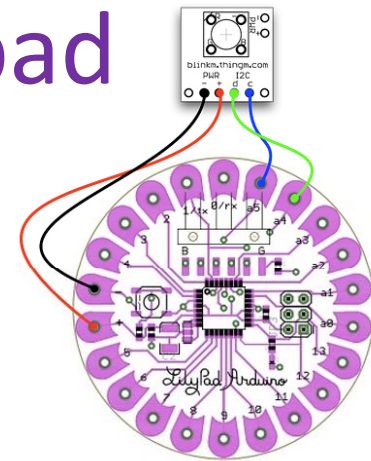


Introduction to LilyPad

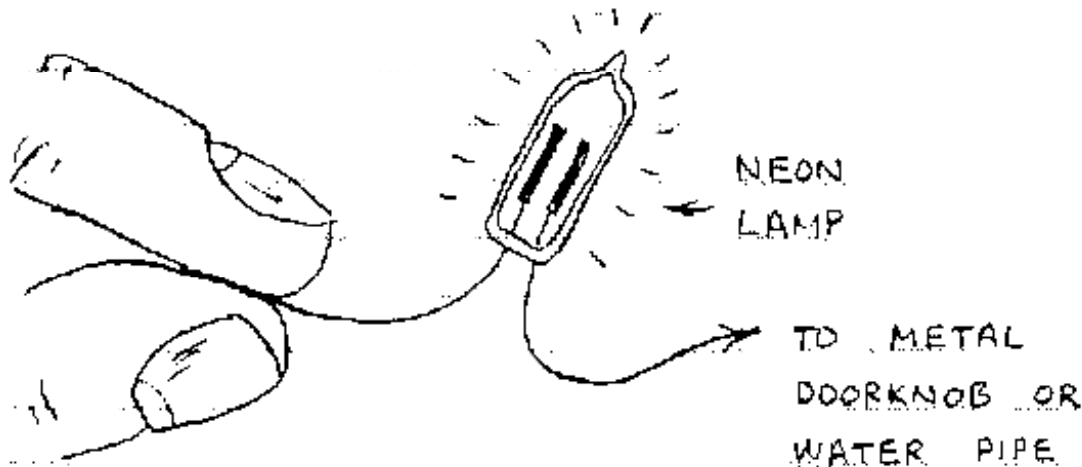


Electricity

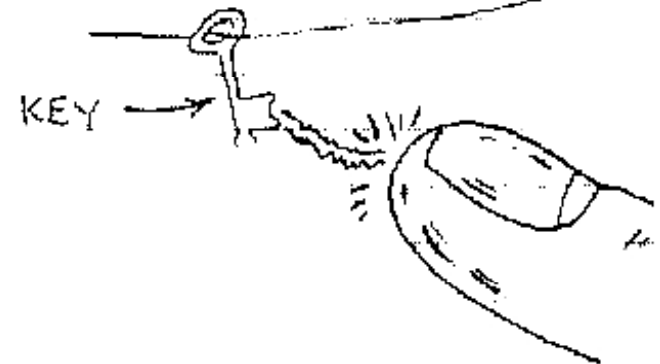
The only difference between a bolt of lightning and the spark between you finger and a doorknob pm a dry day is QUALITY.

Both are electricity

You cannot "see" electricity! You can see effects of electricity which can be many. *Example:*



TO THOSE WHO FLY
A KITE IN THE RAIN,
YOU BETTER SAY "BYE!"
'CAUSE IT'S NOT VERY SAFE.

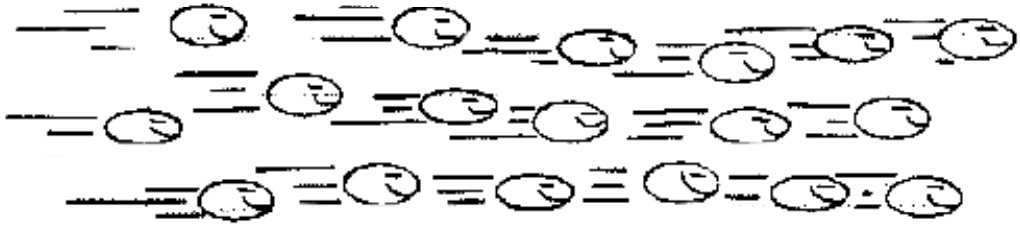


Electricity

Many trillions of electrons can rest on a surface or travel through space or matter at near the speed of light.

