



Sustainability in science and education

Sustainable agriculture:

Building a 'smart' watering
apparatus

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Sustainability

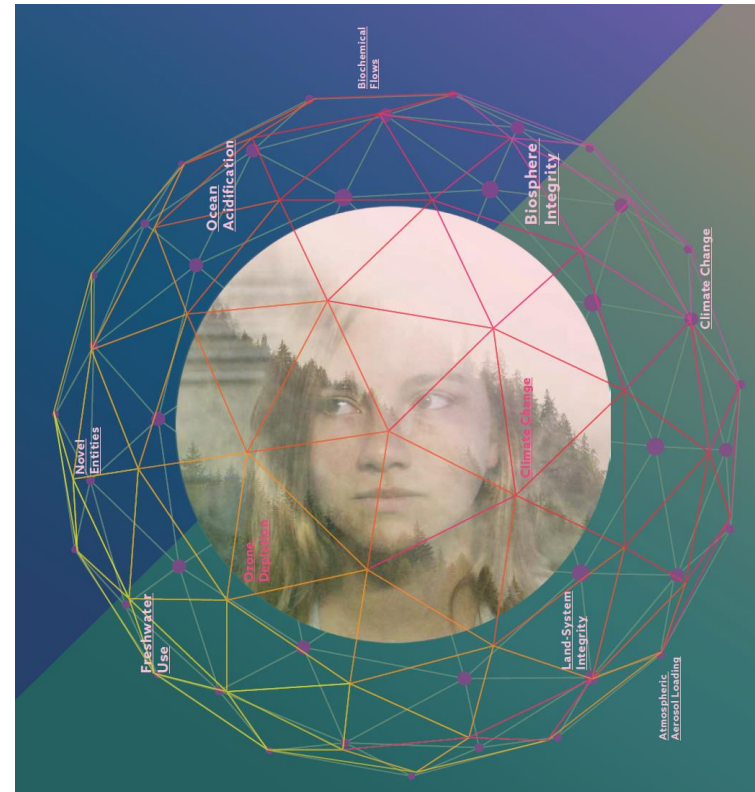
- Earth, a unique planet in our solar system (VR)
- Sustainable agriculture / biodiversity
- Building a sustainable agriculture system
 - Programming with Arduinos
 - Building plant watering system
- A sustainable future for the Earth: playing our part, green chemistry plays a central role, systems thinking, planetary boundaries and the UN SDGs

Activity: let's use the HTC Vive to visualize the solar system in virtual reality!



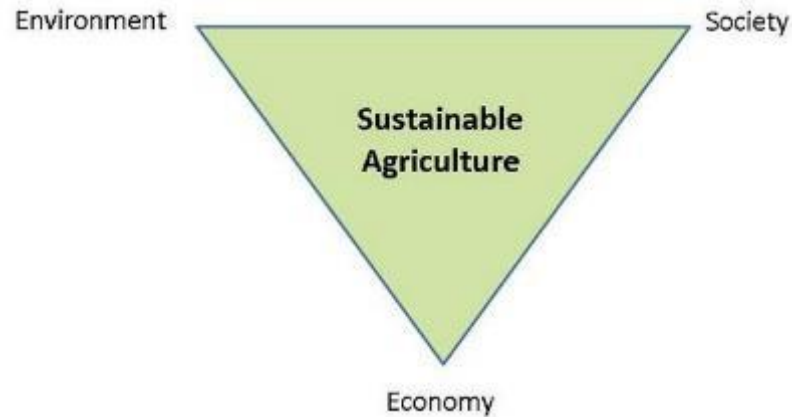
Planetary boundaries

Individual choices affect...



<https://www.stockholmresilience.org/research/planetary-boundaries/planetary-boundaries/about-the-research/the-nine-planetary-boundaries.html>

For example...



Activity: let's plant seeds...

1. Choose your seeds
2. Grab a pot and soil
3. Plant your seeds
4. Add water to soil





Smart Agriculture



'Smart' Agriculture

GPS-controlled farming



Activity: build a 'smart' watering system

Let's build a 'smart' programmable farming system!

