

Actual measurements: Data that is found by making measurements, as opposed to predictions.

All-Purpose: Usable for a number of different tasks.

Algorithm: A systematic method for solving a certain kind of problem that is guaranteed to always give a correct answer. Sometimes used more generally to mean any well-defined, systematic method of doing something.

Amplitude: The difference between the “highest” or “lowest” point of a wave, and the “rest” or “zero” level. For a sound wave, the difference in air pressure between the most-compressed “peak” areas of the wave and undisturbed air (which is represented as the middle “zero” line on a graph). Note that amplitude is NOT the difference between the highest point and the lowest point on the wave – amplitude is measured from the top to the middle, or the bottom to the middle, but not top to bottom.

Axle, TECHNIC: See TECHNIC Axle.

Beam, TECHNIC: See TECHNIC Beam.

Behaviors: Anything a robot “does,” including both observable actions (e.g. move forward for 10 cm) and internal actions (e.g. add 1 to a variable in the program). Complex behaviors are often made of numerous simpler behaviors put together; moving through a maze is a behavior composed of smaller moving and turning behaviors.

Bevel Gear: A gear cut at an angle so that it can mesh with other bevel gears at different angles in three dimensions.

Block (programming): A block is the basic unit of programming in the NXT programming Software. Generally, one block represents one command given to the robot, although some blocks (such as the Loop block) are used instead to organize and control the execution of other blocks. Blocks perform their operations in order along the Sequence Beam (see Sequence Beam).

Bluetooth: A short-range radio communication technology supported by the NXT. Bluetooth allows one NXT to connect to another, allowing them to exchange data while running. An NXT can also connect via Bluetooth to a Bluetooth-equipped desktop/laptop computer or mobile phone. See the NXT User Guide for more information.

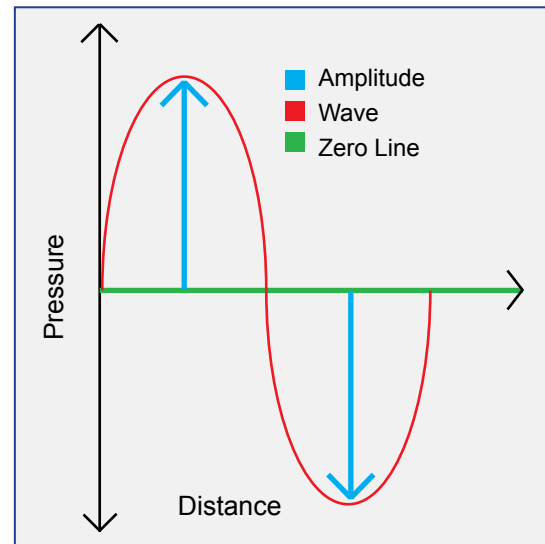
Center of Mass: The “average” location of all the mass in an object. In many cases, you can make predictions about the entire object’s behavior based on the location of its center of mass alone.

Circumference: The distance around the edge of a circle. Equal to diameter times π .

Code: General term for any command or group of commands in a program. In the NXT Programming Software, this is one or more blocks.

Comment: A written note in the program that explains something about that portion of the program. Comments do not actually change the way the robot behaves in any way, but are very important to the programmer’s ability to remember what a certain piece of code does.

Amplitude



Compiler: The compiler is a part of the NXT Programming Software that takes the blocks in a program and converts them into machine language that the NXT brick can understand and run. The compiled code is not exactly the same as the code written in blocks on your computer; this is why you cannot load the program back onto the computer once it is compiled and downloaded to the NXT.

Condition (experimental): A portion of an experiment corresponding to one specific setting of the independent variable. If your experiment involves large wheels and small wheels, for instance, the part of the experiment where you use the large wheels is the “large wheel condition.” Condition can also refer to the setting of the variable itself. See also Condition (programming).

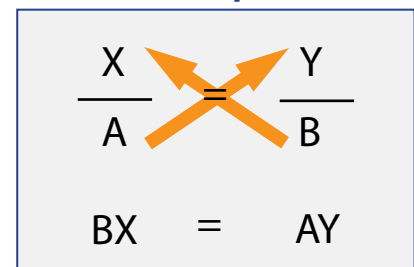
Conditional Statement (programming): A programming block that chooses to run different pieces of code, depending on some factor (for example, it may choose to run straight ahead if the robot does not detect an obstacle, but turn to the left if there is a nearby object). In the NXT Programming Software, this task is performed by the Switch block.