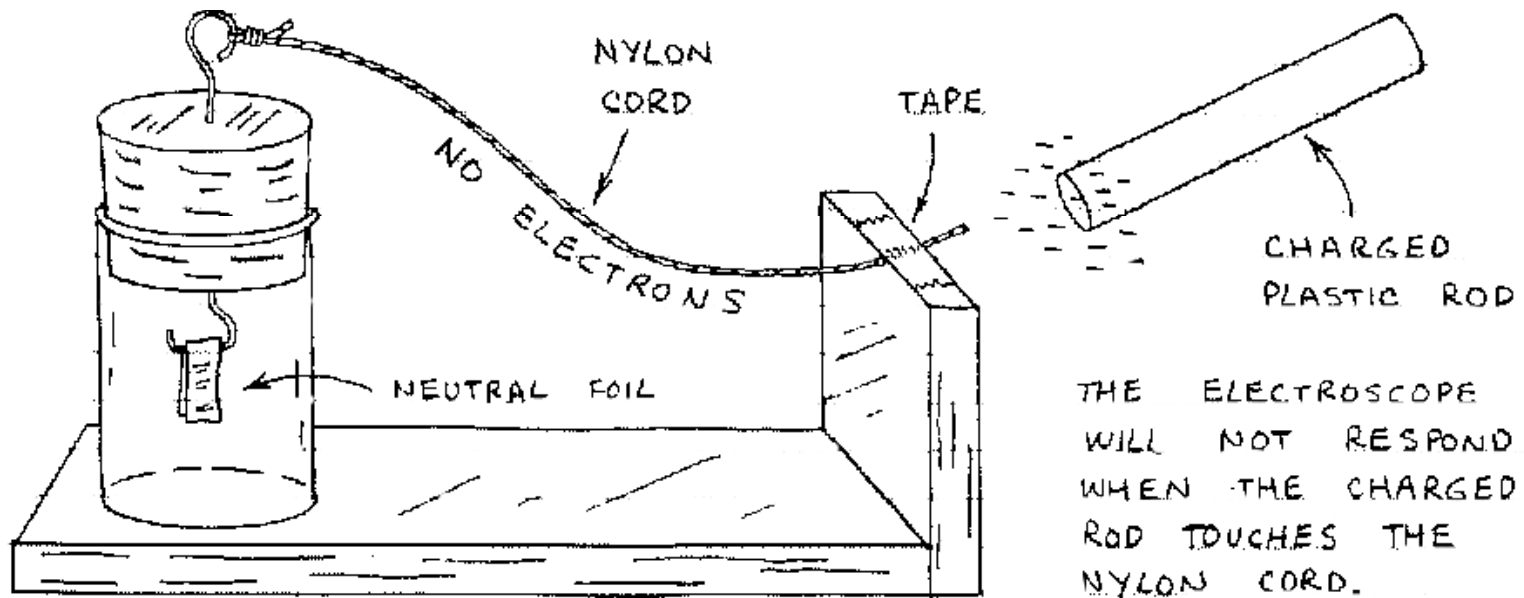
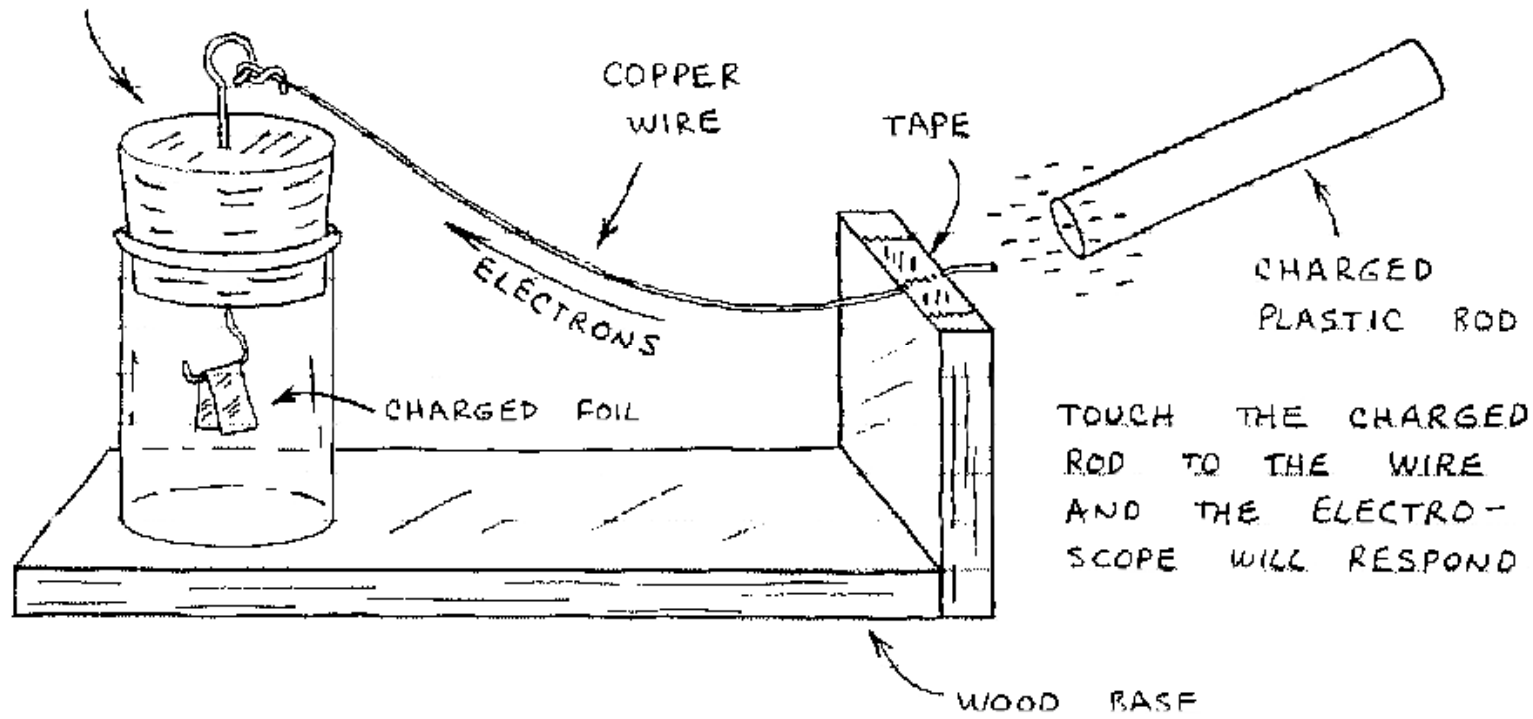