*technology in farming

Farmers = hackers

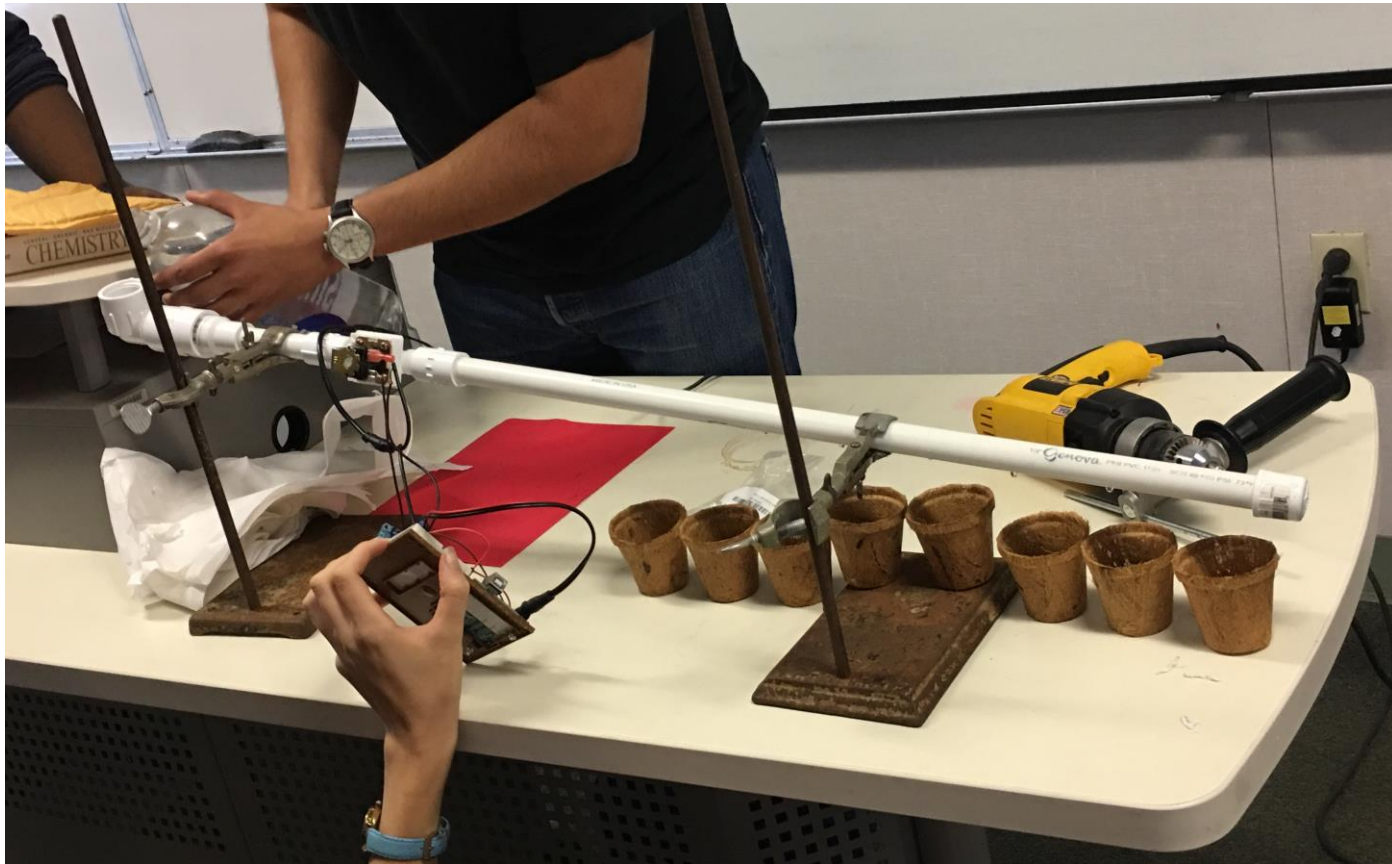
Activity: build a 'smart' watering system

1. Construct the apparatus
2. Program using Arduino (microcontroller)

We will all walk around and help you as you build the apparatus, and we will guide you through the Arduino / Python programming

