Snapshot Notes

## Batteries

Batteries consist of three components: positive node (cathode), negative node (anode), and the electrolytes (one positive and one negative).

Electrons flow through the anode, where the metal ions in the electrolyte are negatively charged, and towards the cathode which has a positively charged electrolyte. There is a buffer between the two electrolytes to prevent flow of electrons through anything other than the connected lead wires.

Batteries are rated for Voltage output and capacity. Voltage output is measured in Volts while capacity is measured in Amp Hours, which describes the amount of current the battery will output before dying in one hour.

## Circuits

Circuits are measured by three different variables: Current (Amps [I]), Voltage (Volts [V]), and Resistance (Ohms [R]).

Ohms Law states:

* A common metaphor for Voltage, Current, and Resistance is water piping, where Volts is your water pressure, current describes water flow, and resistance is anything within the pipes that resists the water flowing through the pipes.
* It is important to note that electron flow is different from current flow. Current flow can be described in either direction (positive to negative or negative to positive), while electron flow is only negative to positive. It is a convention in electrical engineering to, when analyzing circuits, state that the current is flowing from positive to negative.
* Additionally, regarding making circuits, making sure that electrons are flowing in the correct direction is vital, since some components rely on electrons flowing in one direction or the other, such as diodes-- or even more pertinent to us, motors, since the motor will spin the opposite direction than intended if they are hooked up in the wrong direction.
* Resistors, a common electrical component, resist current through a circuit. Resistors take energy in and output some of it in the form of electricity, and the rest as heat. This is an ineffective approach since it wastes energy (the advantage of resistors is that they are small), so in order to control systems (specifically motors) that take a lot of energy, instead of using variable resistors or potentiometers, we can use motor controllers. Motor controllers essentially switch the current to the motor on and off very rapidly. We can change the ratio of on to off time to relate to the percentage of power we would like the motor to operate at.

## Lights

Lights can be broken up into several different categories, but only some are crucial in building a robot in the FIRST Competition.

The main light we will work with is an LED (Light Emitting Diode); a light emitting diode is an electrical component, which also produces light. A diode is a component that only allows the circuit to flow in a specific direction. Lights can also be used for warnings (for example the spinning orange caution light on the bot) and they can be used as binary indicators (on or off, etc.)

## Actuators

Actuators are any device that produces an action. There are many different types of actuators.

For example, technically DC Motors are actuators, even though typically (in the United States at least), actuators are commonly used in short of Linear Actuators, which produce motion in the linear form. Servos are actuators as well. Linear Actuators typically use gear heads and a drive screw to convert power from a DC Motor to turn the drive screw, which causes the actuator head to move outward in a linear fashion. However, there are other types of linear actuators. For example, linear actuators can also use hydraulics or pneumatics to drive the actuator head in or out.

## Sensors

Sensors are devices that take environmental data and convert it into data that we can process to make something change its own processes accordingly to the environment. There are tons of different types of sensors. Three specific sensors that we use are odometers (to measure RPM of motors), accelerometers (to measure acceleration), and IR distance sensors (to measure distance), and a camera (for a human visualization of surroundings). Sensors are a subtly crucial aspect of the robot.

## Pulse-Wave Modulation

Pulse-wave modulation (PWM) is an idea utilized by motor controllers to determine the motor’s speed—that is to change the ratio of on to off time of the motor, thusly adjusting the speed of the motor by “serial modulation.” Additionally, using PWM, we can change the direction of the motor by changing the voltage to a negative value (effectively reversing the direction of electron flow by swapping the negative and positive terminal connections).

## Wireless Fidelity (WiFi)

In our robot, we will use a wireless network for communication between our command station and the bot itself. There are two main frequencies for Wireless Communications. That is: 2.4GHz (UHF [Ultra High Frequency]) and 5GHz (SHF [Super High Frequency]) radio waves. Through these radio waves, we can transmit data to the bot.

## Soldering

Soldering is the method we use to bond wires together or to circuit boards. Solder comes in many variant, but we will be using standard-diameter, lead-free, flux-core solder. Solder melts at around 350-380 degrees Fahrenheit, which means when using a soldering iron or soldering gun we must be very careful. Solder flux is a compound which is a catalyst in the process of melting solder onto metal, which makes flux-core solder very useful. Solder wick, or a solder-sucker is used to remove solder (de-solder) from a contact point.