Connector (NXT): The clear plastic piece that joins and holds the electrical contacts together between the wire and the ports on the NXT. See also Ports.

Connector (TECHNIC system): Any element that joins two or more other elements. See also Peg, Joint, Peg-Joint.

Cross-Multiplication: A mathematical procedure used to solve an equation of the form $X/A=Y/B$ (one fraction equals another fraction, with no other terms outside the fractions). The result of cross-multiplication in the example above is $BX=AY$.

Cross-Multiplication



dB: Abbreviation for decibel (see Decibel). Also refers to a mode of the Sound Sensor (see dB and dBA).

dB and dBA: dB and dBA are modes of the Sound Sensor that refer to different frequency sensitivity settings. When used this way, the terms “dB” and “dBA” are not units! dB mode produces readings that are simply based on how much sound is picked up by the Sound Sensor. dBA mode also gives readings based on the amount of sound detected, but adjusts those readings so that the displayed values more closely match the pattern of human hearing, which is less sensitive to very high and very low frequencies. Just as a human would perceive these sounds to be quieter, dBA mode will give lower readings for those frequencies even if the actual amount of sound is the same.

Decibel: A relative unit of measure commonly used with reference to the amplitude (loudness) of sound. In sound, 0 dB is the quietest sound a person can hear (measured in micropascals, a very small unit of pressure, since sound is based on pressure waves). Every 10 dB increase then means that the sound gets ten times louder. 10 dB is ten times louder than the quietest sound you can hear. 20 dB is ten times louder than that. 30 dB is ten times louder than 20 dB, and is about the level of noise in a quiet room. Note that the Sound Sensor does not measure in decibels, even when its mode is set to dB. Instead, it measures a % value of the loudest sound it can detect.

Dependent Variable: In an experimental setup, the variable whose value is measured to see whether it was affected by a change in the independent variable. Also called the responding variable (RV).

Diameter: The distance “across” the center of a circle from edge to edge. Equal to two times the radius of the circle.

Downloading: Transferring data (usually a compiled program) from the computer to the NXT. See also Uploading.

Driven axle: When considering a pair of axles connected by gears, pulleys, or other means, the driven axle is the one whose movement is an effect of the other’s (rather than the cause). See also Driven Gear, Driving Axle.

Driven gear: When considering a pair of connected gears, the driven gear is the one whose movement is an effect of the other's. If axles are being considered, the driven gear is the gear on the driven axle. See also Driven Axle, Driving Gear.

Driving axle: When considering a pair of axles connected by gears, pulleys, or other means, the driving axle is the one whose movement is the cause of the other's. See also Driving Gear, Driven Axle.

Driving gear: When considering a pair of connected gears, the driving gear is the one whose movement is the cause of the other's. If axles are being considered, the driving gear is the gear on the driving axle. See also Driving Axle, Driven Gear.

Engineering: The study and application of science, mathematics, and technology to find solutions to real-world problems.

Firmware: The special program pre-loaded on the NXT that tells it how to run other programs. This may need to be updated from time to time with new versions to add new and improved functionality. Sometimes it may become corrupted on the NXT, and needs to be re-downloaded before you can resume normal use.

Frequency: The number of waves that pass by a point in space in a certain amount of time. For counting purposes, one "wave" is usually considered an entire cycle from peak to peak (i.e. two "tops" of waves pass by) or trough to trough (two "bottoms" pass by). Frequency is usually expressed in hertz (Hz), which is one wave per second.

Gear Ratio: The number of times the driving axle in a system must spin to make the driven axle turn once. With gears, the gear ratio can be found by counting the number of teeth on the driven gear, and dividing by the number of teeth on the driving gear.

Gear Train: A series of gears that transmit power between axles.

