



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

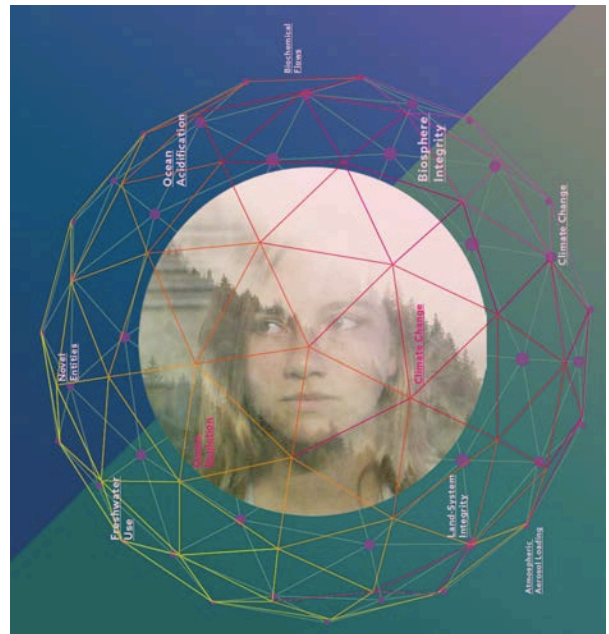
Seeing the solar system in VR

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



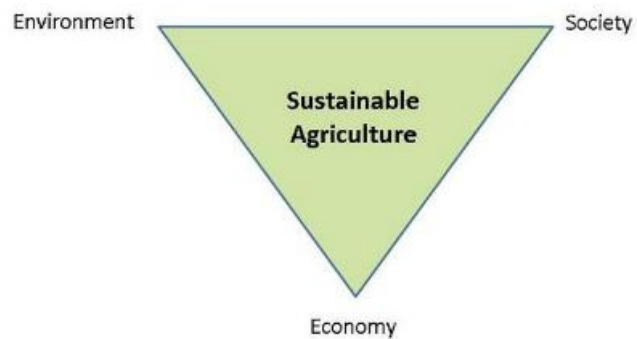
Planetary boundaries

Individual choices affect...



Sustainable Agriculture

For example...



<https://www.nature.com/scitable/knowledge/library/sustainable-agriculture-23562787>

Planting seeds

Activity: let's plant seeds...

