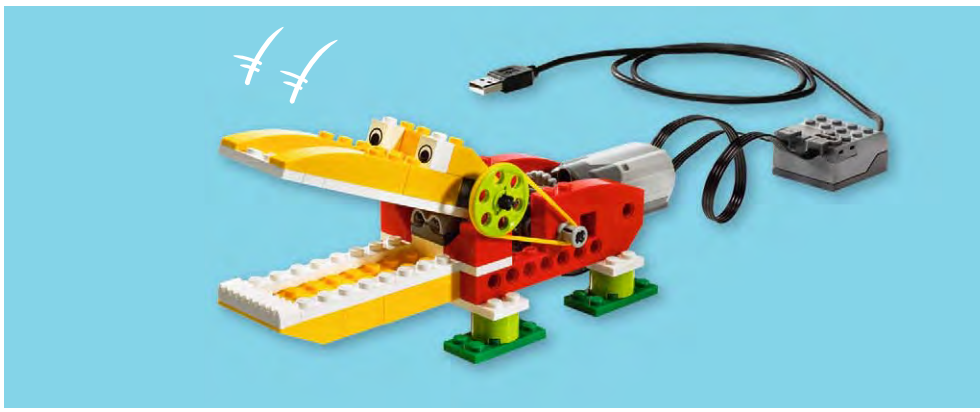
2009580

education



LEGO® Education WeDo™

Teacher's Guide

education

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Introduction

LEGO® Education is pleased to introduce the 2009580 LEGO Education WeDo™ Activity Pack which includes this LEGO Education WeDo Teacher's Guide.

Who is it for?

The material is designed for teachers in elementary school, especially second through fourth grade, although it can be used in higher grades as well. Working individually, in pairs or teams, students of any academic background from seven years and up can learn by building and programming the models and by investigating, writing about, and discussing ideas they encounter using the models in these activities.

What is it for?

The WeDo Activity Pack enables students to work as young scientists, engineers, mathematicians and creative writers providing them with the settings, tools and tasks for completing cross-curricular projects.

Using these materials, students are encouraged to build and program a working model and then use the model for different purposes, depending upon the theme of the activity and its focused subject matter in science, technology, mathematics or language.

The WeDo Activity Pack enables teachers to provide learning opportunities for developing these broader learning goals:

- Think creatively to make a working model
- Develop vocabulary and communication skills to explain how the model works
- Establish links between cause and effect
- Reflect on how to find answers and imagine new possibilities
- Brainstorm ideas and endeavor to bring some of them to fruition
- Make fair tests by changing one factor and observing or measuring the effect
- Make systematic observations and measurements
- Display and communicate data using tables
- Follow 2D drawings to build a 3D model
- Think logically and create a program to produce a specific behavior
- Write and present creative stories using models for visual and dramatic effects

See the Curriculum section for an overview of the highlights, a description of the themes around which the activities are organized, and curriculum grids showing how objectives in science, technology, engineering, mathematics and language are met by each activity.

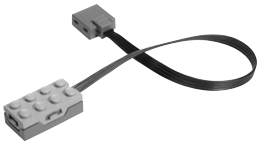
What is in the box?

9580 LEGO® Education WeDo™ Construction Set
The 9580 LEGO® Education WeDo™ Construction Set enables students to build LEGO® models that attach to the LEGO® USB Hub and then control the models using computer programs. The set contains 158 elements including a LEGO Hub, motor, tilt sensor and a motion sensor that add movement and intelligence to the model.

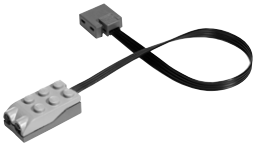
LEGO® USB Hub
The LEGO® USB Hub controls sensors and motors from the 2000095 LEGO® Education WeDo™ Software. Power and data are transmitted from the LEGO motors and sensors to and from the computer using the two LEGO Hub ports. The WeDo Software automatically detects the LEGO Hub and any motors and sensors attached to it. Up to three LEGO Hubs can be attached.

Motor
The motor can be programmed to turn this way or that way and to move at different power levels. Power for the motor is supplied through voltage from the computer's USB port (5V). Axles or other LEGO elements can be attached to the motor.

Tilt Sensor
The tilt sensor reports the direction it is tilted. The tilt sensor detects changes within six different positions: Tilt This Way, Tilt That Way, Tilt Up, Tilt Down, No Tilt and Any Tilt.



Motion Sensor
The motion sensor detects objects within a range of 15 centimeters (or about 6 inches) depending on the design of the object.



2000095 LEGO® Education WeDo™ Software
The LEGO® Education WeDo™ Software is used to create programs by dragging and dropping Blocks into a sequence on the computer screen or Canvas. Several Blocks control the motor, tilt sensor and motion sensor from the LEGO Education WeDo Construction Set. There are also Blocks that control the computer keyboard, display, microphone and speaker. The WeDo Software automatically detects motors and sensors when they are attached to the LEGO Hub. Getting Started examples in the WeDo Software show LEGO building and programming principles.

2009580 LEGO Education WeDo Activity Pack
The LEGO Education WeDo Activity Pack contains 12 activities that can be installed to run with the WeDo Software. Animations and step-by-step Building Instructions are embedded in the activities. In this Teacher's Guide, Teacher Notes for the activities as well as classroom management ideas, curriculum support, WeDo Software overviews, and Getting Started programming and building examples are also included.

The 4C Learning Process

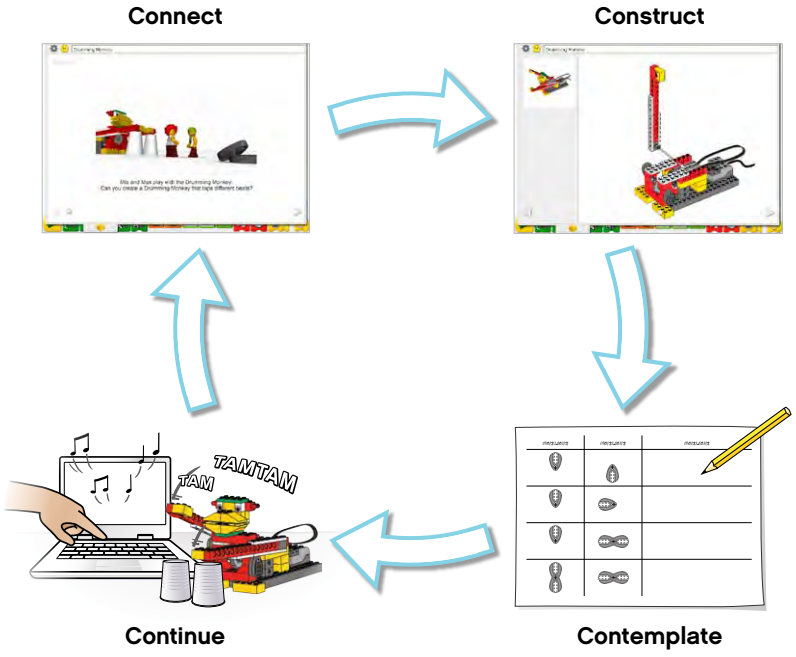
All LEGO® Education materials support a process of learning that includes four phases: Connect, Construct, Contemplate, and Continue.