RESTING ELECTRONS



MOVING ELECTRONS

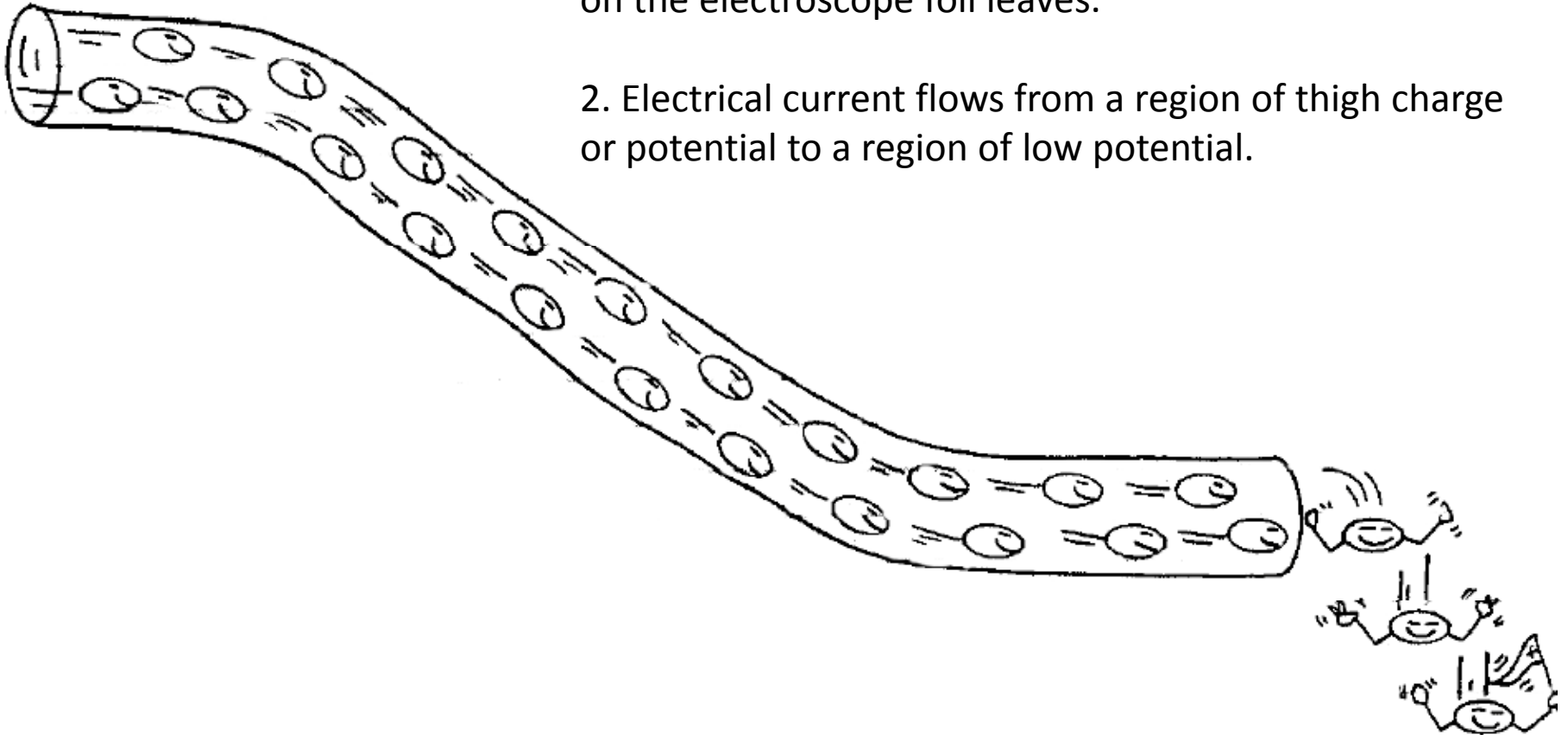
ELECTROSCOPE



Electricity

The conductor – insulator demonstration illustrates who other important points:

1. An immobile static charge flows through a conductor as an electrical current. It then resumes its static state on the electroscope foil leaves.
2. Electrical current flows from a region of high charge or potential to a region of low potential.



