HS-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.

HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction.

HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other.

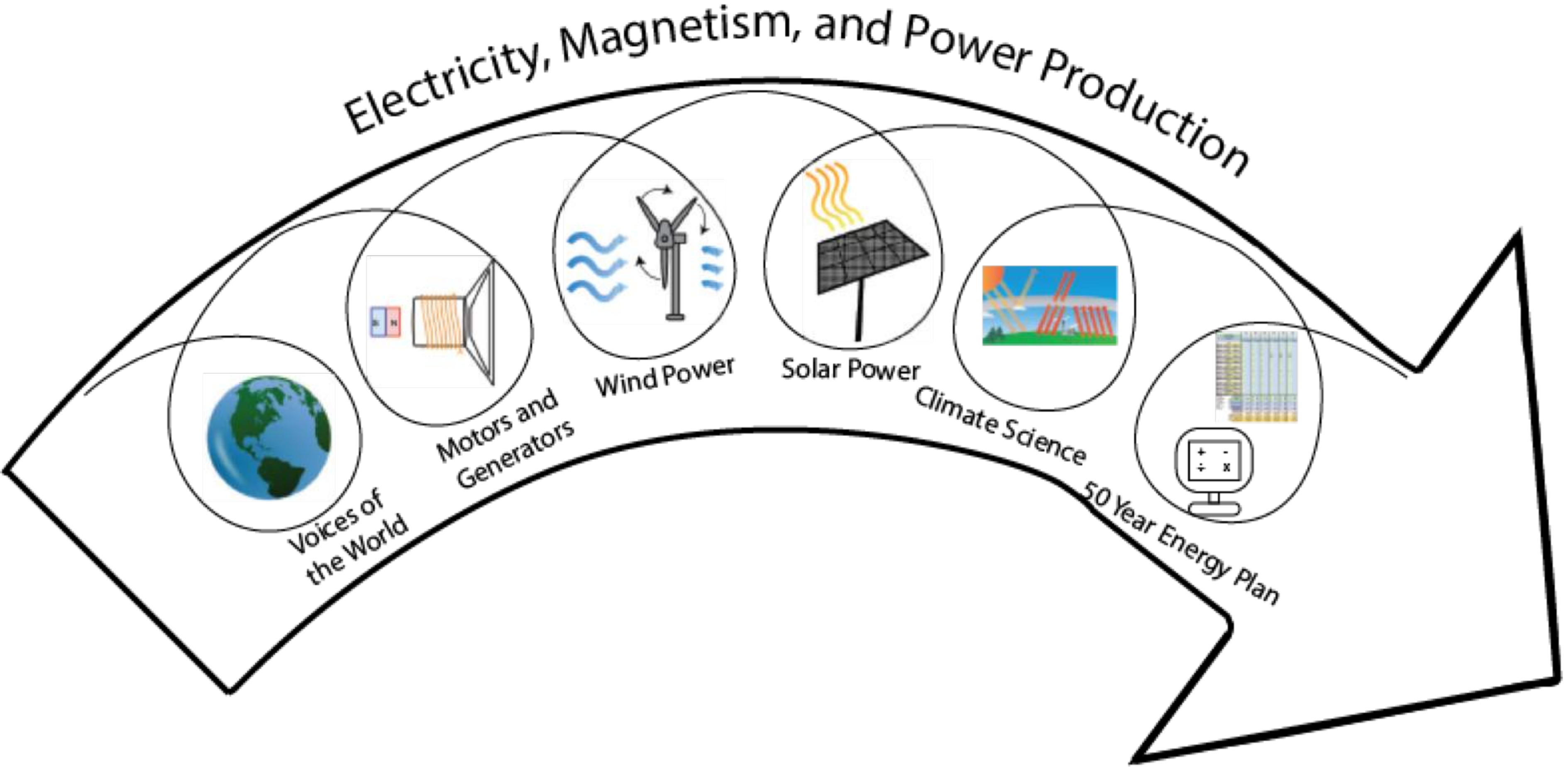
HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