Connect
You add to your brain's knowledge when you connect a new learning experience to those you already have or when an initial learning experience is the seed stimulating the growth of new knowledge. Each LEGO Education WeDo™ activity presents an animated situation with minifigures, Mia and Max. Use these animations to illustrate, inspire, and stimulate discussion about the activity topic. Other ways to Connect are also suggested in the Teacher Notes for each activity.

Construct
Learning is best when hands and minds are engaged. LEGO Education involves learning by making: the construction of models and of ideas. The WeDo activities include step-by-step instructions embedded directly into the Construct phase. Just click to see the next step. If you prefer, plan time for modifying this model or building and programming something of your own design.

Contemplate
When you contemplate what you have done, you have the opportunity to deepen your understanding. As you reflect, you develop connections between previous knowledge and new experiences. In the Contemplate section, students observe and report how specific changes in the pulleys, gears, or cams affects the movement of the model; they research and make presentations about the behavior of their "animals;" they count, take measurements and rate the performance of their soccer models; and they create different types of stories and act them out using their models for visual and sound effects. This phase offers a good opportunity for evaluating the learning and progress of each student.

Continue
Learning is always more enjoyable and creative when it is adequately challenging. Maintaining this challenge and the pleasure of accomplishment naturally inspires the continuation of more advanced work. The Continue phase of each activity includes a challenge to build and program more behavior or complex interaction with the model.



Organizing the Classroom

Use this checklist to prepare for teaching with the LEGO® Education WeDo™ Activity Pack.

- ☐ Install the LEGO Education WeDo Software on each computer or on your network.
- ☐ Install the WeDo Activity Pack on each computer or on your network.
- ☐ Open each LEGO Education WeDo Construction Set. Store the loose elements in the storage box.
- ☐ Arrange the computer and space required for each student or group. For example, place one end of the table near to safe power outlet for the computer. Allow some working space for the storage box and for building models. About 60 centimeters x 40 centimeters (or about 24 inches x 20 inches) next to each computer will do.
- ☐ If not already available in your classroom, prepare a box of measuring tools including rulers or measuring tapes and paper for data charts. Stopwatches are optional but useful.
- ☐ To become familiar with the materials yourself, set aside an hour and try the Dancing Birds activity as if you were the student. Then read the 1. Dancing Birds Teacher Notes.
- ☐ If you have more time, browse Getting Started and try one or more of these: Motor and Axle, Gears, Tilt Sensor, Motion Sensor.

Here are other suggestions recommended by experienced teachers who use LEGO Education materials.

- ☐ Place a number on each WeDo Construction Set. That way, you can sign out a numbered kit to each student or team for the term.
- ☐ Organize a cupboard, a wheeled cart or storeroom to store the sets between sessions. Unfinished models can be stored in the boxes or on another shelf. If stored separately, put a model in a small box or tray.
- ☐ Set aside a resource table or an area that can be used for storing the books related to the current theme topics: e.g., books, photographs, maps and other resources related to the Wild Animals theme.
- ☐ For decorating or extending projects, prepare a box of craft materials, e.g., colored paper, card stock, foil, ribbons, and scissors.
- ☐ Consider using journals as inventors' notebooks either on paper or online to encourage project organization, note-taking, and reflection throughout the project work.

Lesson Planning Routes

There are many ways to use the LEGO® Education WeDo™ materials in your classroom. Here are two different ways to plan your class schedule.

Each activity can take one or more class periods, depending upon the time spent on discussion, the building and computer skills of your students, and the time you allow for experimentation.

Activities can be completed by an individual or a small team or group, depending upon the number of computers and LEGO Education WeDo Construction Sets available.

Route A: Getting Started Introduction Before Themed Activities

Introduce the building and programming ideas first to help the students become familiar with LEGO building using the WeDo Construction Set and with the LEGO Education WeDo Software. Then start on the themed activities.

You can have the students choose one of the three themed activities for each theme as this chart shows, or if you have more time, you can have the students try all of the activities. Some groups will be faster than others and may be able to complete all three in the same time as others complete one or two.

Extension ideas are suggested in the Teacher Notes for each activity. Some of the activity extensions involve combining models from other projects so extensions are recommended as useful ways to encourage cooperation.

You may wish to organize a class exhibition as a finale for the unit.