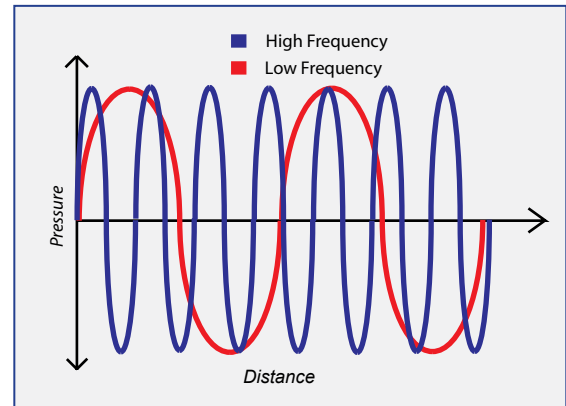
Hertz: Unit of measurement for the frequency of repeating events, defined as one repetition per second. With sound, for instance, frequency is the number of pressure waves that travel past a certain point in a certain amount of time... each time the "peak" of a wave travels by that point, you can count one cycle of the wave. Thus, if ten peaks travel by in one second, the wave has a frequency of 10 hertz. Many waves travel so quickly that thousands of peaks will go by in a second, thus the kilohertz (kHz, 1000 Hz) is a frequently used unit also.

Hypothesis: An educated explanation describing the possible relationship between two or more factors. A good hypothesis is very specific, providing detailed, useful information. A good hypothesis is also testable, meaning that experimentation can help to show whether the hypothesis is correct or incorrect (though it cannot ever conclusively prove correctness).

Independent Variable: In an experimental setup, the variable that is set and changed in different experimental conditions by the experimenter in order to see whether these changes cause a change in the dependent (responding) variable. Also called the manipulated variable (MV).

Interactive Servo Motor: The primary source of physical motion in the Mindstorms NXT system. The Interactive Servo Motors include both an electric motor (which allows them to spin the orange barrel portion of the motor on command) and a built-in rotation sensor. The rotation sensor allows the NXT to monitor the amount the motor has turned, and control the motors accordingly. Interactive Servo Motors are normally plugged into ports A, B, and C on the NXT. For two-wheeled robots, the default setup is to plug the left motor into Motor Port C, and the right motor into Motor Port B.

Frequency



Interactive Servo Motor



Joint (TECHNIC system): An element that holds other elements in various configurations and angles. See also Peg, Peg-Joint.

LCD (Liquid Crystal Display): A transparent screen containing a light-polarizing liquid that is controlled by electric fields to create visible readouts. The NXT uses a monochrome (black-and-green) LCD screen as its primary display on the front of the brick.

LEGO MINDSTORMS Education NXT Programming Software: Software used for programming the NXT robot.

Light Sensor: An NXT sensor that detects the presence of certain wavelengths of light and reports the intensity of light back to the NXT. The Light Sensor has two modes: Reflected Light and Ambient Light. In Reflected Light mode, the Light Sensor will shine a red light and look for the amount of that light that bounces back to it off objects in the environment. In Ambient Light mode, the sensor will not shine the light, instead looking for light that reaches it from other sources.

Loop: A programming block that allows the program to repeat an action or series of actions as many times as desired, or until a certain condition is met.

Manipulated Variable: See Independent Variable.

Module (TECHNIC system): The basic unit of length in the TECHNIC system. One module (abbreviated 1M with an upper-case 'M') is defined as the distance from the center of one hole on a TECHNIC beam to the center of the next hole. By counting the number of holes in a TECHNIC beam, you can find its length in modules.

Motor/Move Block: Blocks designed to control motors on the robot. The Motor and Move blocks can both be used to control the movement of a robot, and have both advantages and disadvantages in doing so. See "Motor vs. Move" in the Basics > Robot Behaviors section for more information.

NXT: Name of the newest generation of LEGO MINDSTORMS robotics hardware and software. Also refers specifically to the NXT Brick (see NXT Brick).

NXT Brick: The electronic component that controls the operation of the robot by following instructions contained in a stored program. Based on these instructions and the data received from any connected sensors, the NXT can direct the actions of the robot to perform a large range of tasks.

Peak: The "top" of a wave on a graph. The point of greatest disturbance from the "rest" state in one direction. See also "trough".

Peg (TECHNIC system): An element that directly attaches two or more other elements using round or cross-shaped holes. Pegs are the primary method of holding pieces together in the studless TECHNIC building system. See also Joint, Peg-Joint.

Peg-Joint (TECHNIC system): An element that functions as both a Peg and a Joint. See Peg-Joint.