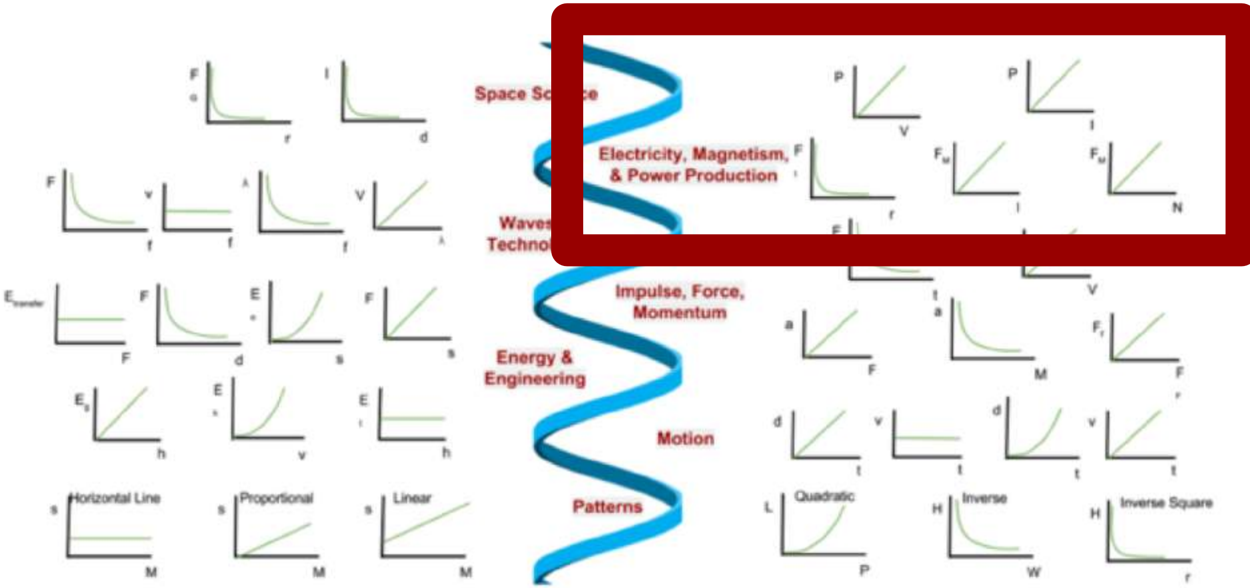
HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.

HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity.

HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*

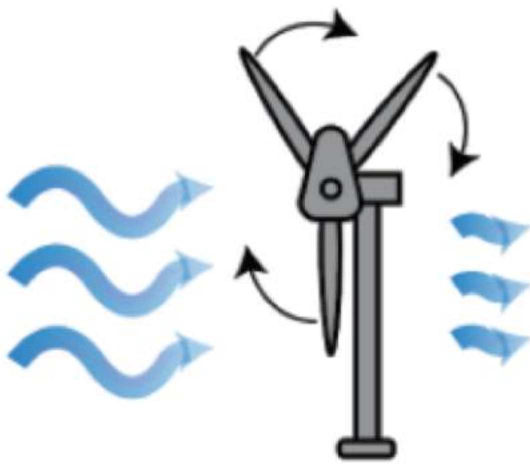

Electricity, Magnetism, and Power Production
Voices of the World
Motors and Generators
Wind Power
Solar Power
Climate Science
50 Year Energy Plan

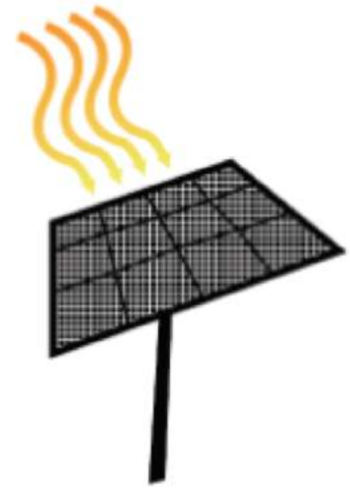
Timeline for the Year



Week	Physics Unit	NGSS Performance Expectations Assessed
1, 2, 3, 4, 5	Patterns & Inquiry	
6, 7, 8, 9	Texting & Driving	HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
10, 11, 12, 13, 14, 15	Energy & Engineering with Bungee Jump	HS-PS3-1. Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
16, 17, 18, 19, 20, 21, 22	Engineer a Shoe (Impulse, Forces, and Momentum)	HS-PS2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. HS-PS2-2. Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. HS-PS2-3. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
23, 24, 25, 26, 27, 28	Waves & Technology with Send a Text	HS-PS4-1. Use mathematical representations to support a claim regarding relationships among the frequency, wavelength, and speed of waves traveling in various media. HS-PS4-2. Evaluate questions about the advantages of using a digital transmission and storage of information. HS-PS4-4. Evaluate the validity and reliability of claims in published materials of the effects that different frequencies of electromagnetic radiation have when absorbed by matter. HS-PS4-5. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.
29, 30, 31, 32, 33, 34	Electricity, Magnetism, & Power Production with Engineer a Wind Turbine; Solar Cell Optimization	HS-PS2-5. Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. HS-PS3-3. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. HS-PS3-5. Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. HS-PS4-3. Evaluate the claims, evidence, and reasoning behind the idea that electromagnetic radiation can be described either by a wave model or a particle model, and that for some situations one model is more useful than the other. HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants. HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts. HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate. HS-ESS3-1. Construct an explanation based on evidence for how the availability of natural resources, occurrence of natural hazards, and changes in climate have influenced human activity. HS-ESS3-2. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.*
35	Space & the Universe	HS-PS2-4. Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. HS-ESS1-2. Construct an explanation of the Big Bang theory based on astronomical evidence of light spectra, motion of distant galaxies, and composition of matter in the universe.