Electricity

The most common electricity analogy is the water bomb analogy. The water level is the voltage, the amount of energy available, tap is resistance they resist to some degree the flow of current, the stream of water is the electrical current and the water wheel is the effect caused by the current.

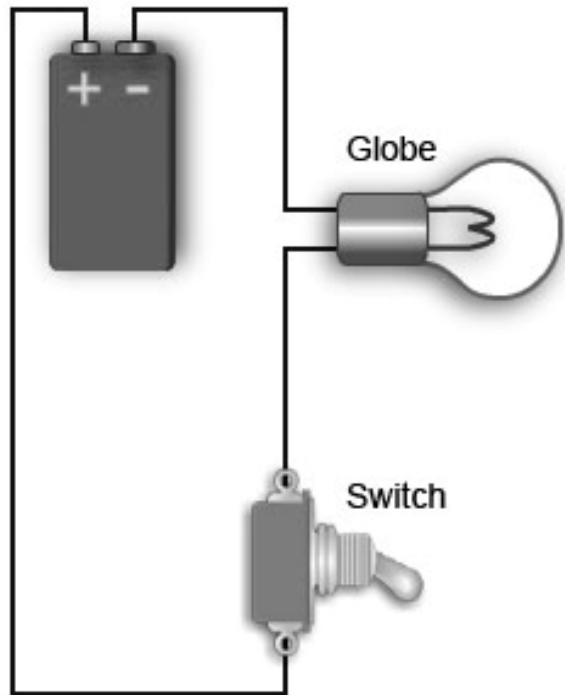


Figure 1: Electrical

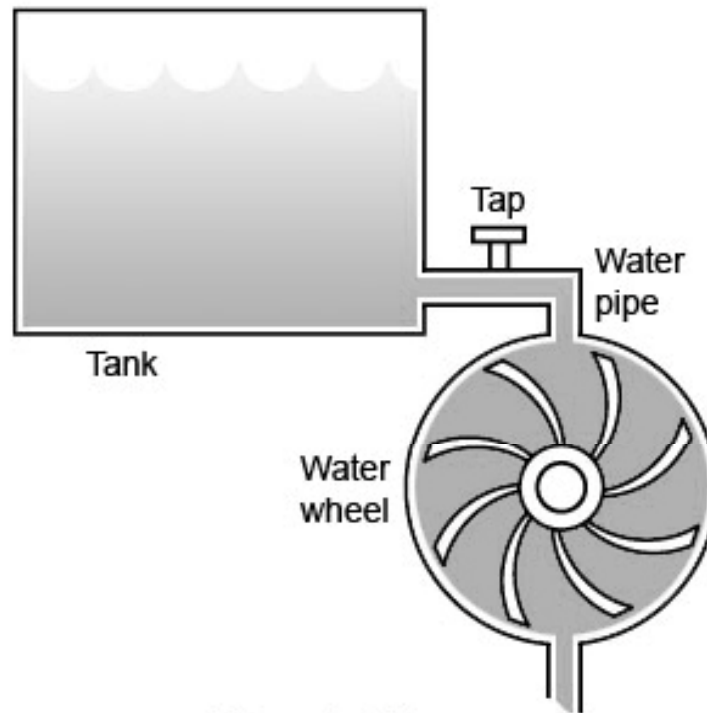
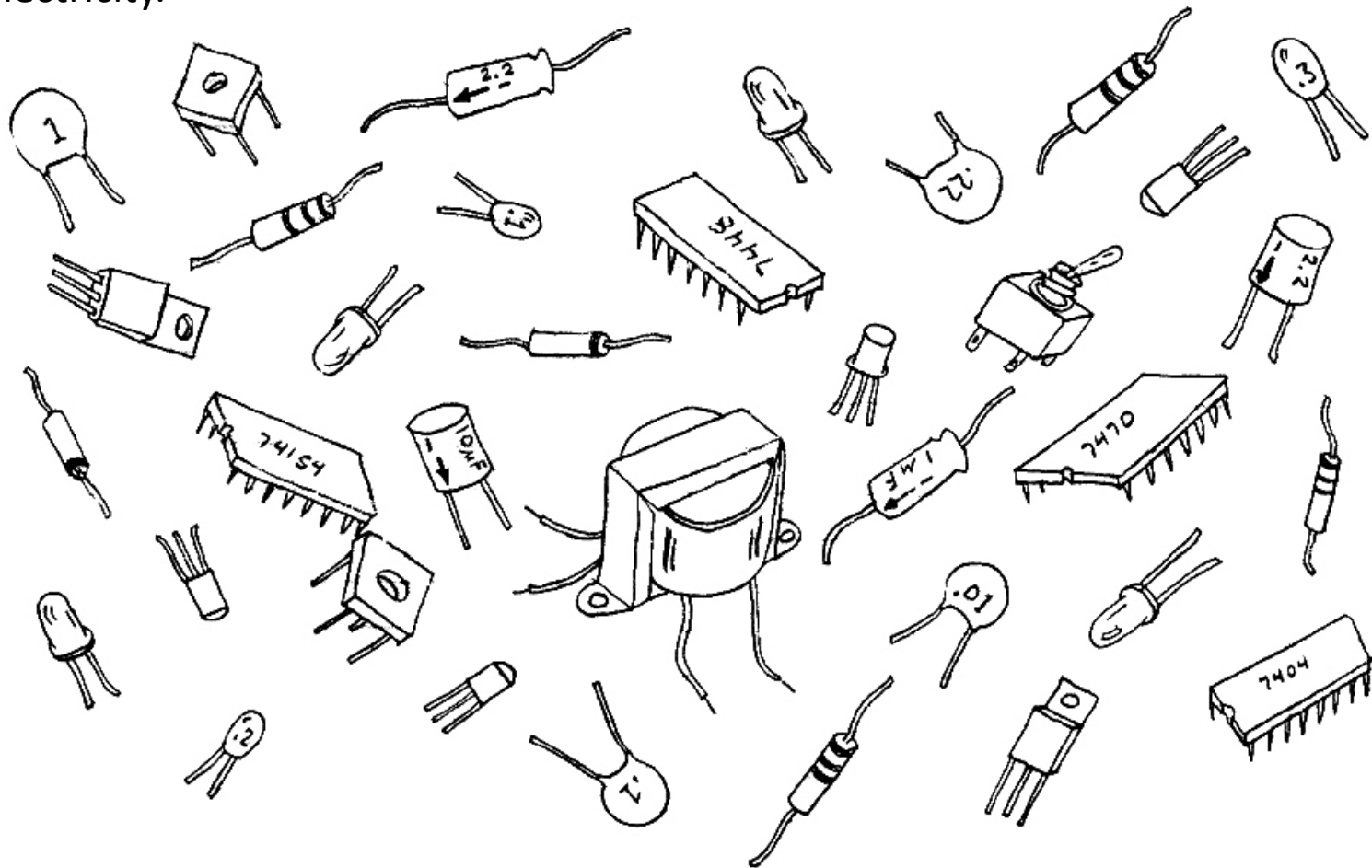