1. Choose seeds
2. Grab a pot and soil
3. Plant your seeds



'Smart' Agriculture



Smart Agriculture



'Smart' Agriculture

GPS-controlled farming



'Smart' Farming

Activity: build a 'smart' watering system

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

*technology in farming

Farmers = hackers

'Smart' Farming

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

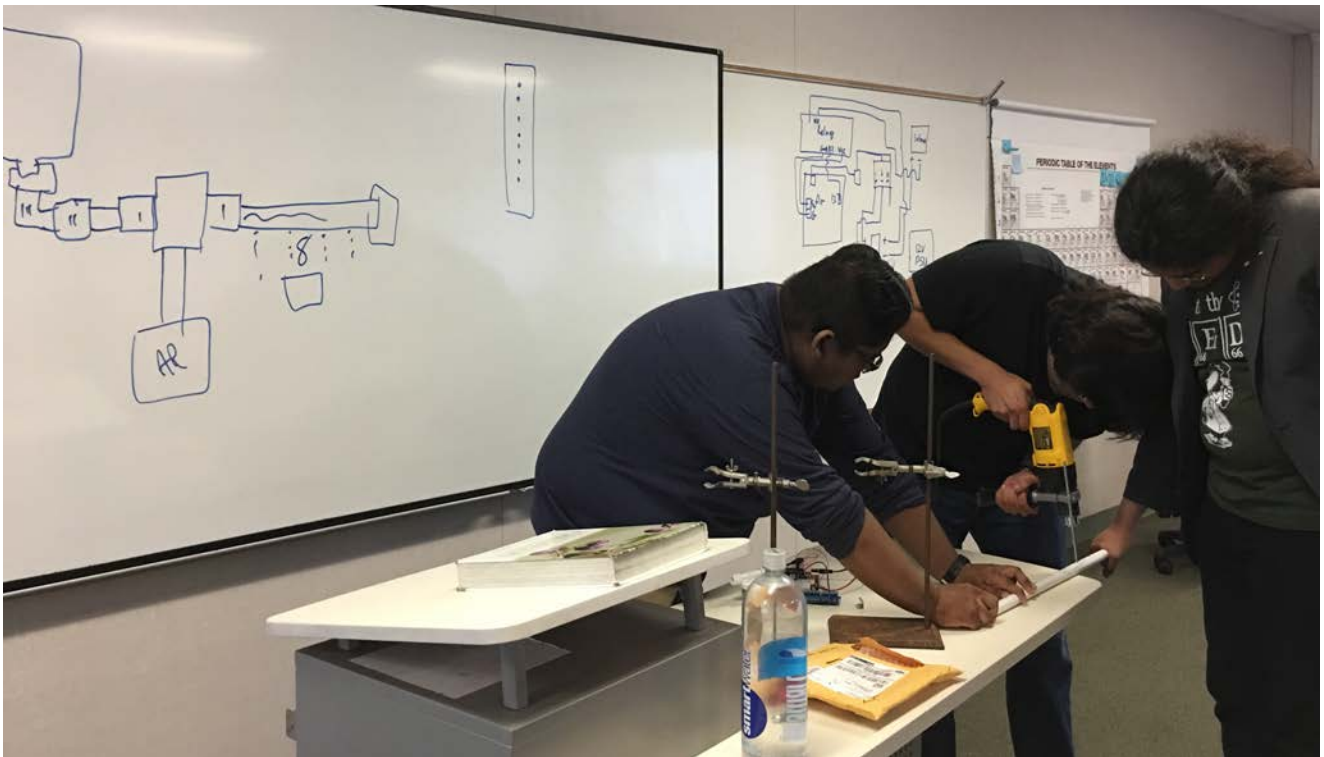
The apparatus

Activity: build a 'smart' watering system

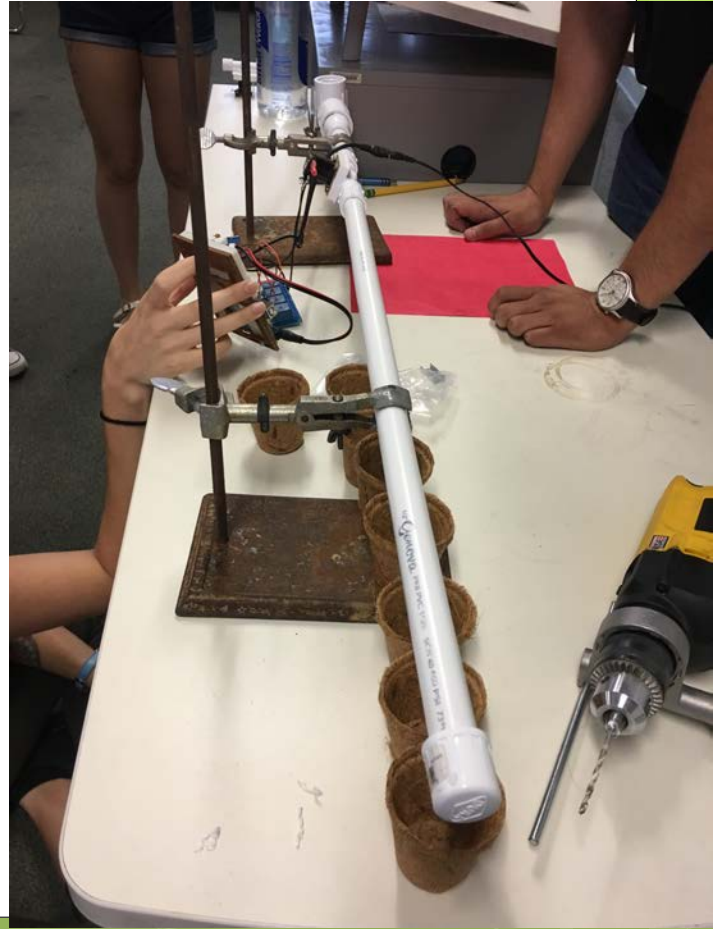


We already drilled...