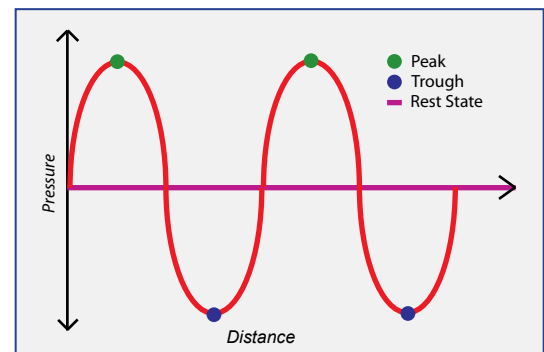
LEGO Mindstorms Education NXT Programming Software



Light Sensor



Peak



Perpendicular: Intersecting at a 90 degree angle.

Point Turn: A turn where one wheel rotates forward and the other rotates backward, causing the robot to sit and spin in place. Also called a “skid turn” in general robotics.

Ports: The designated areas for connecting sensors and/or motors to the NXT. A wire of appropriate length should be used to connect the NXT with each sensor or motor device. Lettered output ports connect to Interactive Servo Motors or Lamps, allowing those devices to be controlled by the NXT. Numbered input ports are for sensors.

Proportion: See Ratio and Proportion.

Protractor: A device used for measuring angles.

Radius: The length of the line segment that joins the center of a circle with any point on its circumference. Equal to half the diameter of the circle.

RCX: The previous-generation LEGO MINDSTORMS robot controller, easily identified by its bright yellow color.

Responding Variable: See Dependent Variable.

Right Angle: A 90 degree angle.

Robot: A machine that is able to interact with and respond to its environment. A robot is characterized by three central capabilities: the ability to Sense, the ability to Plan, and the ability to Act. See Sense, Plan, Act.

Robot Educator: The built-in example and tutorial system in the LEGO MINDSTORMS Edu NXT Programming Software.

Robot Educator Model (REM): The small mobile robot base used in the Robot Educator. This robot is able to perform some but not all of the tasks in the Robotics Engineering activities. See also Taskbot.

Rotation Sensor: A device that measures the amount of rotation of a certain piece or object. The NXT Interactive Servo Motors have rotation sensors built into them that measure the amount of rotation of the orange motor barrel, in either degrees or full rotations.

Scientific Inquiry: The process by which scientists seek to ask and answer questions about the world. Evidence, models, and logical explanation are all key parts of the process. Inquiry is NOT a rigid series of steps, but rather a fluid cycle of proposing, examining, and revising explanations to find the best answer to a question.

Sense-Plan-Act: The three characteristic capabilities that define a robot. The robot must be able to “Sense” things about its environment, it must be able to “Plan” an appropriate response to those factors, and it must be able to “Act” accordingly.

Sensor: A device that detects some important physical quality or quantity about the surrounding environment, and conveys the information to the robot in electronic form. A Sound Sensor, for example, will detect vibrations in the air, and send an electrical signal to the NXT indicating how strong those vibrations were.

Protractor



Robotics Educator Model



Sound Sensor: An NXT sensor that detects sound waves and reports the amount of sound back to the NXT.

Sound Sensor



Sound wave: A “moving” pattern of high and low pressure in air (or other medium), perceived as sound.

SPA: See Sense-Plan-Act.

Speed: The rate at which an object is moving. The rate of change an object’s position over time. Calculated by dividing the distance an object moves by the amount of time it took to move.

STEM: Acronym for the closely related fields of Science, Technology, Engineering, and Mathematics.

Support Polygon: The imaginary polygon formed by connecting all the points where an object touches the ground. This polygon marks the boundaries of where the object’s Center of Mass can be while remaining stable. If the Center of Mass is not directly over the interior of the Support Polygon, the object will fall over.

Swing Turn: A turn where one wheel rotates and the other stays in place, causing the robot’s body to “swing” around the stationary wheel.

Taskbot



Taskbot: A versatile all-purpose robot designed for the Robotics Engineering activities.

TECHNIC Axle: Basic TECHNIC element. A rigid plastic rod with a cross-shaped cross section. The cross-shaped hole will force any other attached cross-hole elements to turn together with the axle. For this reason, axles are often used in the center of a wheel and gear to link the rotation of the wheel/gear to the rotation of another piece, such as a motor.

TECHNIC Beam: Basic TECHNIC element. A long beam-shaped piece with evenly-spaced holes in one side. TECHNIC Beams are the primary structural elements of most TECHNIC designs, and can be found in both studded and unstudded varieties.