Route B: Focus on Themed Activities

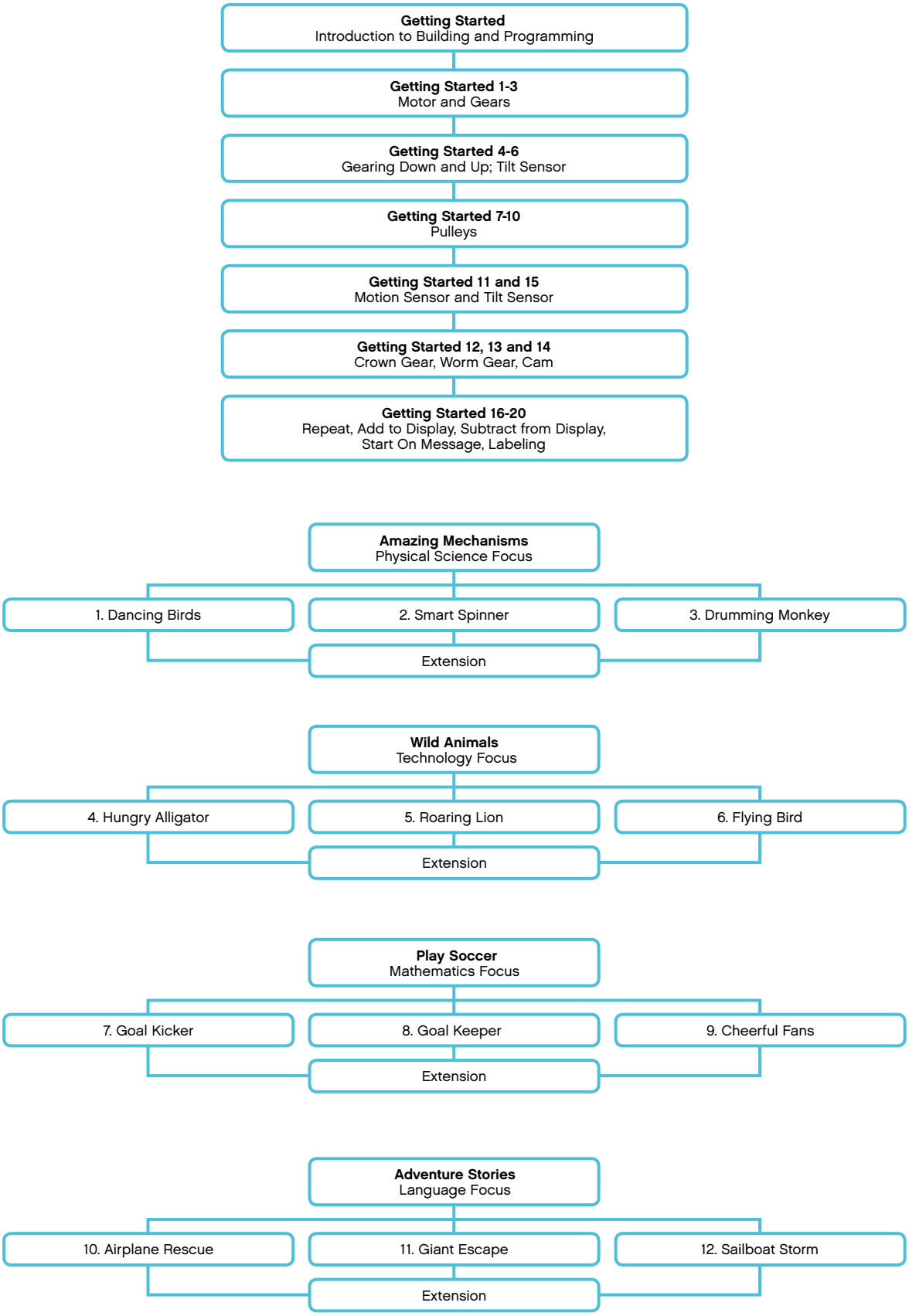
Start with the themed activities, spending more time with them as projects to encourage experimentation.

You can have the students try all of the activities as this chart shows, or if you have less time, you can have the students choose one activity from each theme. Some groups will be faster than others and may be able to complete all three in the same time as others complete one or two.

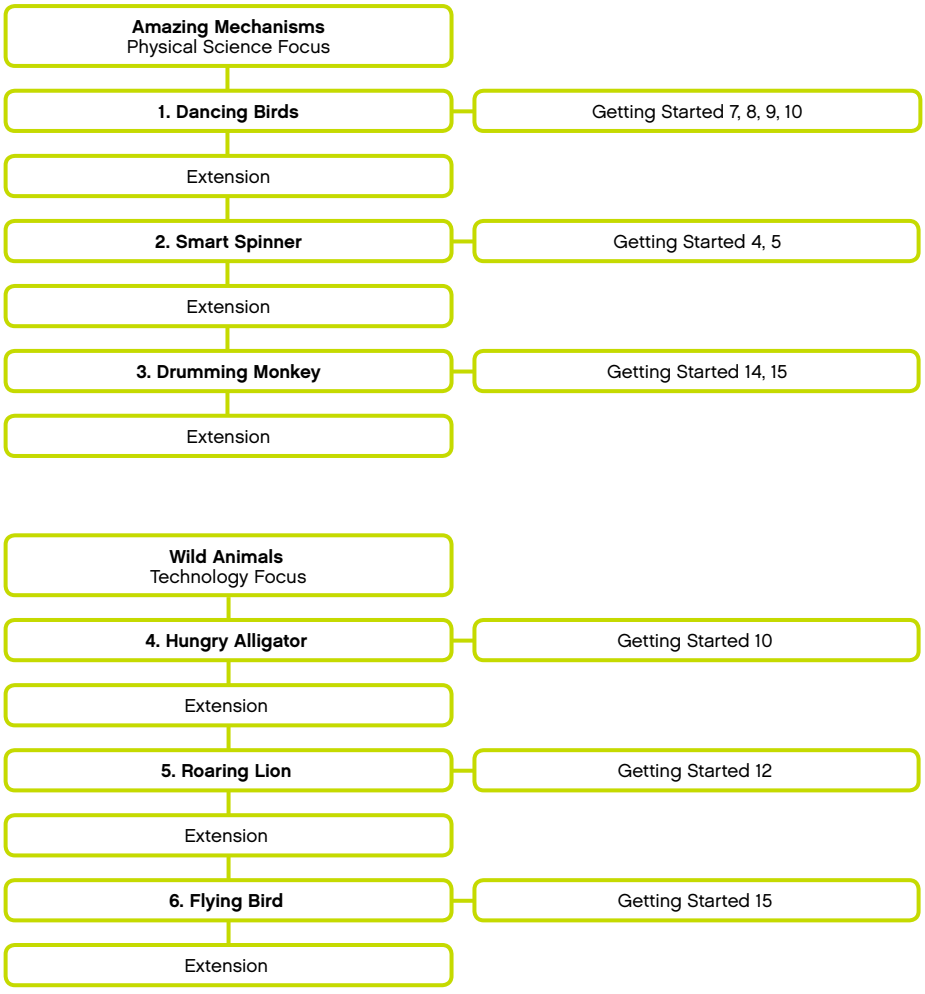
Use the Getting Started materials as a reference. Extension ideas are suggested in the Teacher Notes for each activity.

You may wish to organize a class exhibition as a finale for the unit.