Activity: build a 'smart' watering system



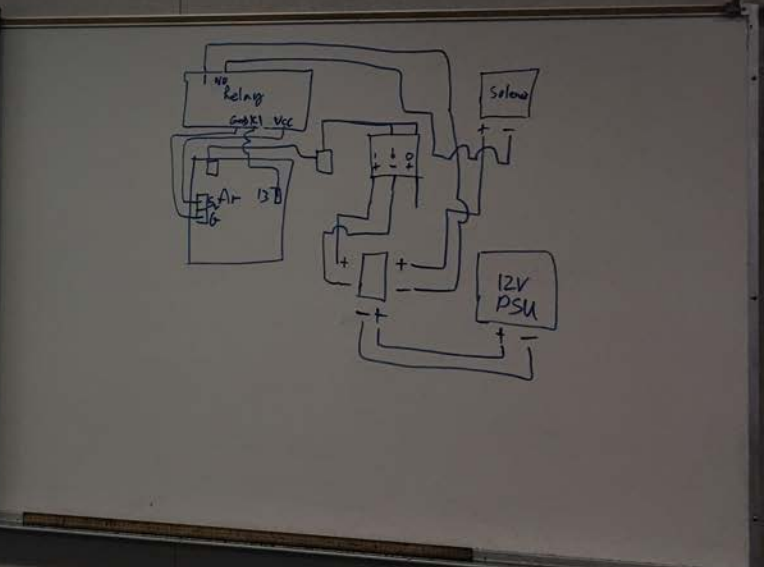
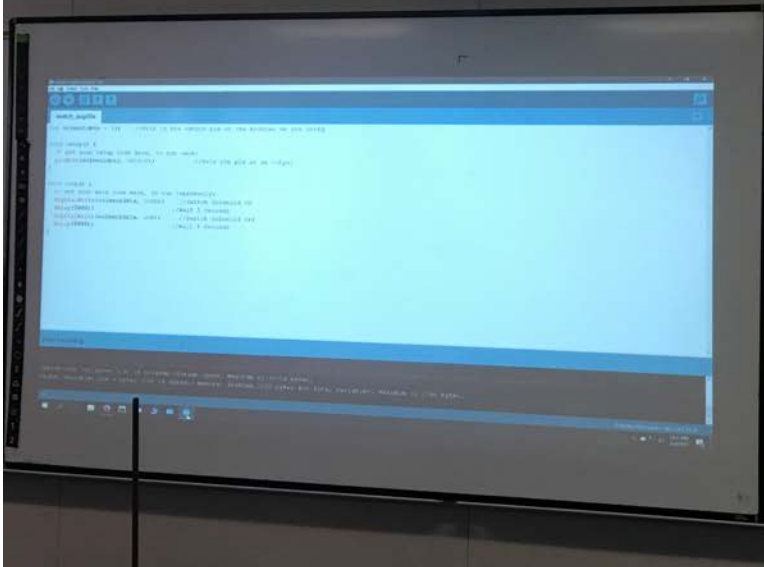
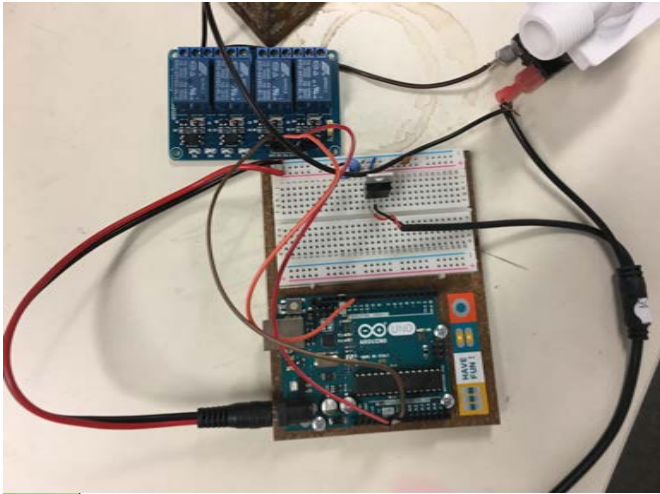
We tested it...