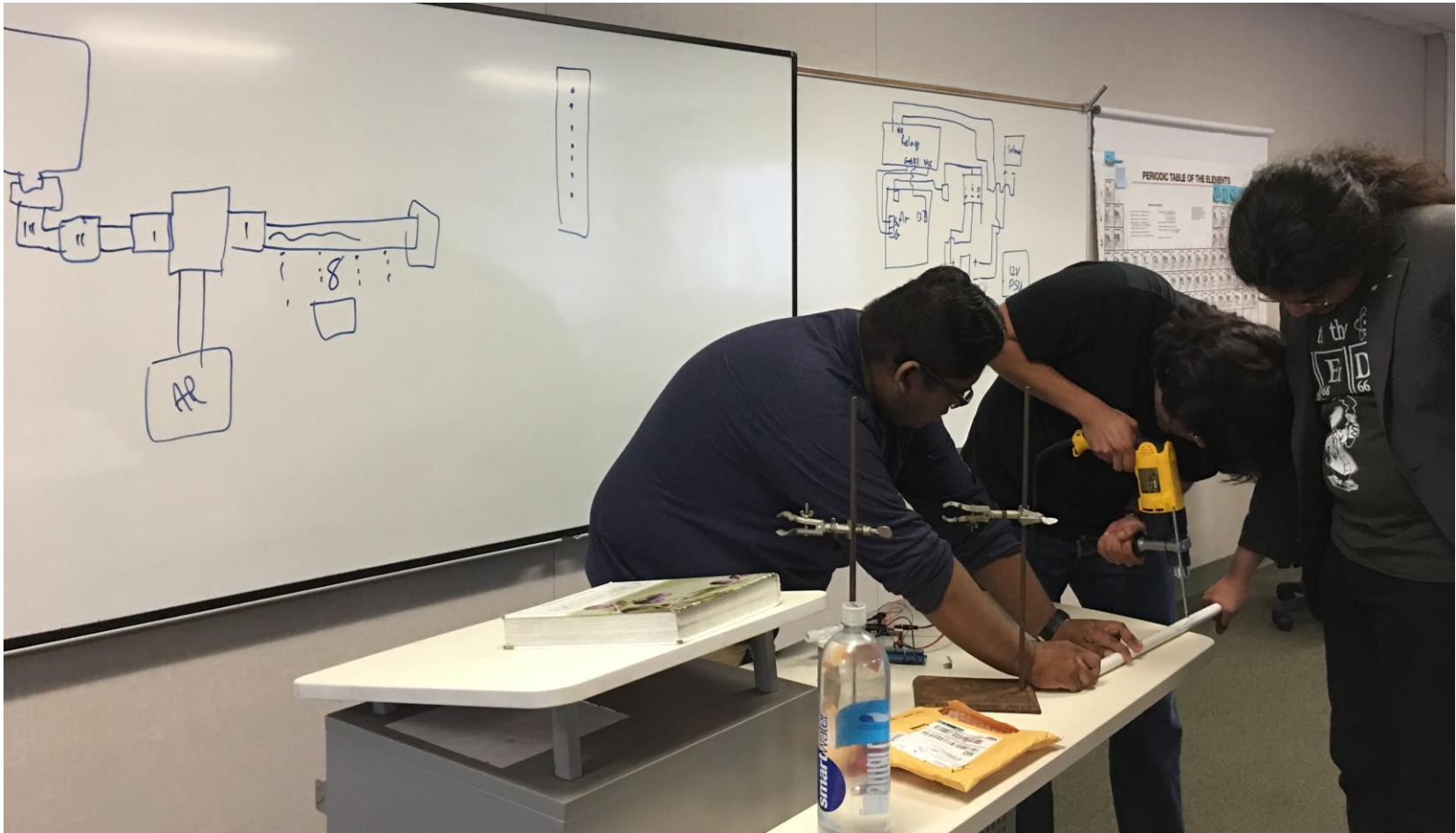
The apparatus

Activity: build a 'smart' watering system

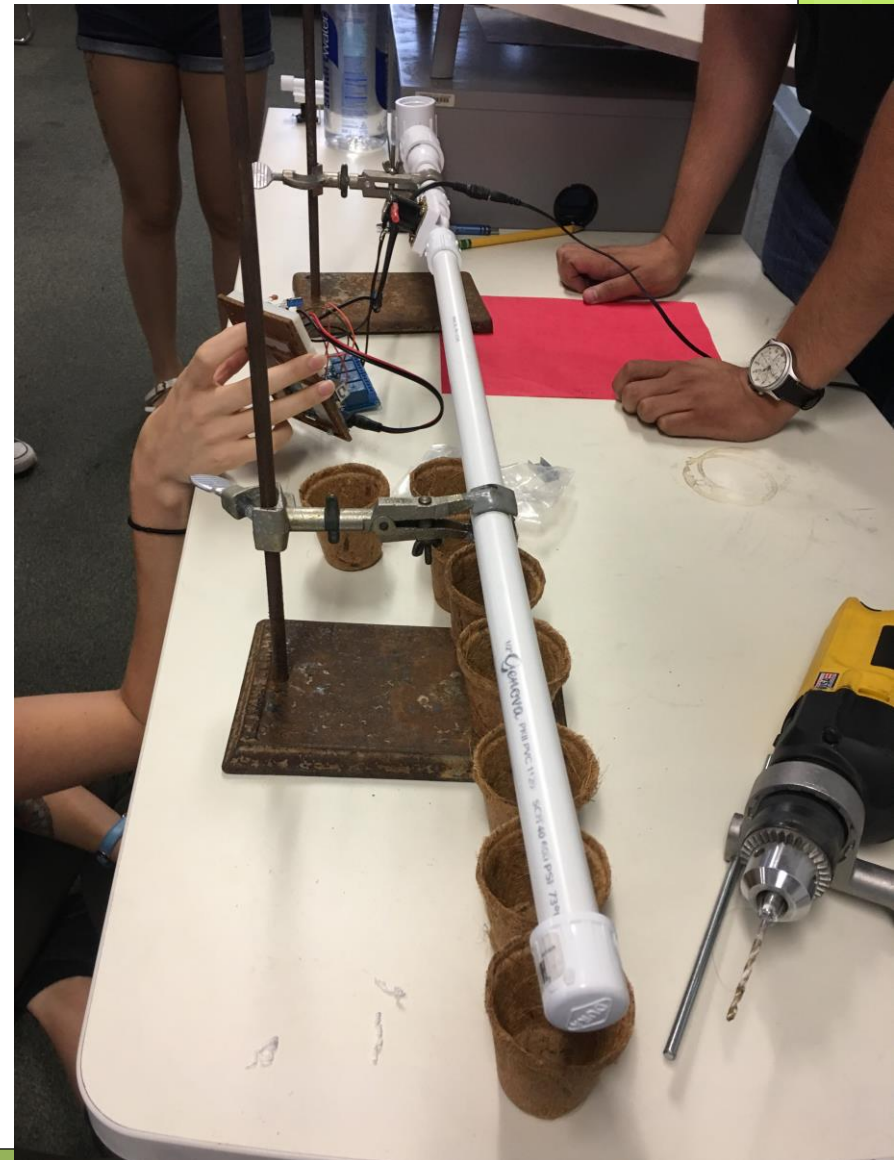


We already drilled...

Activity: build a 'smart' watering system



We tested it...



...and it works!



