# INTRODUCING YOUR CHILD TO STEM

Science, Technology, Engineering, and Mathematics (STEM) education provides young adults with the opportunity to participate in many themed, **hands-on activities**, including those with connections to sports, history, and other subjects.

Activities involving the Balancing Boxer construction toys by Hexbug help individuals learn more about **physics** and **engineering** by engaging in activities that are useful and enjoyable while providing them hands-on experiences in those key areas.

This activity with the Balancing Boxer provides a fun and interesting way for students to learn about the **physics** and **sensors** involved in keeping a robot balanced in an upright position. They also learn about how their own bodies remain upright and balanced.

## VOCABULARY TO KNOW

### ALGORITHM
Set of rules for calculations; to be more specific, the algorithm involved in maintaining an upright posture (or other setpoints) would be called a PID (proportional-integral-derivative) algorithm.

### CALIBRATING SENSORS
Setting a sensor to a baseline measurement so that all other measurements can be relative to that initial calibration.
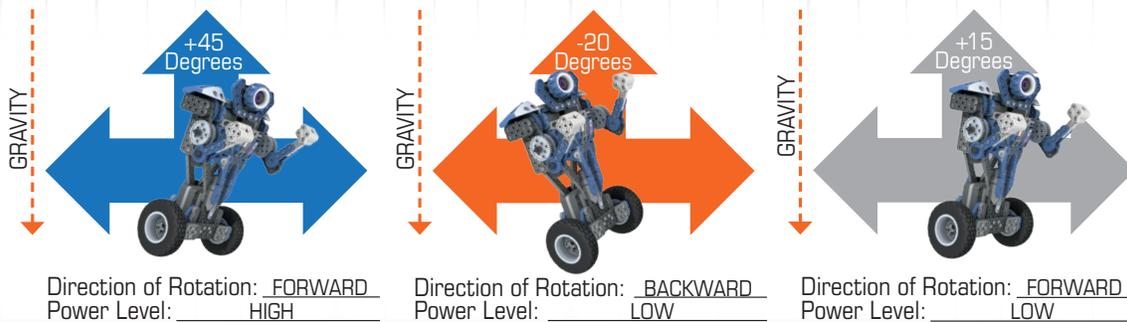
### GYRO SENSOR
A sensor used for collecting data about the position of a robot and/or how much it has moved.

## GENERAL SOLUTIONS

Students testing their own balance and muscles should do so on a soft surface in case they fall.

Students should notice that muscles in their toes, feet, legs, and possibly back all work to keep them upright while leaning. Shaking their heads while leaning should make remaining balanced difficult.

The Balancing Boxer rotates its motors to roll its wheel in the direction that it is leaning. More power is used when it is leaning farther.

GRAVITY — +45 Degrees

Direction of Rotation: __FORWARD__
Power Level: _____HIGH_____

GRAVITY — -20 Degrees

Direction of Rotation: __BACKWARD__
Power Level: _____LOW_____

GRAVITY — +15 Degrees

Direction of Rotation: __FORWARD__
Power Level: _____LOW_____

## EXTEND YOUR LEARNING

### DISCUSS
The Balancing Boxer works by constantly monitoring its position and adjusting accordingly. What does it use to do this?
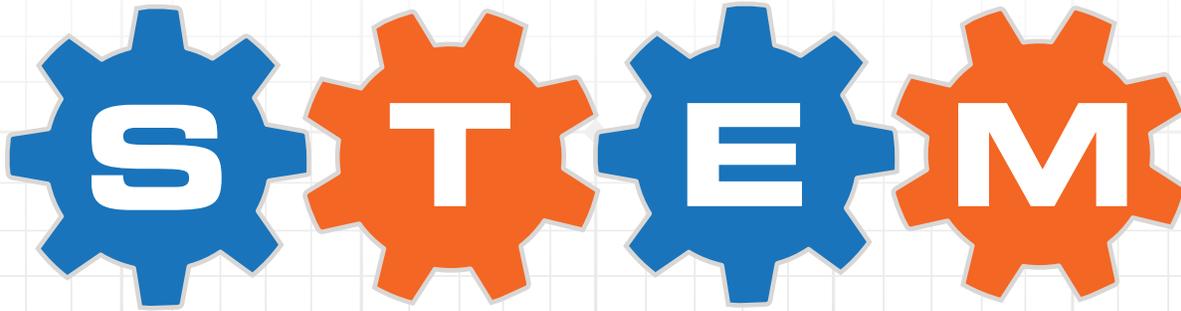
### APPLY
Think about your own senses. What types of sensors might make a robot more like a person?

### EXPLORE
You can explore additional VEX Hexbug builds and investigations here:
https://www.hexbug.com/vex

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# STEM STANDARDS ADDRESSED

## S T E M

### MS-ESS1-1
Patterns can be used to identify cause and effect relationships.

### 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.

### 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.

### MS-PS2-2
Plan an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

### HE-ETS1-2
Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

### ISTE1.1D
Students understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.

### ISTE3.3D
Students build knowledge by actively exploring real-world issues and problems, developing ideas and theories, and pursuing answers and solutions.

### ISTE4.4D
Students exhibit a tolerance for ambiguity, perseverance, and the capacity to work with open-ended problems.

### 3-5-ETS1-1
Define a simple design problem that can be solved through the development of an object, tool, process, or system and includes several criteria for success and constraints on materials, time, or cost.

### MS-PS3-2
Develop a model to describe unobservable mechanisms.

### MS-ETS1-4
Develop a model to generate data to test ideas about designed systems, including those representing inputs and output.

### CCSS.MATH.PRACTICE.MP1
Make sense of problems and persevere in solving them.

### CCSS.MATH.PRACTICE.MP3
Construct viable arguments and critique the reasoning of others.

### CCSS.MATH.PRACTICE.MP4
Model with mathematics.

### CCSS.MATH.PRACTICE.MP7
Look for and make use of structure.

## STANDARDS REFERENCED

**MATH**
Common Core Standards for Math
http://www.corestandards.org/math/

**SCIENCE & ENGINEERING**
Next Generation Science Standards
http://www.nextgenscience.org/

**TECHNOLOGY**
International Society for Technology in Education
http://www.iste.org/standards/