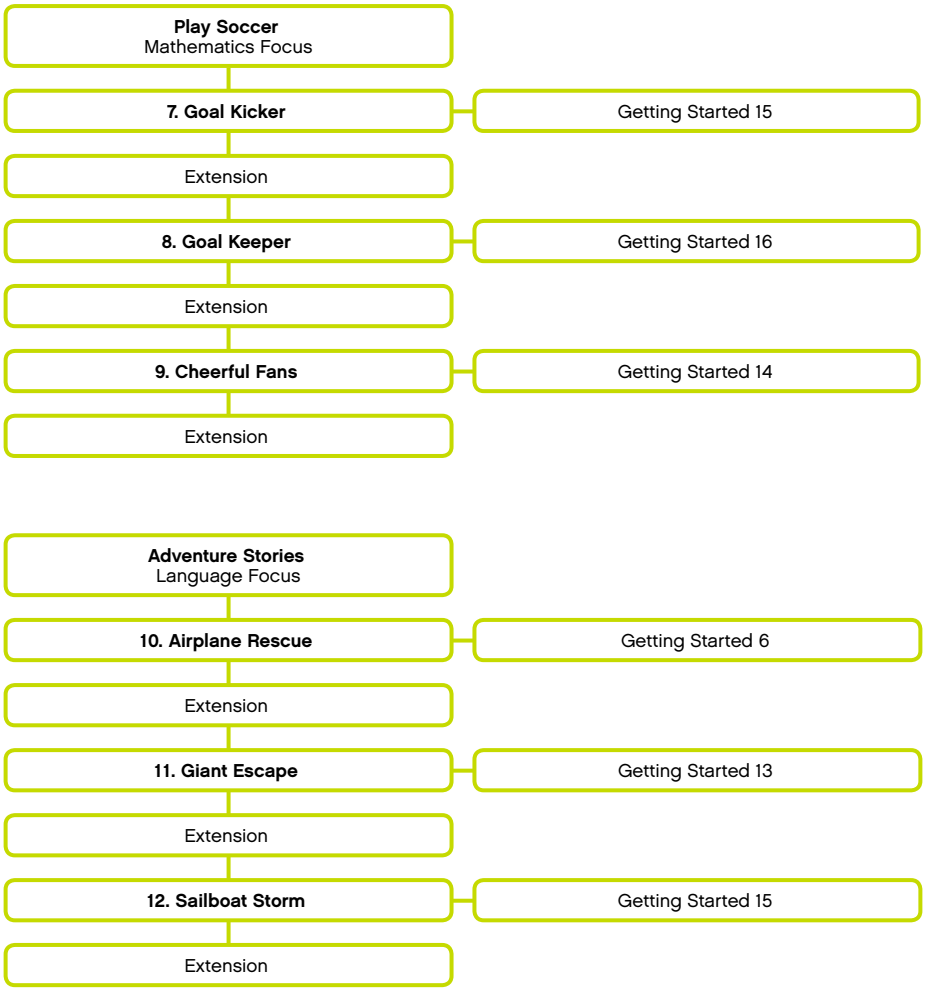
Route A: Getting Started Introduction Before Themed Activities



Route B: Focus on Themed Activities



Route B: Focus on Themed Activities



Curriculum

Highlights

The process of students actively building, programming, investigating, writing, and communicating benefits their development in numerous ways. The opportunity to integrate subject matter across the curriculum in projects provides a range of contexts for applying concepts, learning new skills, and broadening interests. Specific subject matter is also addressed in the activities. Here are the highlights. For more information, see the Themes and Curriculum Grids sections.

Science

Trace the transmission of motion and transfer of energy through the machine. Identify the simple machines mechanisms at work in the models, including levers, gears, and pulleys. Become familiar with complex motion using a cam, worm gear, and crown gear. Understand that friction can affect the movement of the model. Understand and discuss criteria for a fair test. Consider the needs of living animals.

Technology

Program and create a working model. Interpret 2D and 3D illustrations and models. Understand that animals use parts of their bodies as tools. Compare natural systems with mechanical systems. Use software media to acquire information. Demonstrate the knowledge and operation of digital tools and technological systems.

Engineering

Build, program, and test the models. Modify a model's behavior by changing the mechanical system or by adding a sensor to provide feedback. Brainstorm to find creative alternative solutions. Learn to share ideas and work together.

Mathematics

Measure time in seconds and tenths of a second. Estimate and measure the distance in centimeters or inches. Understand the concept of randomness. Compare the diameter and rotational speed. Understand and use numbers to represent the type of sounds played and the amount of time the motor turns on. Understand and use the distance between an object and to activate the motion sensor. Understand how the position of the model is measured by the tilt sensor. Understand and use numbers to measure and score qualitative characteristics.

Language

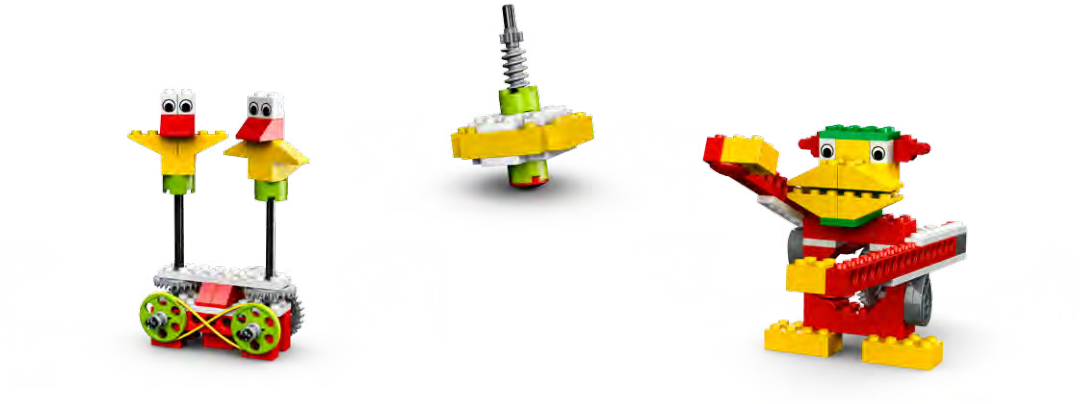
Communicate in spoken or written forms using appropriate vocabulary. Prepare and deliver a demonstration using a model. Use interview questions to find out information and write a story. Write a script with a dialogue. Write a logical sequence of events and create a story including main characters and dramatizing with visual and sound effects. Use technology to create and communicate ideas. Participate as knowledgeable, reflective members of the group and class.