Figure 2: Water

Electricity Components

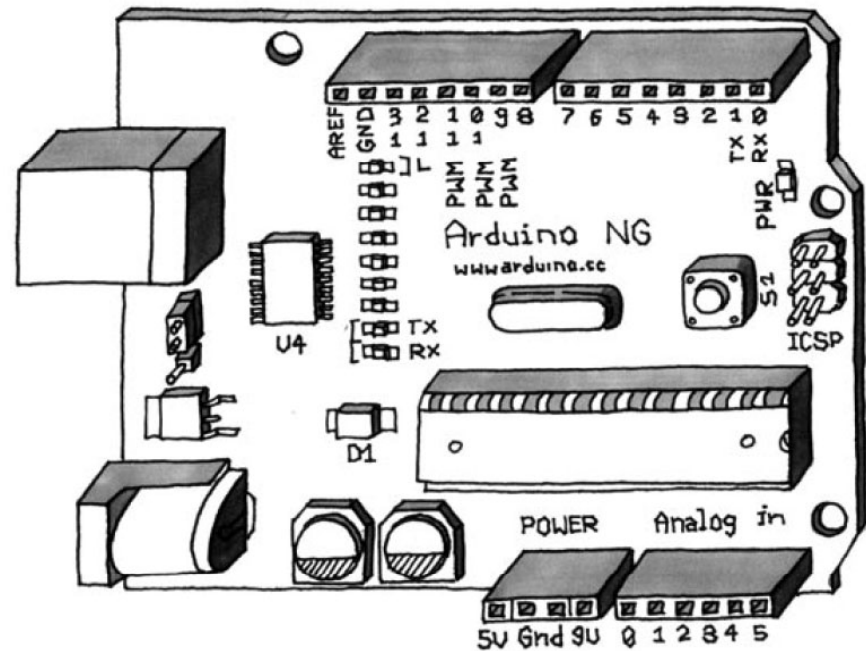
All matter has electrical properties. That's why scientists over the past few centuries have been able to invent hundreds of gadgets that generate, store, control and switch electricity.



Microcontrollers

What are microcontrollers? They are what their name suggests. Today they can be found in almost any complex electronic device - from portable music devices to washing machines to your car. They are programmable, cheap, small, can handle abuse, require almost zero power, and there are so many varieties to suit every need.

Formally Arduino Boards can be called an augmented microcontroller. But in reality, most people just say 'microcontroller' even if it has augmentation. Other abbreviations would be ucontroller and MicroController Unit (MCU). Usually when I say 'microcontroller' what I really mean to say is 'augmented microcontroller.'