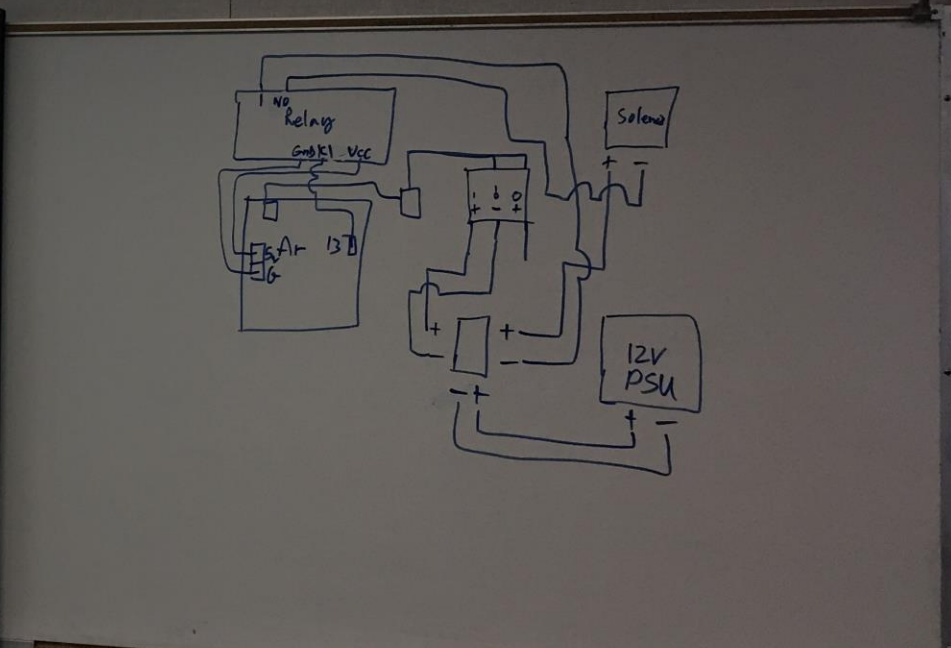
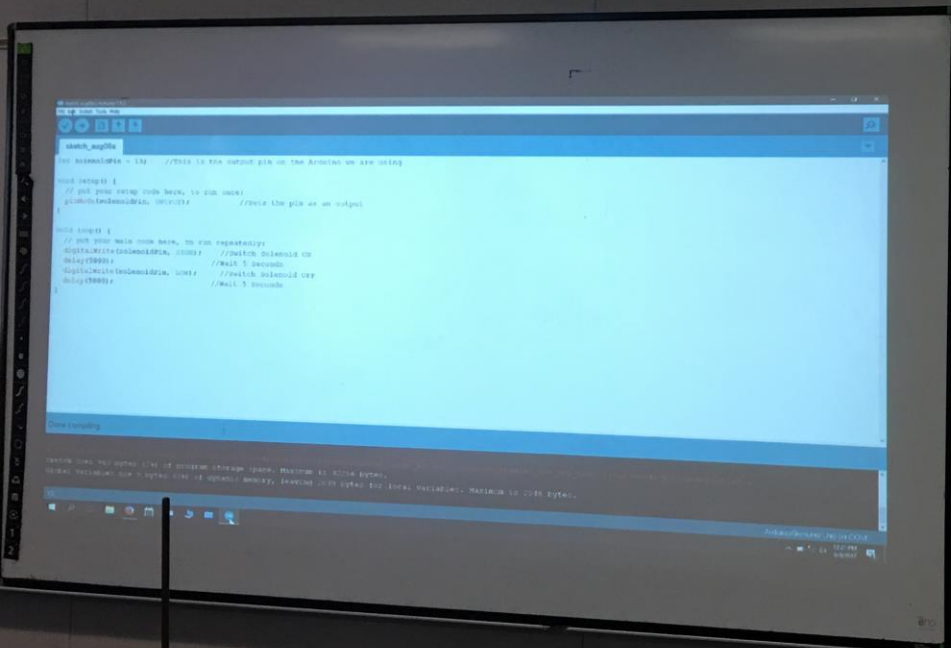
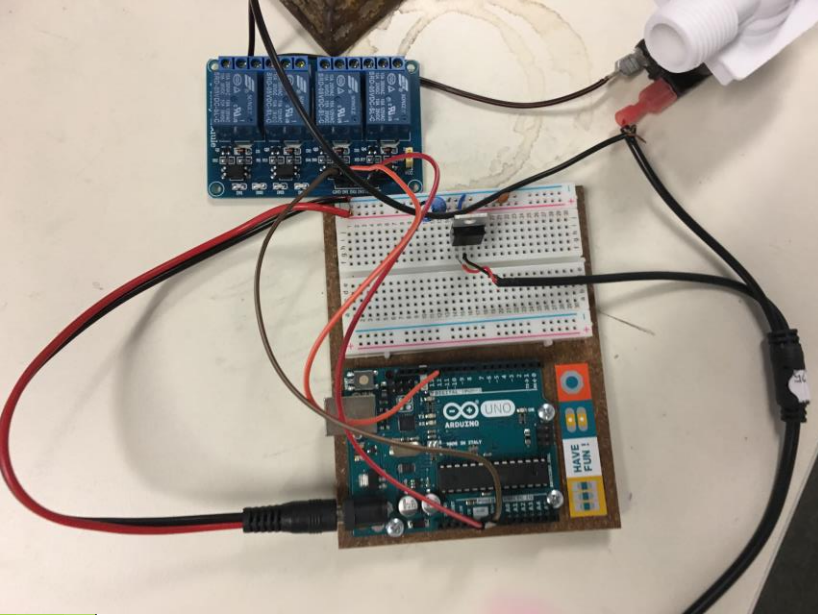


<https://www.arduino.cc/>

- single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world
- From making robots to controlling the flow of water, they are a versatile tool that help in numerous projects.
- Arduinos are used primarily for prototyping