Themes

The 12 activities have been organized around four themes with three activities in each theme. The themes use technology, the building and programming of the model, along with a project-oriented approach to integrate concepts across the curriculum. However, each theme does focus on one subject area more than others.

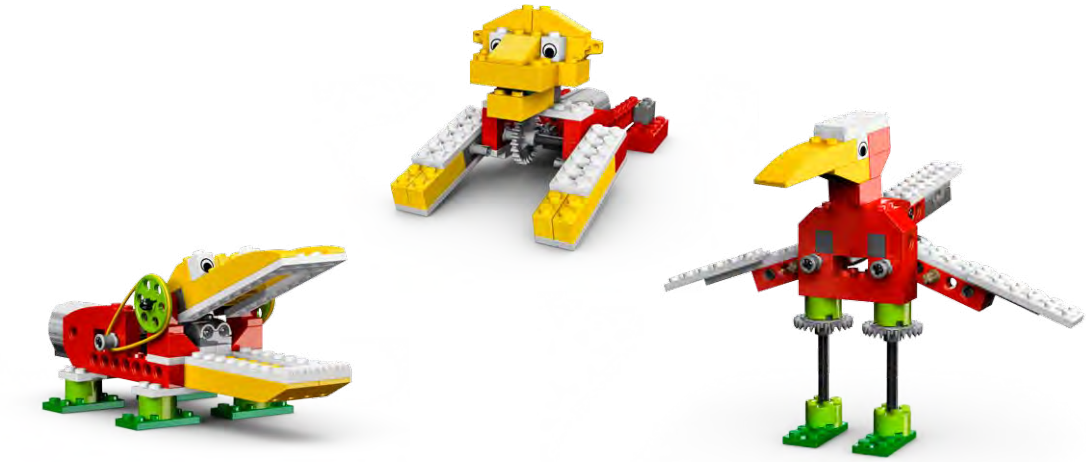
Amazing Mechanisms

The Amazing Mechanisms theme focuses on physical science concepts. In Dancing Birds, students learn about pulleys and belts, experimenting with the size of pulleys and the crossing and uncrossing of the belt. In Smart Spinner, students investigate the effect of smaller and larger gears on a spinning top. In Drumming Monkey, students learn about levers, cams, and patterns of movement. They experiment with the number and position of cams, using them as the effort causing the monkey's arms to drum up and down on a surface at different rates.



Wild Animals

The Wild Animals theme focuses on technology, emphasizing the concept of sensing and responding to external stimuli. In Hungry Alligator, students program the alligator to snap its jaw shut when the motion sensor sees something near its mouth. In Roaring Lion, students program the lion to sit up and then lie down and roar when it senses a bone. In Flying Bird, students program the tilt sensor to activate a flapping sound as they move the tail up and down, flapping the wings. They also program the motion sensor to activate a tweet sound when the bird tilts down to its feet.



Play Soccer
The Play Soccer theme focuses on mathematics. In Goal Kicker, students measure the distance the kicking leg model kicks paper balls. In Goal Keeper, students calculate the number of blocks, goals, misses as they try to flick paper balls past a mechanical goal keeper. They also learn to program an automatic score keeping system. In Cheerful Fans, students apply a numerical rating system to judging the best performance in three subjective categories.

Adventure Stories
The Adventure Stories theme focuses on language using the model to dramatize events. In Airplane Rescue, students learn important interview questions: Who, What, Where, Why, and How and report a story of Max the LEGO® minifigure's airplane ride. In Giant Escape, students act out the dialogue, role-playing as Mia and Max wake the sleeping giant and must escape the forest. In Sailboat Storm, students describe the sequence of events as Max endures a thunderstorm at sea.

For more details about the specific curriculum objectives covered by each activity, see the Curriculum Grids.

Curriculum Grids

	1. Dancing Birds	2. Smart Spinner	3. Drumming Monkey	4. Hungry Alligator	5. Roaring Lion	6. Flying Bird	7. Goal Kicker	8. Goal Keeper	9. Cheerful Fans	10. Airplane Rescue	11. Giant Escape	12. Sailboat Storm
Science												
Scientific inquiry												
Conduct investigation												
Use tools to gather information												
Communicate investigations and explanations												
Fair testing												
Observation												
Reasoning												
Teamwork												
Transmission of motion												
Transfer of energy												
Lever												
Pulley												
Gear												
Compound gearing												
Friction												
Needs of living animals												
Use evidence to support conclusions												
Technology												
Program and create a working model												
Interpret 2D and 3D illustrations and models												
Compare natural systems with mechanical systems												
Demonstrate the knowledge and operation of digital tools and technological systems												
Use software media to acquire information												
Understand that animals use parts of their bodies as tools												
Use feedback to adjust a programming system output												
Apply principles of motion and other concepts in physical science												

	1. Dancing Birds	2. Smart Spinner	3. Drumming Monkey	4. Hungry Alligator	5. Roaring Lion	6. Flying Bird	7. Goal Kicker	8. Goal Keeper	9. Cheerful Fans	10. Airplane Rescue	11. Giant Escape	12. Sailboat Storm
Engineering												
Build, program and test models												
Modify a model's behavior by changing the mechanical system or by adding a sensor to provide feedback												
Brainstorm to find creative solutions												
Teamwork: Learn to communicate, share ideas and work together												
Mathematics												
Whole number relationships												
Use standard units												
Calculate using numbers with one or two place values												
Estimate												
Count												
Time in seconds and tenths of seconds												
Measure in centimeters or inches												
Measure "soft" qualitative variables												
Use simple counting variables												
Use random numbers between 1 and 10												
Use numbers to represent sounds, displays, distance, tilt value and other data												
Ratio of gear teeth and pulley diameter affects speed												
Cams affect frequency and timing of sound												
Relate numerical values to patterns of movement												
Organize lists or tables of information												
Organize and display data												
Analyze change in many contexts												
Language												
Communicate in spoken form using the appropriate vocabulary												
Use visual props to illustrate and dramatize your presentation												
Communicate in writing to explain information using the appropriate vocabulary												
Use interview questions to find out information												
Write a logical sequence of events												
Organize events to create a story, maintaining a focus on the characters and objects												
Write a script with a dialogue among three characters												
Use technology to create and communicate ideas												
Participate as knowledgeable, reflective members of the group and class												

1. Dancing Birds Teacher Notes

Students will build and program two mechanical birds that make sounds and are motorized to dance using a pulley and belt drive system.

