Glossary:

ADC: Analog to Digital Converter. Any method of converting an analog signal (a voltage) to a digital signal (a number). Here is the equation necessary to do this:

$$ADC\ Value = \frac{(Voltage\ on\ Pin(mV)) * (Max.\ ADC\ Value)}{(System\ Voltage(mV))}$$

Analog: A measurement or signal that has values between On and Off. Examples include voltage, pressure, any type of wave, and volume. One useful metaphor for teaching is the zipper (if you have a zipper on your jacket or hoodie). In comparison to the button (Digital) the zipper has many states between completely open and closed. Analog's counter part is Digital.

API mode: One of the firmware modes for XBee radios, particularly important for series 2 Xbee radios, as the coordinator radio needs to be in API mode to receive i/o data. You can change the firmware to API mode using the free X-CTU software from Digi.

array: Arrays are a way to store several variables in a list, or array. In Arduino arrays are declared in a couple different ways. Example: *int arrayName [6];* this will create an array called arrayName with six spaces for variables inside it. A value of 100 would be assigned to the first space in arrayName like this: *arrayName [0] = 100;* (The first value is assigned to the 0 slot.) Here is an example of declaring and assigning values in an array at the same time: *arrayName [6] = {100, 150, 300, 50, 100, 120};* Here is an example of referencing the sixth value in the array arrayName: *arrayName [5]*.

Bias: A state describing voltage and current in a component.

Boolean: A variable type or form of logic based on the assumption that any given variable or state can only have one of two values; true or false, HIGH or LOW, 1 or 0.

bounce: Bounce occurs when a switch (or other type of input) attempts to change it's position to open or closed but does not stay in that position. Due to this you will see the electrical signal rising and falling when it should be at a constant value. If you're experiencing bounce issues, try using the `delay( )` function.

button: A digital input with only two states; pressed or not pressed. Depending on the layout of the circuit these two states can correspond to either HIGH or LOW.

char: Variable type character, 8-bit size, any single symbol. Examples: A, a, 1, or !

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command mode: The mode in which you can set certain behaviors of an XBee radio using AT commands. You can enter command mode by sending '+++' without a carriage return to the radio over serial. The radio requires a second of silence before and after in order to enter command mode. The radio will exit command mode after 10 seconds if it does not receive a command. (See the AT commands breakdown in this binder for most of the AT command set).

comments: Used to write notes in code that are not part of the execution. For a single line use //, for a block of lines start with /* and end with */

constrain: A function used to constrain a value between a given range. Example: *sensVal = constrain (sensVal, 10, 150);* This constrains the sensVal value between 10 and 150. If it is under 10 sensVal is assigned 10, if it is over 150 sensVal is assigned 150.

coordinator: The coordinator radio is the one and only node in a wireless sensor network that is responsible for receiving and coordinating the flow of data between other radios across the network. Router radios can also pass on messages, but every network must have one and only one coordinator radio.

current: This can refer to either the the flow of electrical charge or the rate of flow of electrical charge, measured in mA.

Digital: A measurement or signal that has only two values, On and Off. On and Off can also be expressed as HIGH and LOW, as well as 1 and 0. Examples include Boolean logic, open or closed and button state. One useful metaphor for teaching is the button (if you have a button on your jacket or hoodie). In comparison to the zipper (Analog) the button has only two states; connected and unconnected. Digital's counter part is Analog.

diode: A two terminal electrical component that only conducts in one direction.

Ground: In electrical engineering, ground or earth may be the reference point in an electrical circuit from which other voltages are measured, or a common return path for electric current, or a direct physical connection to the Earth.

firmware: Generally, firmware refers to any program that is loaded onto a chip to run logic in a circuit. In XBee radios, you will have to change and occasionally update the firmware on each radio depending on the functions you want them to perform within your network.

float (signal): A signal due to a pin that is not attached to anything. A floating pin can read anything between HIGH and LOW.

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float (data type): Variable type float, used for floating point operations (i.e. numbers with decimal points).

for: for(variable declaration and assignment; condition; variable increment){ }
A form of iteration, code inside the curly brackets will repeat until the condition is false. Example of a for loop that will loop four times:

```
for (i = 0, i < 4, i++) {//do this code each time};
```

forward bias: The state of a component describing voltage saturation necessary to activate a component.

footprint: A footprint is the pattern on a circuit board to which your parts are attached. This includes the electrical connections and silkscreen.

flyback diode: Used to reduce voltage spikes seen across inductive loads due to a sudden loss in voltage from the power source.

hexadecimal: In mathematics and computer science, **hexadecimal** (also **base 16**, or **hex**) is a positional numeral system with a base of 16. It uses sixteen distinct symbols, most often the symbols **0**–**9** to represent values zero to nine, and **A**, **B**, **C**, **D**, **E**, **F** (or alternatively **a**–**f**) to represent values ten to fifteen. For example, the hexadecimal number 2AF3 is equal, in decimal, to $(2 \times 16^3) + (10 \times 16^2) + (15 \times 16^1) + (3 \times 16^0)$, or 10,995. Often you will need to add hexadecimal notation to the beginning of a number represented in hexadecimal. To do this type "0x" before the number.

if statements: if(condition){ }
else if (condition) { }
else { }
This will execute the code inside the curly brackets if the condition is true, and if the condition is false it will test the "else if" condition. If the "else if" condition is true it will execute the code in the second set of curly brackets. Otherwise it will execute the code inside the third set of curly brackets.