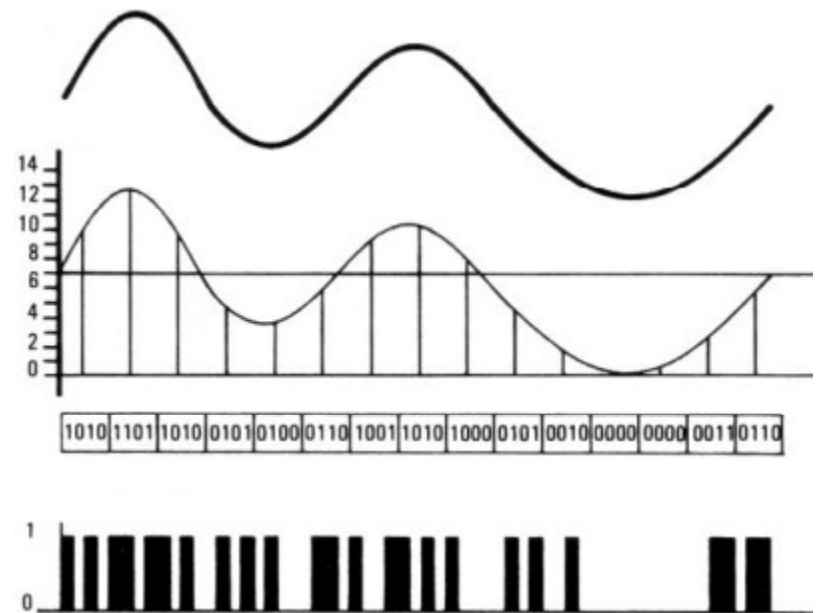
Microcontrollers I/O ports - Analog

Input ports are used for taking in sensor data, while output is used for sending commands to external hardware such as servos. There are two types of I/O ports, analog and digital.

Analog Input Ports

Also known as an analog to digital converter (ADC), they receive analog signals and convert them to a digital number within a certain numerical range.

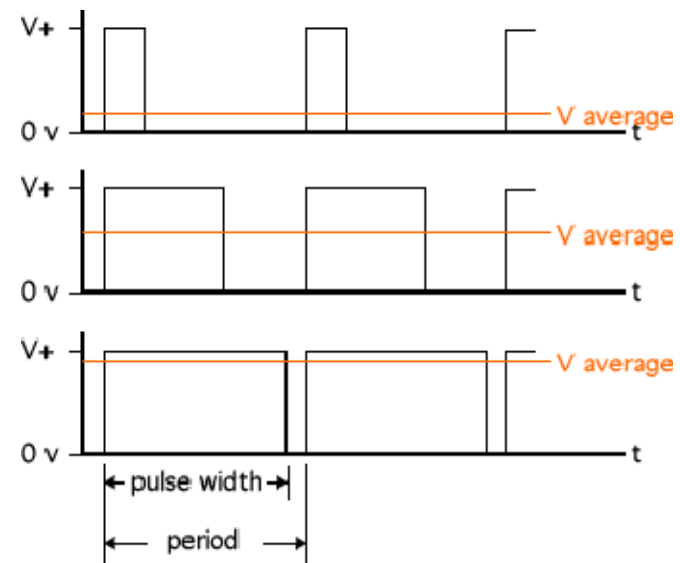
So what is analog? Analog is a continuous voltage range and is typically found with sensors. However computers can only operate in the digital realm with 0's and 1's.



Microcontrollers I/O ports - Digital

Digital ports are like analog ports, but with only 1 bit ($2^1=2$) hence a resolution of 2 - on and off. Digital ports obviously for that reason are rarely used for sensors, except for maybe on/off switches . . . What they are mostly used for is signal output. You can use them to control motors or LED's or just about anything. Send a high 5V signal to turn something on, or a low 0V to turn something off. Or if you want to have an LED at only half brightness, or a motor at half speed, send a square wave. Square waves are like turning something on and off so fast that its almost like sending out an analog voltage of your choice.

These square waves are called PWM, short for pulse width modulation.

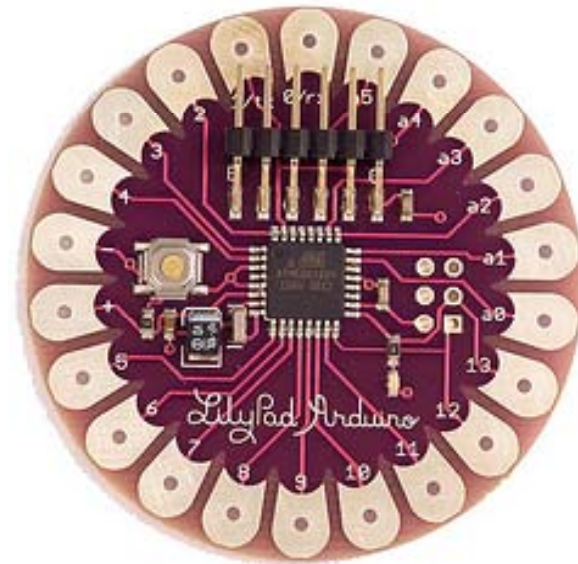


LilyPad

The LilyPad Arduino is a microcontroller board designed for wearables and e-textiles. It can be sewn to fabric and similarly mounted power supplies, sensors and actuators with conductive thread. The LilyPad Arduino was designed and developed by Leah Buechley and SparkFun Electronics.