Objectives

Science
Trace the transmission of motion and transfer of energy through the machine. Identify the pulleys and belt drive mechanism, and the effect changing the belt has on the direction and speed of the dancing birds' movement.

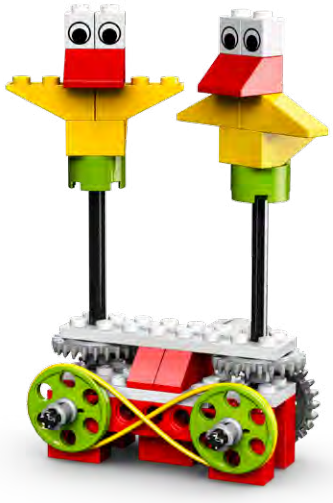
Technology
Create a programmable model to demonstrate the knowledge and operation of digital tools and technological systems.

Engineering
Build and test the dancing birds' movement.
Modify the dancing behavior by changing the pulleys and belt to affect the speed and direction of motion.

Mathematics
Understand how the diameter of the pulleys affects the speed of the dancing birds' movement.
Compare the diameter and rotational speed as a ratio.
Understand and use numbers to represent the amount of time the motor is turned on in seconds and in tenths of seconds.

Language
Communicate in spoken or written forms using the appropriate vocabulary.

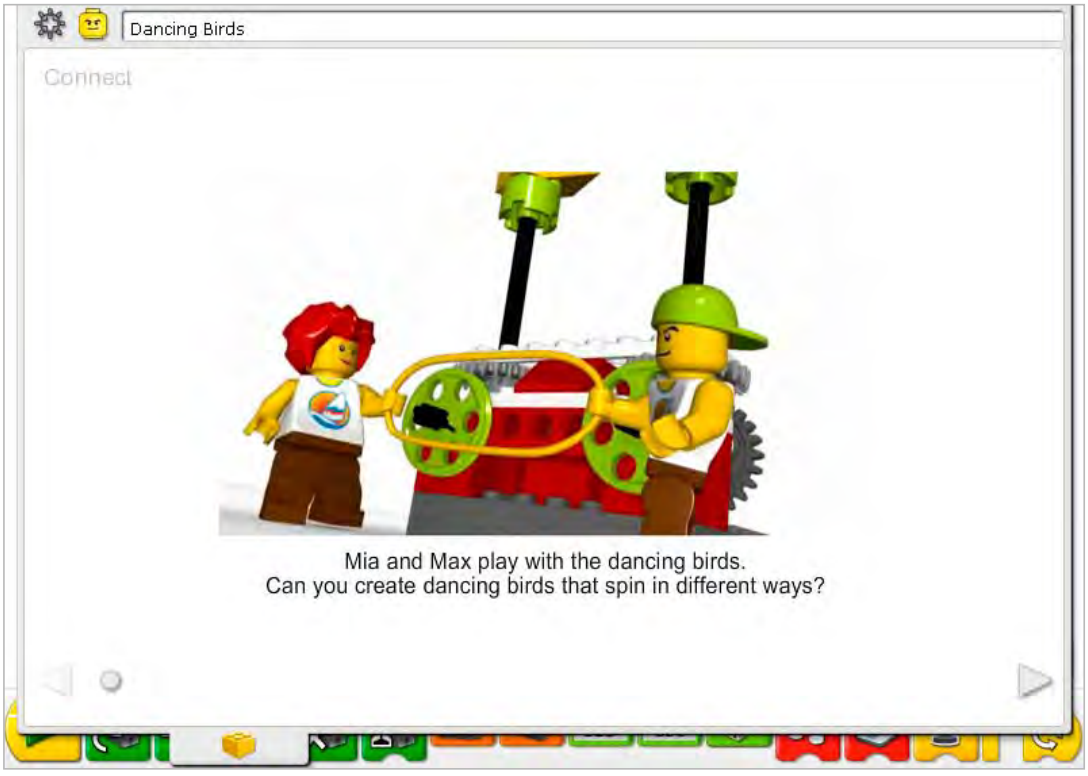
Vocabulary
Belt, pulley, and random. Blocks: Motor Power, Motor This Way, Motor That Way, Random Input, Play Sound, Repeat, Start, and Wait For.



Connect

Review the Connect animation and discuss:

What do Mia and Max see when they look at the birds turning?
Can the birds go in the same direction? Opposite directions?
What is making the birds move?



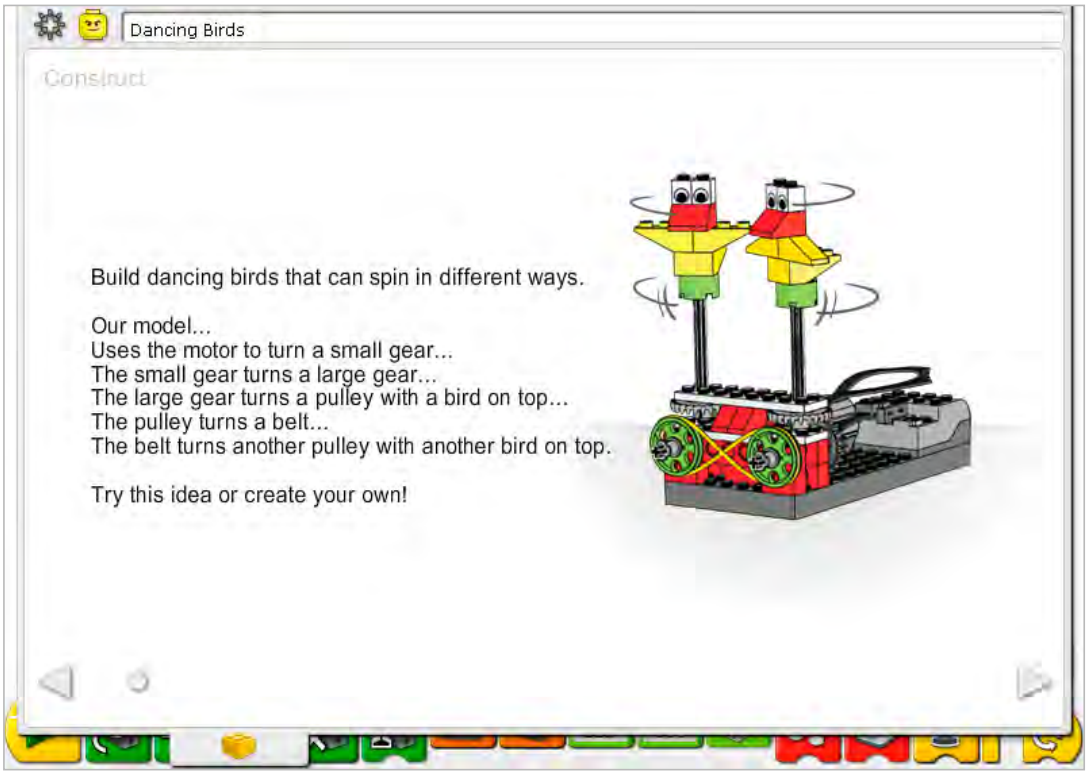
Here are other ways of connecting:

Split into teams of three. Place two students inside a hula hoop or in a long rope tied together to form a circle. Hold onto the hoop or rope. The third student pushes the hoop or one of the students inside the circle to make them turn. What happens to the other student inside the hoop? That student turns the same direction.

Did you know...
The dancing birds are moving because they are connected with pulleys and a belt? See the models in Getting Started:
7. Pulleys and Belt
8. Crossed Belt
9. Decrease Speed
10. Increase Speed

How can you reverse the direction of one of the pulleys?
Cross the belt.
How do you make one pulley spin faster than the other?
Change one pulley to a pulley with a smaller diameter.

Construct



Build the model following step-by-step instructions or create your own dancing birds. If you create your own, you may need to change the example program.

To operate the dancing birds best, make sure the pulleys and belt on the front of the model can move freely.

The energy transfers from the computer powering the motor to the small gear. The small gear turns a large gear. The large gear is connected on the same axle as a pulley so the pulley turns also. The pulley has a bird mechanism on top that turns as the pulley turns. Also connected to the pulley is a belt. As the pulley turns, the belt turns. The belt then turns another pulley with another bird on top. The speed of the birds can be changed by shifting the belt from the larger pulley to the smaller pulley on one side or the other. The direction of the birds can be changed by crossing or uncrossing the belt.

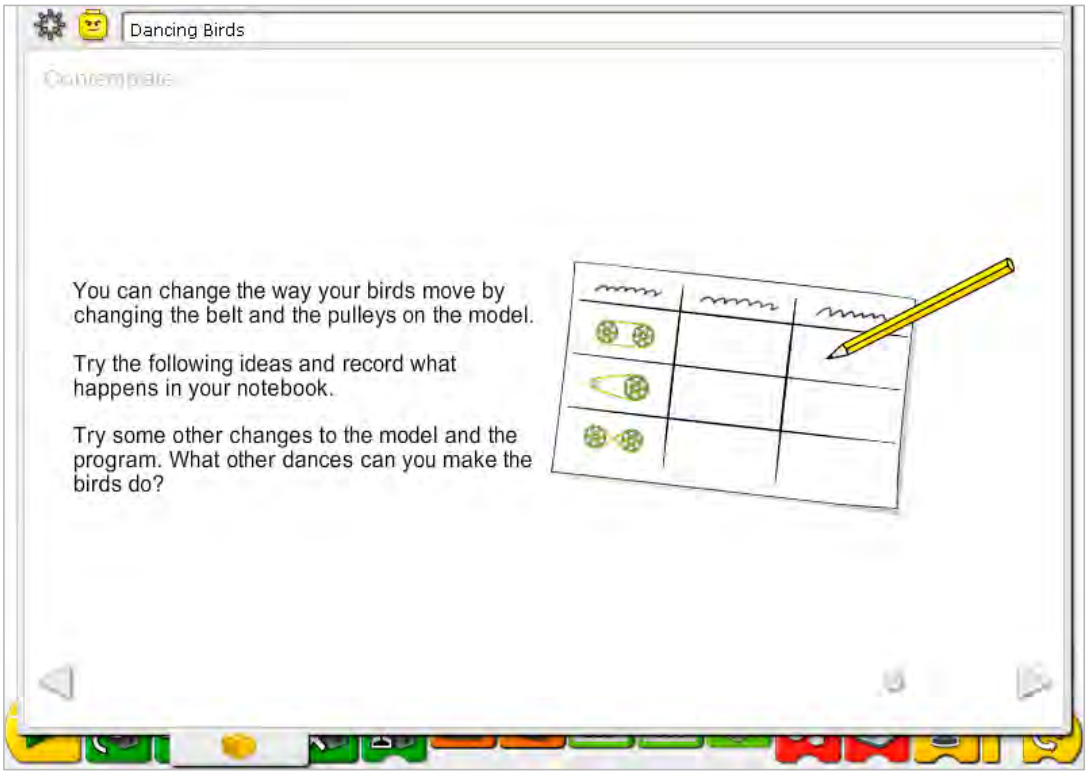
The energy changes from electrical (the computer and motor) to mechanical (physical movement of the gears, pulleys and belts, and axles).

The dancing birds program uses the Start and the Motor This Way Blocks to turn on the motor.

The power level can be changed using the Motor Power Block if desired. More complex programs are shown in the Continue section of this activity.

See Getting Started for more examples with the Start and Motor This Way Blocks.

Contemplate



Set up enough space to experiment with the pulleys and belt and make notes of your observations.

Draw a data table on a separate sheet of paper.

