# LEGO® ROBOTICS for YOUNG BEGINNERS

## A LEGOLAND® California
## Educational Resource Guide
## Grades 1-3

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## Welcome to LEGOLAND California

**Education Programs**: "Robotics for Young Beginners" was developed by the LEGOLAND Education Department, using LEGO® Education WeDo® software and materials. For information on LEGOLAND Education programs, visit **www.LEGOLAND.com/education** .

**Arrival and Entry:** Please arrive 30 minutes before your program. Teachers must be present during the 45-minute program.

**Extended Learning in the Park:** Lab Notes are provided to guide your experience on recommended rides and attractions, to enhance the Robotics for Young Beginners-themed educational experience and provide opportunities for applied learning.

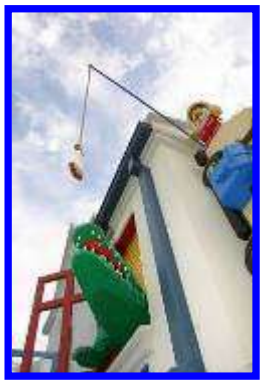
**Lunches**: School groups may bring lunches in disposable containers and use self-storage bins. Lunches may be pre-ordered when you book your program, or purchased at LEGOLAND restaurants.

**Safety**: LEGOLAND Parks are built to the highest standards of quality and safety. Height restrictions apply on selected attractions throughout the park.

# Background Information

## Build a Robot: Gears, Levers, and Pulleys

Have you ever used a shovel in the sand? Have you ridden a bicycle? Have you seen a flag raised on a flagpole? If so, then you have seen three simple machines at work—levers, gears, and pulleys!



### LEVERS

**Levers** move diagonally, and help us to lift heavy objects easily.
A shovel can be used as a lever. A screwdriver can be used as a lever to open a paint can.
A crane is a lever. Levers use power to increase force.

### GEARS

**Gears** are wheels with teeth around the edge. They mesh with other gears to cause circular movement, as on an electric can opener.

Gears can be used to make things go faster or slower, as on a bicycle. Gears can also change the direction of movement. **Gearing up** is when a large gear drives a small gear and makes the small gear go faster. **Gearing down** is when a small gear drives a large gear and makes the large gear go slower.

### PULLEYS

**Pulleys**, like those on a flagpole, are smooth wheels with a groove around the wheel. A cable or belt fits into the groove of the pulley wheel. Two pulleys can be connected by the belt, and the belt helps one pulley to turn the other.

Pulleys are like gears with a belt. Pulleys change speed when the size of the pulley wheels are changed. Pulleys help lift or move things more easily, and reduce friction. Window blinds and tow trucks use pulleys.

## Animate a robot: Programs, Sensors and Motors

Build Gator-bot with a touch sensor and a motor. Put the touch sensor in the Gator-bot's mouth.

Program the motor to turn on when the touch sensor is pushed.

Build a Gator-Bot with a touch sensor in the gator's mouth. Program the jaws to move up and down when the touch sensor is pushed.

When the gator "feels" food, it will CHOMP!

# Discovery and Learning at LEGOLAND

## Find the simple machines in these rides!

**Remember:**

**Gears** are wheels with teeth. They mesh with other gears to cause movement in a circle.
**Levers** move diagonally to help lift heavy objects more easily.
**Pulleys** use a belt or cable to help move things more easily.

**Kid Power Tower** riders pull a cable to help them get to the top. Name the simple machine riders use.

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**Bionicle Blaster** turns in a circle. Which simple machine causes this movement?
*Hint: One is shown for decoration on top of the ridecar!*

_____

**Fun Town Fire Academy** features a heavy water jet. What simple machine helps riders aim?

_____

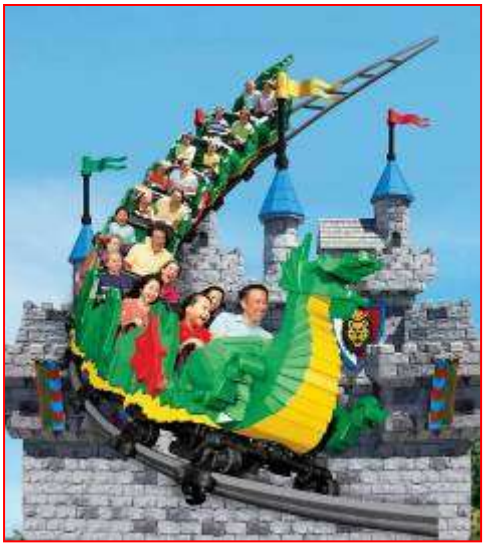
## Experience a LEGOLAND Robot!

### Ride Knights' Tournament

Choose the power of your ride!
Robotic arms are programmed for five levels of power.
Within each power level, random combinations
of movements make each ride a unique experience.

# Discovery and Learning at LEGOLAND

## The Dragon Coaster



Ride The Dragon! Find robotic elements that make the LEGO models move.
Read the Challenges and complete the answers.
*Hint*: Think about programming robots with sensors, motors, and timers.

**Challenge #1**
The coaster will pass through the castle at random times. How will the castle models come alive just as a coaster approaches?
*Hint: How did your alligator model know that the "food" was near?*

**Answer**
As the roller coaster car approaches the model scene, the car crosses a special beam that goes across the track. When the beam is broken, it is a signal to the motors to "turn on," and start the animation. The beam is called a

_____ _____.

**Challenge #2**
Motor 1, 2 and 3 move the dragon's body up, head up, and open the jaws. With only three motors, how do we program for body down, head down, and jaws closed?
*Hint: What do you do in a car do when you want it to go backwards?*

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**Challenge #3**
The dragon's eyes light up and we hear him roar! How can we program him to stop after a short outburst?
*Hint: What robotic device does a kitchen microwave use?*

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**Teacher Notes**: 1. Light sensor 2. Program the motors to go in reverse! 3. Use a timer to program a number of seconds.