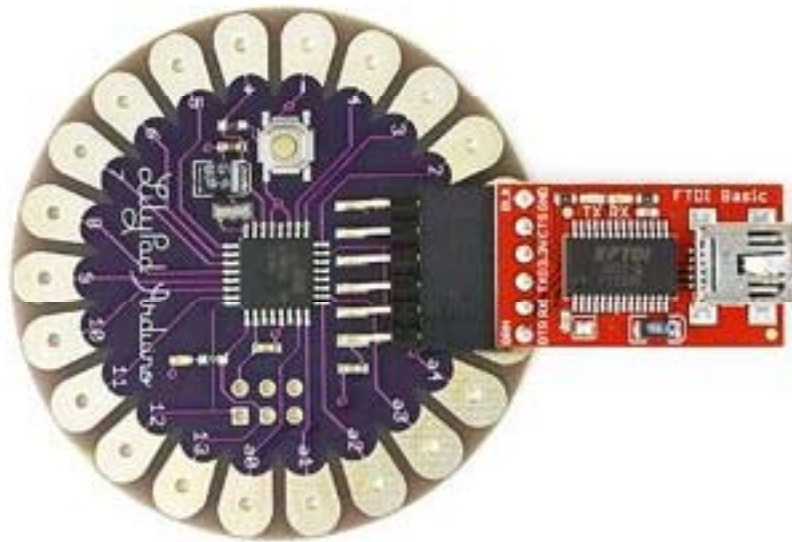
The LilyPad Arduino is a circle, approximately 50mm (2") in diameter. The board itself is .8mm (1/32") thick (approximately 3mm (1/8") where electronics are attached).

Wash at your own risk - we do ;). We recommend washing projects by hand with a mild detergent. Drip dry. Make sure you remove your power supply first!



Attaching the LilyPad Arduino to your computer

You need to attach your LilyPad Arduino to your computer so that you can talk to the LilyPad. If your LilyPad has 6 pins and you're using SparkFun's FTDI breakout board, this is what your connection should look like:



Installing and configuring the arduino software

Before you connect a FTDI Cable (printer's cable) on your computer download the Arduino software from www.arduino.cc.

Once you connect a FTDI Cable with you computer, the OS will ask you to install it's drivers. If your computer is connected online it may find the driver automatically, otherwise, you can install it manually from your OS.

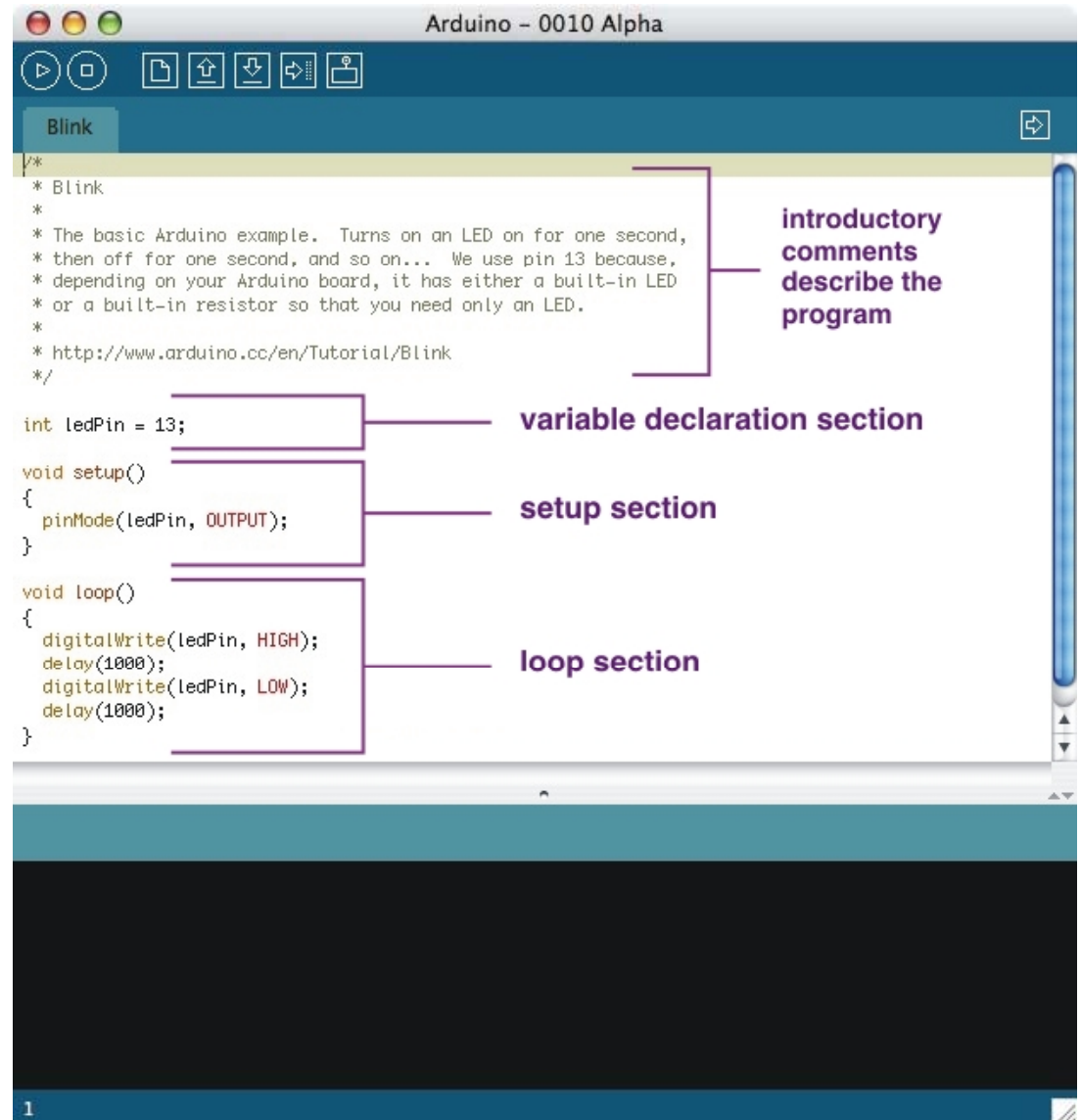
Drivers inside of the software folder.