TECHNIC Axle



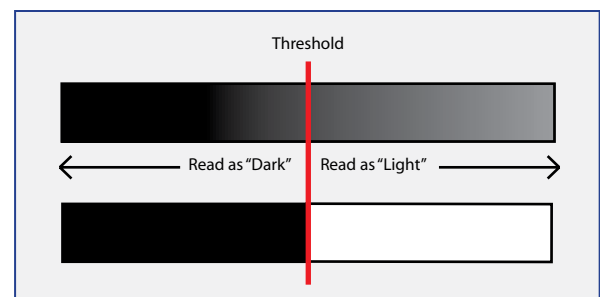
TECHNIC Beam



Theoretical Measurement: A predicted value for a measurement. Usually, these predictions are made by taking a real measurement, then using a hypothesis or theory (hence the name “theoretical”) to predict what the value should be under slightly different conditions. After this prediction is made, the real measurement is usually taken, and compared against the theoretical one to see how well the prediction matched the real outcome.

Threshold: A “cutoff” or dividing line between two regions. One common use for thresholds is to divide the hundreds of possible sensor readings from a sensor (a Light Sensor can give a value anywhere from 0-100, for example) into two manageable categories. For the Light Sensor, this would mean setting a threshold value somewhere between 0 and 100, then declaring that all values above the threshold are now “light” while all values below the threshold are now “dark.” A light sensor reading can then be easily categorized and handled appropriately. The threshold value can be chosen in any way desired, but it is conventional to choose a value exactly halfway between two known extremes (e.g. halfway between a very dark surface and a very light one).

Threshold



Torque: Roughly speaking, torque is the rotational equivalent of force. Whereas force causes an object to speed up or slow down its (linear) motion, torque causes an object to speed up or slow down its rotation. A motor that generates more torque will let the robot speed up or slow down more rapidly, as well as handle larger tires, heavier loads, and steeper inclines.

Touch Sensor: An NXT sensor that detects physical contact (touch) and reports back to the NXT whether its contact area is being pushed in or not.

Trough: The “bottom” of a wave on a graph. The point of greatest disturbance from the “rest” state in one direction (the one that corresponds to “downward” on the graph). See also “peak”.

Ultrasonic Sensor: An NXT sensor that measures distance by emitting ultrasonic sound waves, then measuring how long it takes them to echo back off of objects or surfaces in the environment. The Ultrasonic Sensor then reports the calculated distance back to the NXT.

Uploading: Transferring data (usually gathered data) from the NXT to the computer. See also Downloading.

Variable (mathematics): A stand-in for a not-yet-known value in a mathematical equation. Once a variable’s value has been found, the value can be substituted anywhere in place of the variable.

Variable (experimental): A factor that is either manipulated or measured during the course of an experiment. See also Independent Variable, Dependent Variable.

Variable (programming): A “container” for a value. The programmer may choose to store a value (perhaps a sensor reading) in the variable, and use it in a later operation (display it to the screen at the end of the program, for instance). The programmer may also choose to perform mathematical operations on the stored value, such as adding 1 to it.

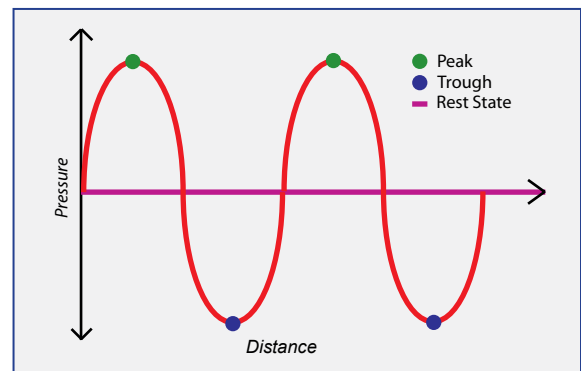
Wavelength: The distance between successive equivalent points on a wave. For example, the distance between two neighboring peaks on the wave.

Worm Gear: A special type of gear that uses a screw-like shaft and a wheel with slanted teeth to reduce speed or transmit torque between nonparallel axles. Also has the special properties of being a “one-way” gear and having effectively only one tooth for gear ratio calculations.

Touch Sensor



Trough



Ultrasonic Sensor



Wavelength