# Hands-On Activities at LEGOLAND

LEGOLAND Staff facilitates building and programming. Students work in pairs at their own pace.

## Build a working model that uses a simple machine.

Use on-screen building instructions to create Gator-bot. Include a motor and a pulley.

Add a touch sensor inside Gator-bot's mouth.

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## Use LEGO® WeDo® Robotics to animate your model.

Drag and drop the icons to build a program.

Program the motor to turn on, go forward and then reverse, when the touch sensor is pushed.

Program the jaws to move up and down when the touch sensor is pushed.

Start your program.

Put a "fish" in Gator-bot's mouth.

When the gator "feels" food, it will CHOMP!

Try other programs and animate Gator-bot in different ways!

# About
# LEGO® Robotics for Young Beginners

## Learning Outcomes

- Learn about simple machines, such as gears, levers, and pulleys.
- Build a model using a simple machine and a motor. Explain how it works.
- Learn and to use computer software to program animation for a model.
- Experience and explore simple machines and robotics on LEGOLAND rides and attractions.

## California Next Generation Science Standards

**K-2 Engineering Design**

K-2-ETS1-1. …Define a simple problem that can be solved through development of a new or improved object or tool.
K-2-ETS1-2. Develop a simple…physical model to illustrate how the shape …helps it function to solve a given problem.
K-2-ETS1-3. (T)est two objects designed to solve the same problem to compare strengths and weaknesses of each….

**K-2 Matter and Its Interactions**

2-PS1-3. Make observations to construct an evidence-based account of how an object made of a small set of pieces can be disassembled and made into a new object. [Clarification Statement: Examples of pieces could include…building bricks…]

**GRADE 3-5 Engineering Design**

3-5-ETS1-1. Define a simple design problem…that includes criteria for success and constraints on materials, time, or cost.
3-5-ETS1-2. Generate and compare multiple possible solutions…based on how well each is likely to meet the criteria….
3-5-ETS1-3. Plan and carry out fair tests…to identify aspects of a model or prototype that can be improved.

The performance expectations above were developed using NRC Framework for K-12 Science Education:

**Science and Engineering Practices**

**Asking Questions and Defining Problems**

Ask Q's based on observations to find…info about the designed world. (K-2-ETS1-1) & based on patterns such as cause and effect (3-PS2-3)

Define a simple problem that can be solved thru development of a new/improved object…(K-2-ETS1-1) & includes…criteria for success….(3-5-ETS1-1)

Define a simple problem that can be solved through the development of a new or improved object or tool. (3-PS2-4)

**Developing and Using Models…** based on evidence to represent a proposed object or tool. (K-2-ETS1-2)
**Analyzing and Interpret Data** from tests of an object…to determine if it works as intended. (K-2-ETS1-3)
**Planning and Carrying Out Investigations** …to…test a design solution. (3-PS2-2)
**Construct Explanations and Design Solutions** Generate & compare solutions…based on how well they meet criteria….(3-5-ETS1-2)

**Disciplinary Core Ideas**

**ETS1.A: Defining and Delimiting Engineering Problems**

- A situation people want to change or create can be approached as a problem to be solved through engineering.(K-2-ETS1-1)
- Asking questions, making observations, and gathering information are helpful in thinking about problems. (K-2-ETS1-1)
- Before beginning to design a solution, it is important to clearly understand the problem. (K-2-ETS1-1)
- …Different…solutions can be compared on the basis of how well each one meets the criteria for success…. (3-5-ETS1-1)

**ETS1.B: Develop Possible Solutions**

- Designs can be conveyed through…models (and) are useful in communicating…solutions. (K-2-ETS1-2)
- …Testing a solution involves investigating how well it performs under a range of likely conditions. (3-5-ETS1-2)
- Communicating with peers about proposed solutions…can lead to improved designs. (3-5-ETS1-2)
- Tests are often designed to identify…difficulties, which suggest elements…that need to be improved. (3-5-ETS1-3)

**ETS1.C: Optimizing the Design Solution**

- Because there is always more than one possible solution to a problem, it is useful to compare and test designs. (K-2-ETS1-3)
- A great variety of objects can be built up from a small set of pieces. (2-PS1-3)
- (Test) different solutions to determine which best solves the problem, given the criteria and constraints. (3-5-ETS1-3)

**Crosscutting Concepts**

**Structure and Function** Shape and stability of structures of …designed objects are related to their function(s). (K-2-ETS1-2)
**Cause and Effect** Events have causes that generate observable patterns. (2-PS1-4).
Simple tests can be designed to gather evidence to support or refute student ideas about causes. (2-PS1-2)
**Energy and Matter** Objects may break into smaller pieces and be put together into larger pieces, or change shapes. (2-PS1-)
**Cause and Effect** relationships are routinely identified (3-PS2-1), tested, and used to explain change. (3-PS2-3)

**Common Core State Standards Connections K-2 and Grades 3-5**

***ELA/Literacy –***
**W.2.8** Recall information from experiences…to answer a question. (K-2-ETS1-1),*(K-2-ETS1-3)*
**SL.2.5** Create…visual displays to…recount experiences…to clarify ideas…. *(K-2-ETS1-2)*
**SL.3.3** Ask and answer questions about information from a speaker, offering appropriate elaboration and detail. *(3-PS2-3)*
**Mathematics –**
**MP.2** Reason abstractly and quantitatively. (K-2-ETS1-1),(K-2-ETS1-3) (3-PS2-1)
**MP.5** Use appropriate tools strategically. *(K-2-ETS1-1),(K-2-ETS1-3) (3-PS2-1)*