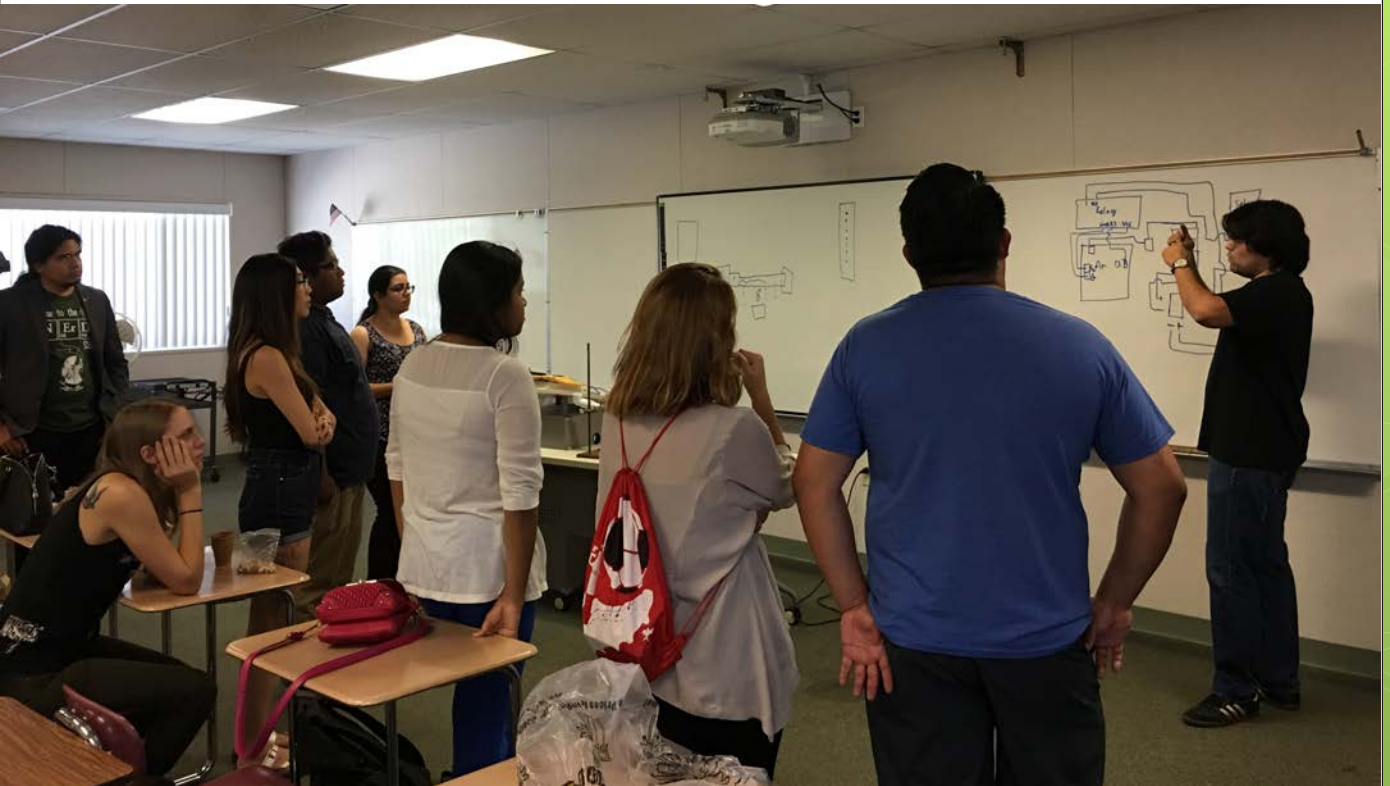
...and it works!