Input: A signal or data received by a processor.

int: Variable type integer, 16-bit size, any number between -32,768 and 32,767.

iteration: When something happens over and over and over, but changes a little each time.

lead: Electrical contacts for parts, these usually look like wires or pins extending off the part.

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LED: A light emitting diode.

Library: A collection of code that has been packaged so it can be included and then used in code. Servo example: `#include <Servo.h>` (This includes the library so it can be used) `Servo myservo;` (This creates a servo object so the functions inside the library can be used) `myservo.write(90);` (This uses the write function in the servo library, setting the servo's angle to 90 degrees.

loop ( ): Looks like- `void loop ( ){ }` The main loop in an Arduino sketch, this where the action happens. The `loop ( )` function is present in every single Arduino sketch. The Arduino will execute the code inside the curly brackets, once it has finished this code it will start over from the beginning of the loop function.

map: A function used to re-map a value between a range to a value between another given range. Example: `sensVal = map (sensVal, 10, 150, 100, 1500);` This maps the sensVal value from somewhere between 10 and 150 to somewhere between 100 and 1500 proportionally.

microcontroller: A tiny computer on a single integrated circuit with a core processor, memory and programmable input/output.

motor: An electrical component that converts electrical energy to mechanical energy.

Ohm's Law: V = I * R where V is Voltage, I is Current and R is Resistance. A handy way to figure out any one of these values given the other two. The complicated version: Ohm's law states that the current through a conductor between two points is directly proportional to the potential difference or voltage across the two points, and inversely proportional to the resistance between them.

operators: Similar to mathematical symbols, pay special attention to the difference between = and ==.

output: A signal or data transmitted by a processor.

PAN ID: Personal Area Network ID. A number used to define which Xbee Radios can talk to each other.

PAN Address: A hexadecimal number in the range 0x0 – 0xFFFF that defines which Network the Xbee will attach to.

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piezo element: A digital component which moves a disc to one of two possible positions to create an analog output via vibration, often used to create annoying melodies with little aesthetic value.

Pin: A place to connect electrical circuits to one another.

pinMode: Arduino command used to set pins to either INPUT or OUTPUT.
Looks like- `pinMode ( pinNumber, value );` where pinNumber is the pin to be set and value is either INPUT or OUTPUT. pinMode can also be used to turn Analog In pins into Digital pins.

potentiometer: A voltage divider with a dial to change the values of the two resistors inside.

polarity: Electical polarity is present is every circuit we make, and refers to the flow of electrons through a circuit (typically from negative to positive). In DC circuits, one pole is always positive and one pole is always negative. Often we call a specific component 'polarized' if it requires a specific orientation within the circuit (e.g. since diodes block current in one direction, we want to make sure they are placed so that they allow current in the direction that we need).

pseudo-code: A human-readable way of describing a computer program so that it is easier to understand. See the description of 'if statements' in the glossary for an example.

Pulse Width Modulation: A commonly used technique for controlling digital systems to create a simulated analog output. Often abbreviated as PWM.9

relay: An electrically operated switch.

Resistance: A measure of the opposition to electrical current. Measured in Ω (ohms).

resistor: Component used to restrict the amount of current that can flow through a circuit. Rated in Ω (ohms).

router: A router can refer to any device that can receive and re-route data packets towards a specific destination. In XBee radios, a radio in Router mode performs a similar function: to send, receive, and route data from other radios to their intended receivers. There can be zero, one, or many routers within any wireless sensor network design.

Serial: universal asynchronous receiver/transmitter.

Serial Monitor: Window in Arduino programming environment that allows the user to monitor serial communication.

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setup (): Looks like- `void setup ( ){ }` All the code between the curly brackets will run once when the Arduino program first starts. (As well as each time it is restarted.)

shift register: In this case a chip which allows you to change the value of it's output pins, starting with either the first or last pin, by “shifting” a new value in and “shifting” all the old values towards the opposite end of the chip. The shift register uses three pins (latch, clock, and data) to control eight output pins.

sketch: The code created in your Arduino environment which is then saved onto your Arduino board to make something happen.

sketchbook: Folder where your sketches are stored.

temperature sensor: A sensor used to convert temperature to an analog reading, in this case a voltage, which can be read by your Arduino.

trace: A copper path on a PCB necessary for electrical conductivity between parts.

transistor: A semiconductor device used to amplify or control an electronic signal.

value: Worth or symbol stored in a variable.

variable: A symbolic name associated with a value and whose associated value may be changed.

voltage: The difference in electrical potential between any two given points of a circuit.

voltage saturation: When a component has the necessary voltage present to allow it to operate.

Xbee: Low power radios that use the IEEE 802 standard for Personal Area Networking. These units operate at 2.4 Ghz.