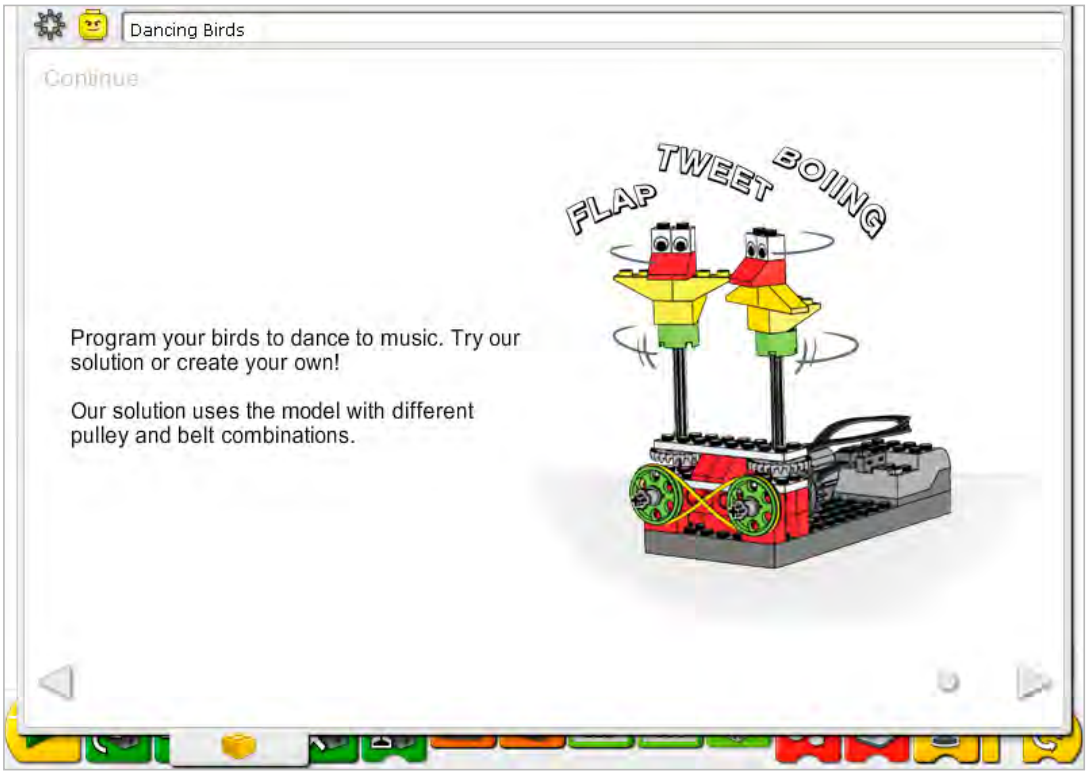
Use the data table to record the changes in the pulley and belt positions and the effect on the speed and direction of the dancing birds.

After investigating the pulleys and belt, discuss conclusions to the data tables.

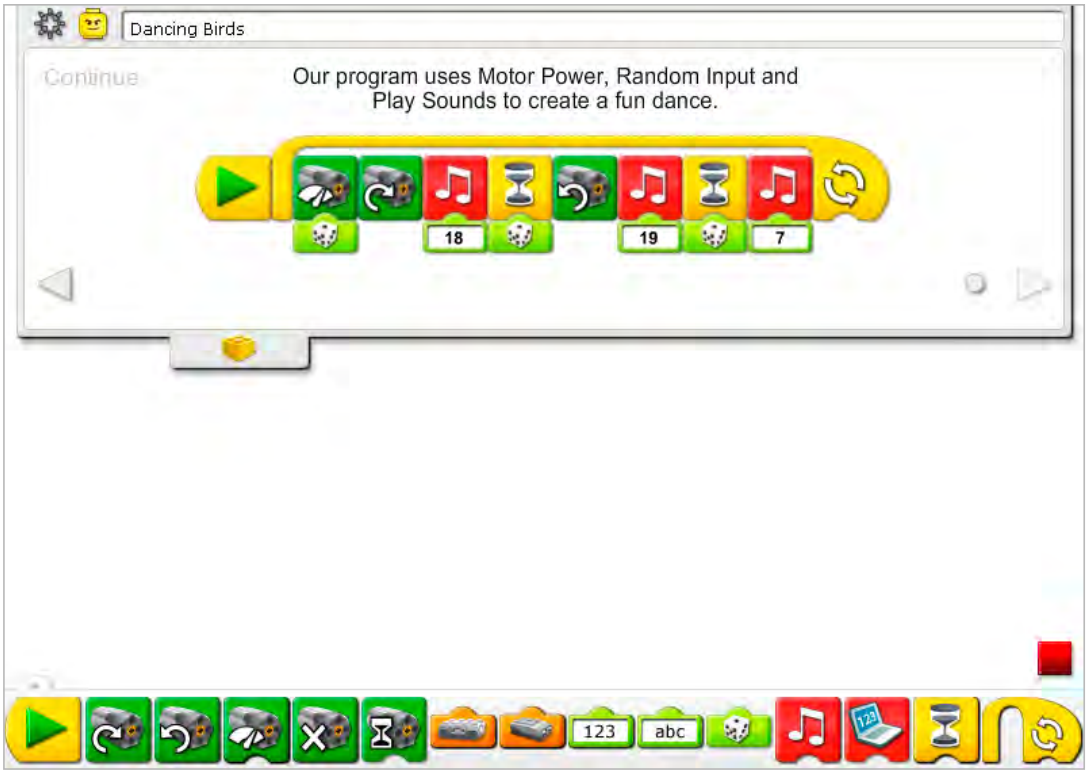
Use your hands to show how the birds move when the large pulleys are connected and the belt is not crossed as shown in the first line of the chart.
The birds turn the same direction and move the same speed.
What happens when you move the belt from one large pulley to the smaller pulley as shown in the second line of the chart?
The speed of the smaller pulley increases and so does the speed of the dancing bird connected to the smaller pulley.
What happens when you cross the belt so that it looks like a sideways figure 8 around the two pulleys as shown in the third line of the chart?
The pulleys and the two birds connected to the pulleys spin in opposite directions.

Alternative ideas...
How much faster do the birds dance when they are on the small pulley compared to the large pulley? Work in pairs so that one person counts the rotations of one bird and the other person counts the rotations of the other bird. How much faster is the bird on the smaller pulley?
About 3-4 times faster. You can also measure the diameter of the pulleys. The ratio of the small to large pulley is about 1:3.8.

Continue



There are no building instruction changes required in this activity. Change the pulleys and belt to create a dancing pattern you prefer.



The Dancing Birds program is modified to change the power level of the motor randomly, play a sound, wait, change the motor direction and play two more sounds with a pause in between. The program repeats.

See the LEGO® Education WeDo™ Software section for the Sound List referencing the Play Sound Block numbers with descriptive names.

See Getting Started for more examples with the Motor Power, Motor This Way, Motor That Way, Play Sound, Random Input, Repeat and Wait For.

Extension
Join with another team that has a drumming monkey model. Program the monkey and the dancing birds to play and dance together.