p.s. follow instructions from here - http://web.media.mit.edu/~leah/LilyPad/02_software.html



Programming

Each Arduino program has three main parts: a section where you declare variables, a "setup" section and a "loop" section. When your program executes, it will first define your variables, will then execute the setup section once and will then execute the loop section over and over. Here is a full example program in the Arduino window:



The screenshot shows the Arduino IDE window titled "Arduino - 0010 Alpha". The code editor displays the following code for a "Blink" program:

```
/*  
 * Blink  
 *  
 * The basic Arduino example. Turns on an LED on for one second,  
 * then off for one second, and so on... We use pin 13 because,  
 * depending on your Arduino board, it has either a built-in LED  
 * or a built-in resistor so that you need only an LED.  
 *  
 * http://www.arduino.cc/en/Tutorial/Blink  
 */  
  
int ledPin = 13;  
  
void setup()  
{  
  pinMode(ledPin, OUTPUT);  
}  
  
void loop()  
{  
  digitalWrite(ledPin, HIGH);  
  delay(1000);  
  digitalWrite(ledPin, LOW);  
  delay(1000);  
}
```

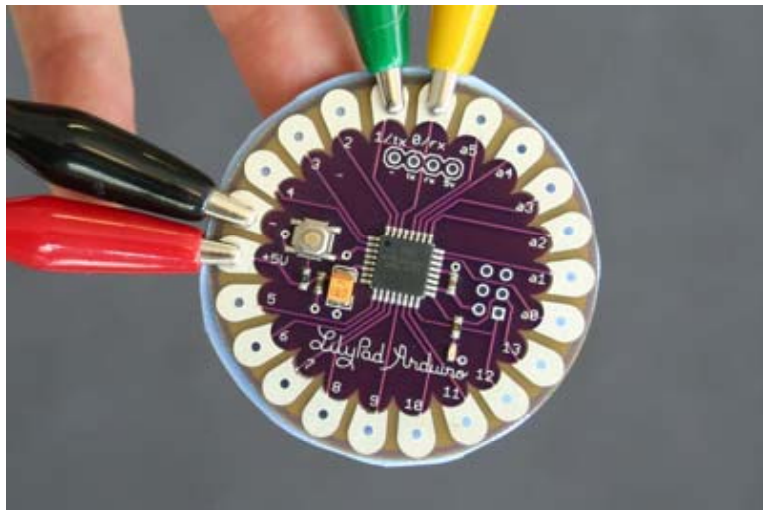
Annotations on the right side of the code editor identify the following sections:

- introductory comments describe the program**: Points to the multi-line comment block at the top of the code.
- variable declaration section**: Points to the line `int ledPin = 13;`.
- setup section**: Points to the `void setup()` function block.
- loop section**: Points to the `void loop()` function block.

The status bar at the bottom left of the window shows the number "1".

Coaster

Make a soft "coaster" backing for your LilyPad so that alligator clips won't slip and slide when they're clipped on. Alligator clips are great for prototyping designs. Trust me, it's worth it to do this if you're going to be using clips!



References

- <http://www.forrestmims.com>
<http://arduino.cc/en/Main/ArduinoBoardLilyPad>
- <http://lilypadarduino.org>
- <http://web.media.mit.edu/~leah/LilyPad/>
- [www.sgbotic.com>Development Tools>Lilypad](http://www.sgbotic.com/Development%20Tools/Lilypad)
- <https://www.sparkfun.com/categories/135?>
- [http://quarknet.fnal.gov/fnal-uc/quarknet-summer-research/QNET2011/project_files/teacher_files/Getting Started with Arduino.pdf](http://quarknet.fnal.gov/fnal-uc/quarknet-summer-research/QNET2011/project_files/teacher_files/Getting_Started_with_Arduino.pdf)