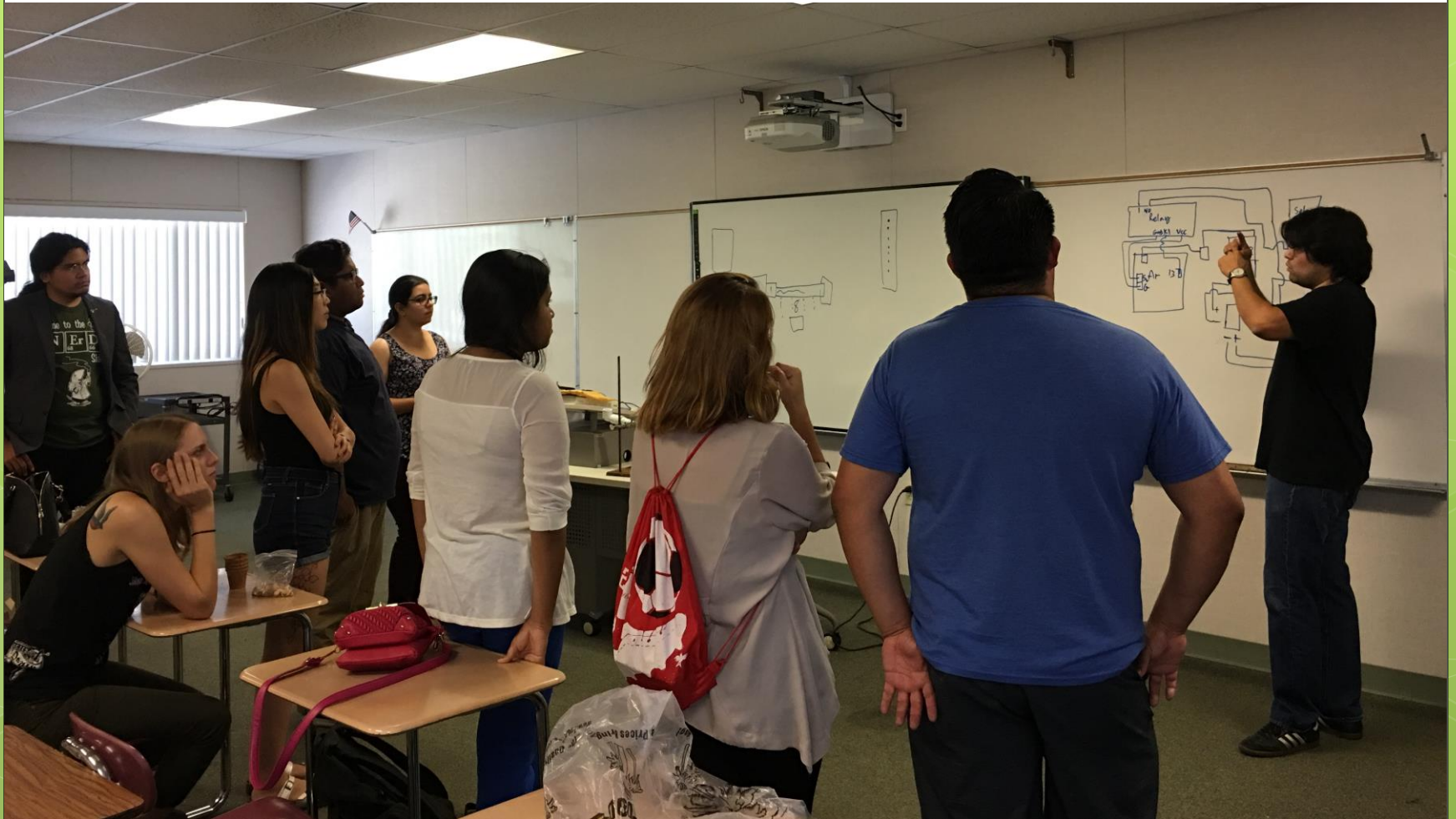
Programming with Arduino

<https://www.arduino.cc/>

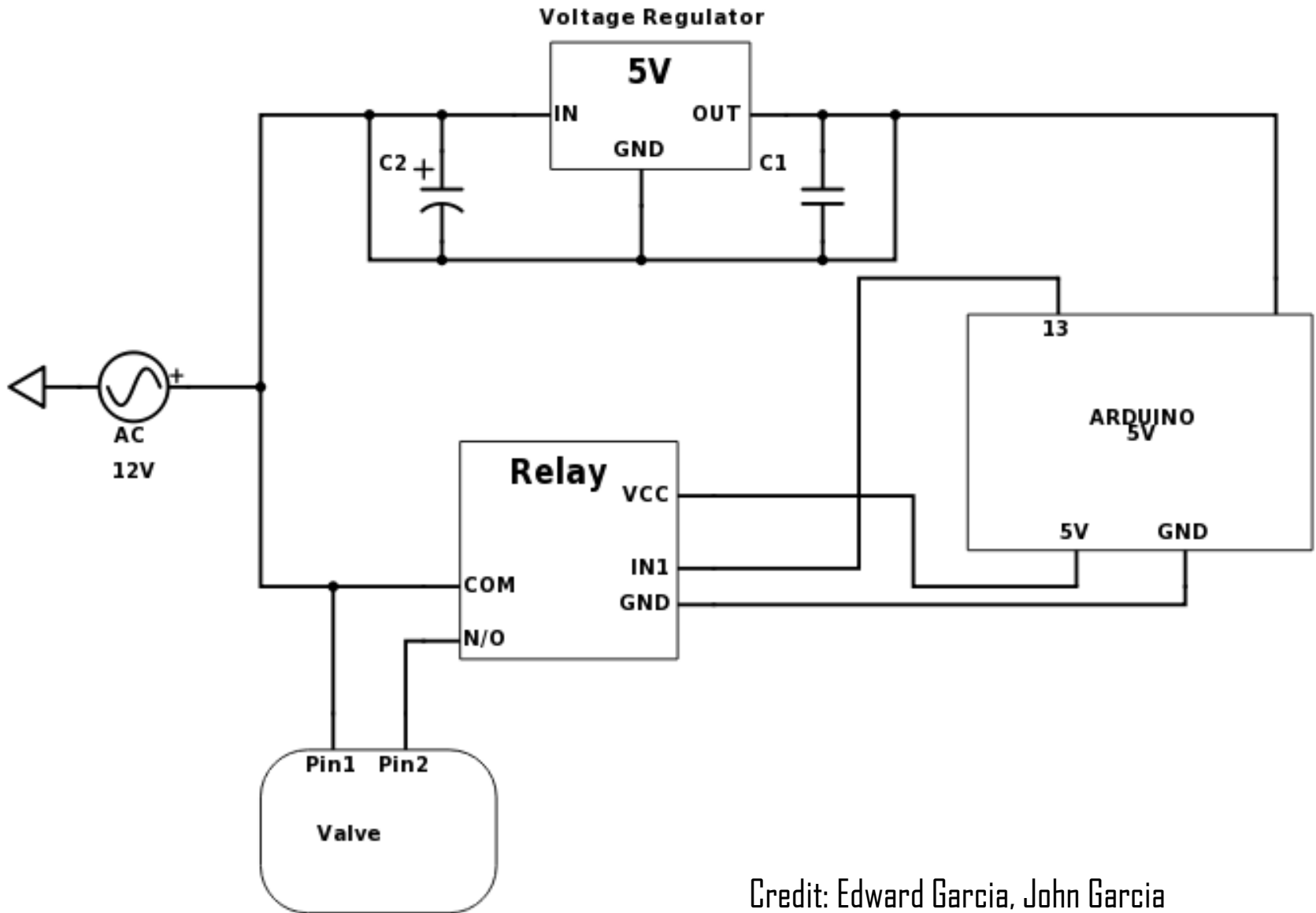


Programming with Arduino

<https://www.arduino.cc/>



Arduino: schematic



Credit: Edward Garcia, John Garcia

```
// life motto  
if (sad() == true) {  
  sad().stop();  
  beAwesome();  
}
```

<https://www.arduino.cc/>

<https://www.python.org/>

<http://www.toptechboy.com/using-python-with-arduino-lessons/>

- Coding is what makes it possible for us to create computer software
- A set of simple instructions that the Arduino will follow
- Arduino Language is a set of C/C++ functions that is used for this reason

Python code:

```
int solenoidPin = 13; //This is the output pin on the Arduino we are using
```

```
void setup() {  
  // put your setup code here, to run once:  
  pinMode(solenoidPin, OUTPUT); //Sets the pin as an output  
}
```

```
void loop() {  
  // put your main code here, to run repeatedly:  
  digitalWrite(solenoidPin, HIGH); //Switch Solenoid ON  
  delay(5000); //Wait 5 Seconds  
  digitalWrite(solenoidPin, LOW); //Switch Solenoid OFF  
  delay(5000); //Wait 5 Seconds  
}
```

-----End of code-----