults changed warfare, how pulleys and levers made it easier to get water, or how wheels and axles were developed to grind grain into flour. (60 minutes)

Portfolio Suggestion:

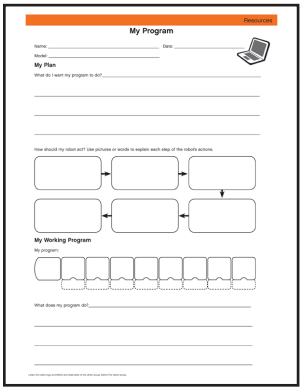
Expand the reflective journal entry about a simple machine invention into a poster describing its uses and merits.

Hints:

- If possible, use a real bicycle to demonstrate the way simple machines come together to make it work.

Science – Suggested Programming

Resources:



"My Program" tracking sheet

The "My Program" tracking sheet is a helpful tool for students to organize their program before actually going to the computer.

Standard Dancing Birds Program on Low Speed

We can see the dancing birds spin when they are powered by the motor. To see all the movements of the gears and pulleys at work, we will create a program that spins the motor at a very slow speed, like the one shown in Figure 1, so we can easily observe it.

Figure 1

Science – Suggested Building

Experimenting with Simple Machines
If we remove the motor from the Dancing Birds and insert a rod into one of the slots in the driver's gear, we can manually cause the birds to dance by spinning the gears. This will help us understand the movements of the mechanisms and give us a good understanding of simple machines. The steps are shown in Figure 2.

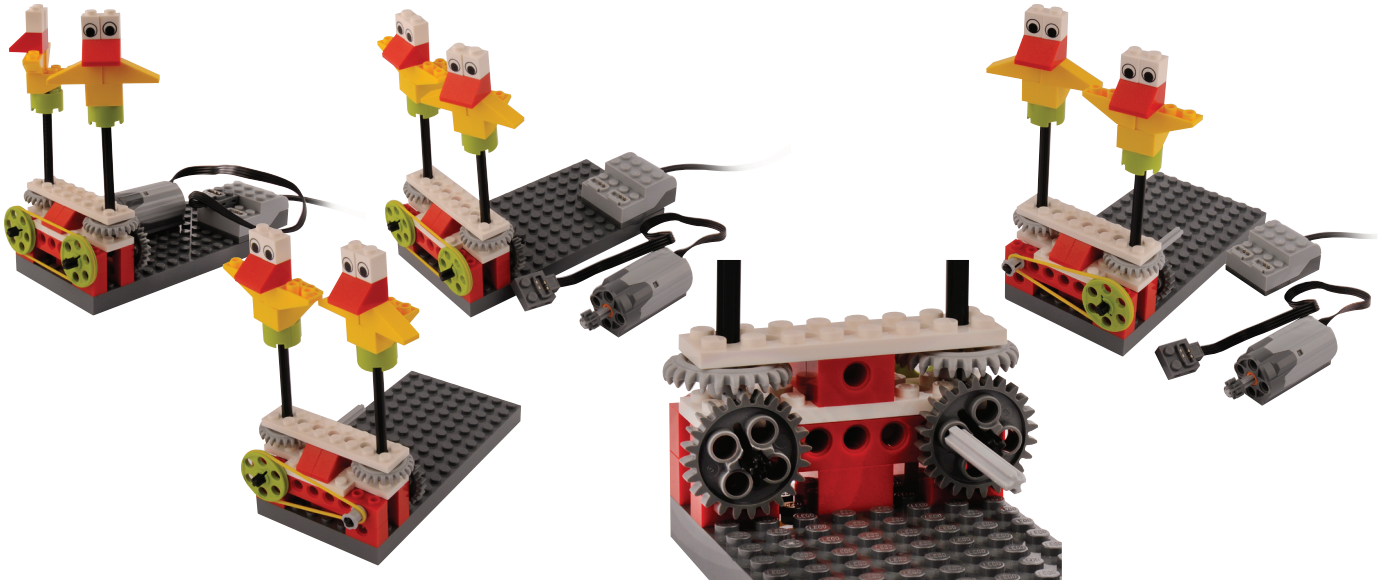


Figure 2

We can now rearrange the pulleys to see how different pulleys affect the simple machine. If we leave the large pulley on the driver and replace the large pulley on the follower with a bushing, as is shown in Figure 3, we see that the follower spins faster than the driver, as shown in Figure 4.

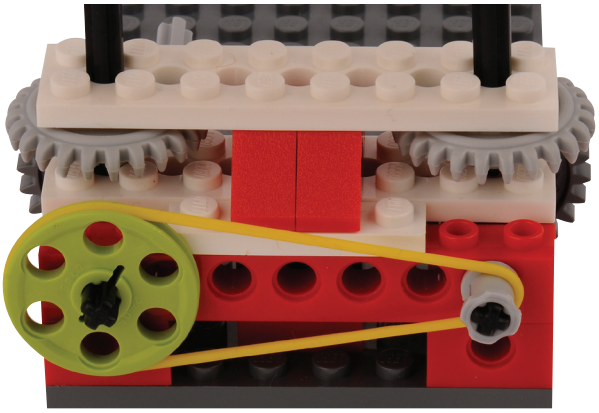


Figure 3

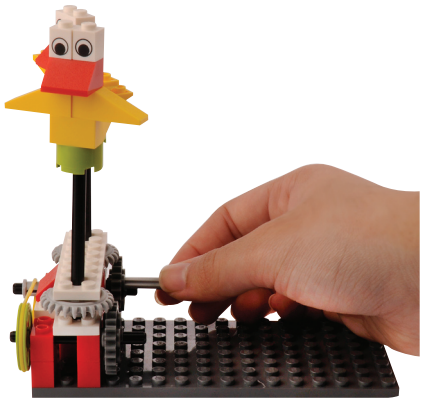


Figure 4

If we leave the large pulley on the follower and replace the large pulley on the driver with a bushing, we see that the follower now moves slower than the driver, as shown in Figure 5.