Programming with Arduino



Programming with Arduino



Arduinos



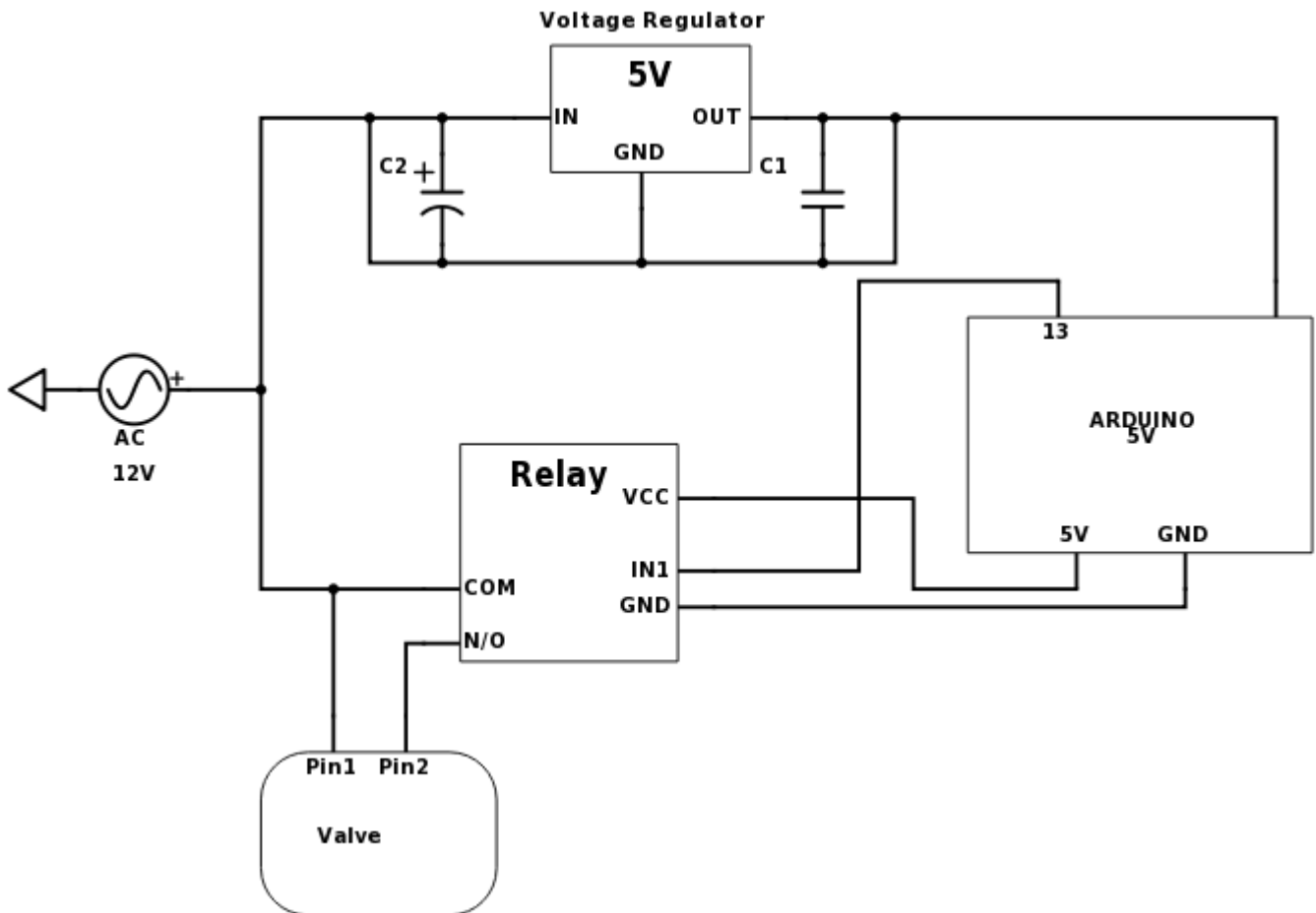
- single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world
- From making robots to controlling the flow of water, they are a versatile tool that help in numerous projects.
- Arduinos are used primarily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

Arduino code

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

- 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

Arduino schematic



Arduino Python code

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-----