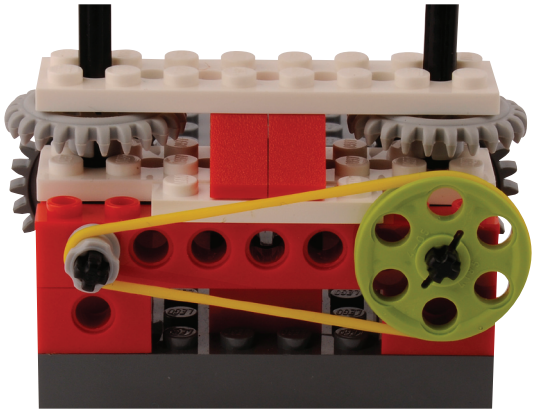


Figure 5

Now that we have an understanding of gears, pulleys, and axles, as well as of a few simple machines in general, we can create our own simple machines to move an eraser on a desk. Some examples are shown in Figure 6. These examples show elements from the **We**Do™ Elements Set and from the Sceneries Set.

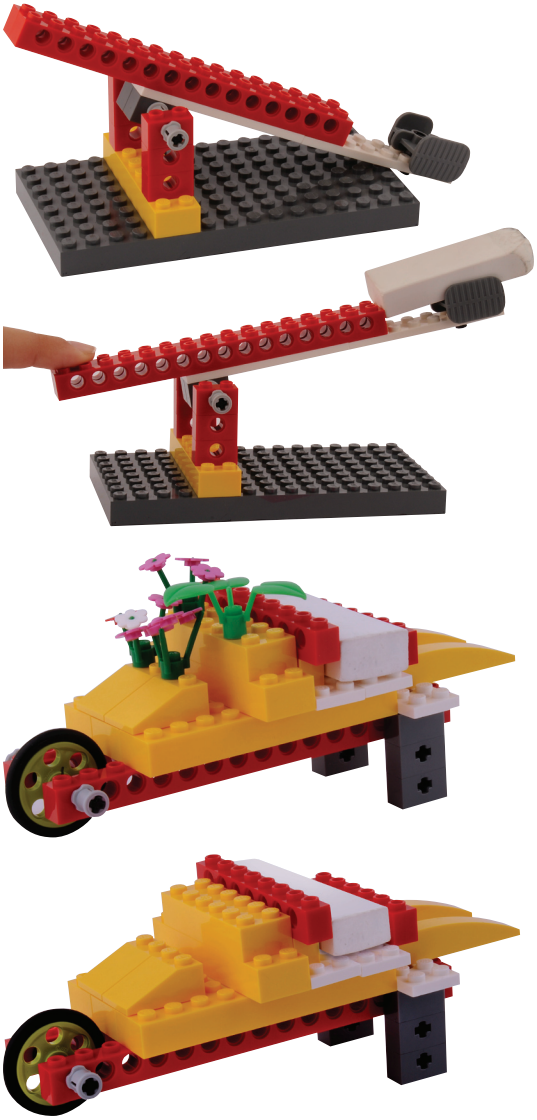


Figure 6

axle	diameter
gear	machine
belt	wheel
pulley	work
motion	force

Make It Work

Name: _____ Date: _____

Look carefully at the Dancing Birds.

Draw and label the elements used in a **wheel and axle.**

Draw and label two real-life examples of a **wheel and axle.**

Draw and label the elements used in a **gear and axle.**

Draw and label two real-life examples of a **gear and axle.**

Draw and label the elements used in a **pulley.**

Draw and label two real-life examples of a **pulley.**

Design Challenge:

How can you change one of these simple machines to make one of the Dancing Birds spin faster without using any extra force?

Name: _____ Date: _____

Dancing Birds Science Rubric				
Expectation:	**Needs Improvement**	**Fair**	**Good**	**Excellent**
	5 ---------- 10	11 ---------- 15	16 ---------- 20	21 ---------- 25
Demonstrates understanding of scientific work and simple machines. **/25**	Demonstrates a limited understanding of scientific work and simple machines.	Demonstrates some understanding of scientific work and simple machines.	Demonstrates a considerable understanding of scientific work and simple machines.	Demonstrates a thorough understanding of scientific work and simple machines.
Uses critical and creative thinking to identify and classify simple machines. **/25**	Uses critical and creative thinking to identify and classify simple machines with limited effectiveness.	Uses critical and creative thinking to identify and classify simple machines with some effectiveness.	Uses critical and creative thinking to identify and classify simple machines with considerable effectiveness.	Uses critical and creative thinking to identify and classify simple machines with a high degree of effectiveness.
Expresses and organizes ideas about simple machines. **/25**	Expresses and organizes ideas about simple machines with limited effectiveness.	Expresses and organizes ideas about simple machines with some effectiveness.	Expresses and organizes ideas about simple machines with considerable effectiveness.	Expresses and organizes ideas about simple machines with a high degree of effectiveness.
Applies knowledge and skills in familiar contexts. **/25**	Applies knowledge and skills in familiar contexts with limited effectiveness.	Applies knowledge and skills in familiar contexts with some effectiveness.	Applies knowledge and skills in familiar contexts with considerable effectiveness.	Applies knowledge and skills in familiar contexts with a high degree of effectiveness.
Comments: **/100**				