Overview of the Unit





This unit is loaded with phenomena. The real world task that propels students through an arc of electricity, magnetism, power production, and climate science is a 50-Year Energy Plan. After the Request for a 50-Year Energy Plan, students jig-saw innovative power solutions. Next, they build and explore motors (starting with speakers which also connect to the Waves & Technology unit) and inefficient generators. The need for massive, efficient generators leads us to harness energy in nature so we will be engineer designing wind turbines and optimizing solar cells for a local parks use. Creating the rubric to evaluate large scale power production launches us into climate science. With all the learning of the unit students and many real world constraints

Electricity, Magnetism, & Power Production - Day 1

Agenda:

Voices Around the World

Introduction to Our
Engineering Challenge

Where do we get power from?

Due Next Class:

Background Research on Power Production

Due This Class:

Voices of the World

Warm Up Question:

What do you know about climate science, global warming, and climate change?

What do you want to learn about these topics?

Self Assessment on the Big Ideas of this Unit

On the front page of the packet, using a scale of 1 - 4: where is your current understanding?

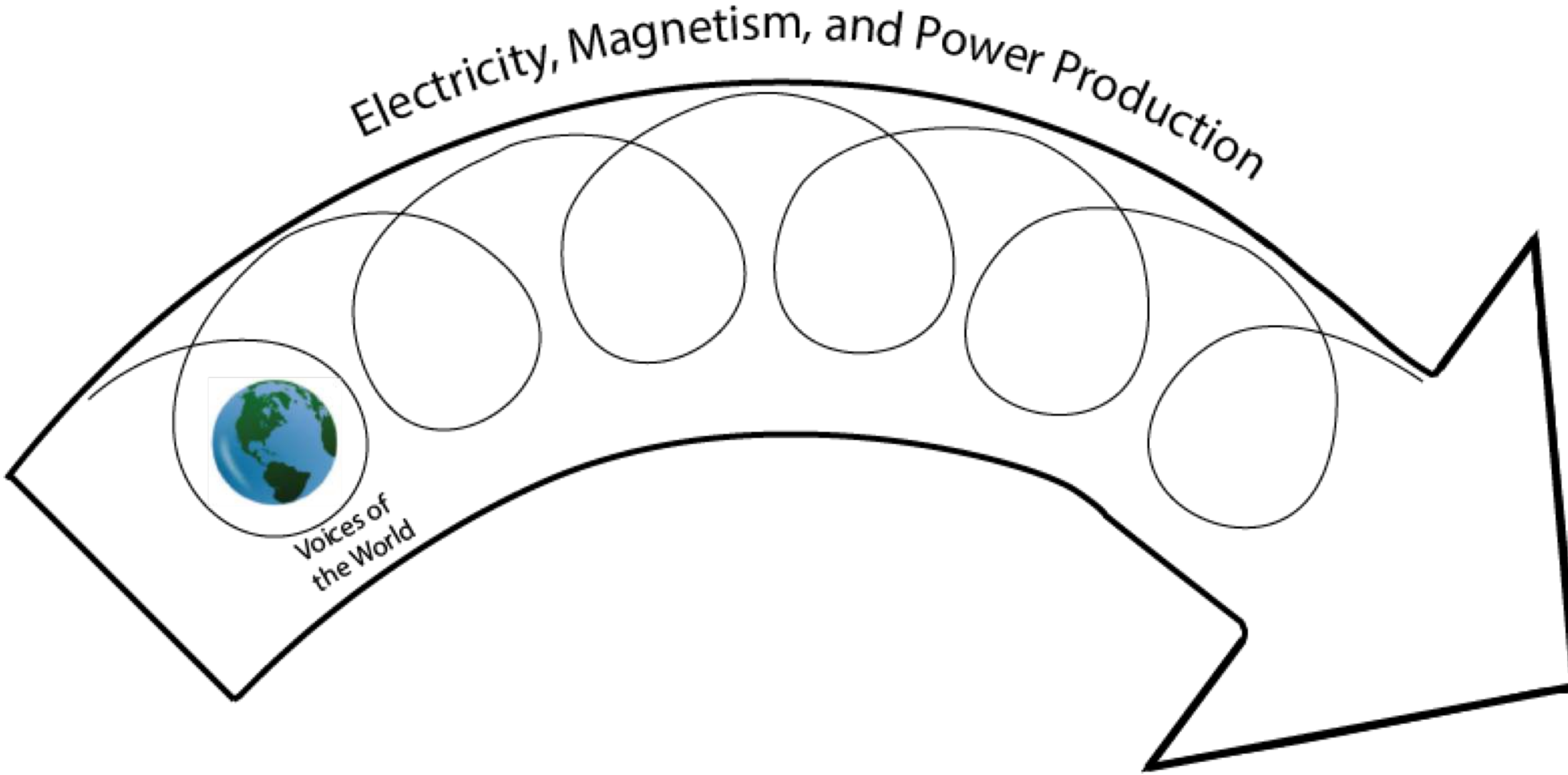
By the End of this Day
You Should Be able to Answer:

Focus Question

What are the different perspectives on climate change?

Language Focus

Be able to convey important characteristics about different energy sources used for Power Production.

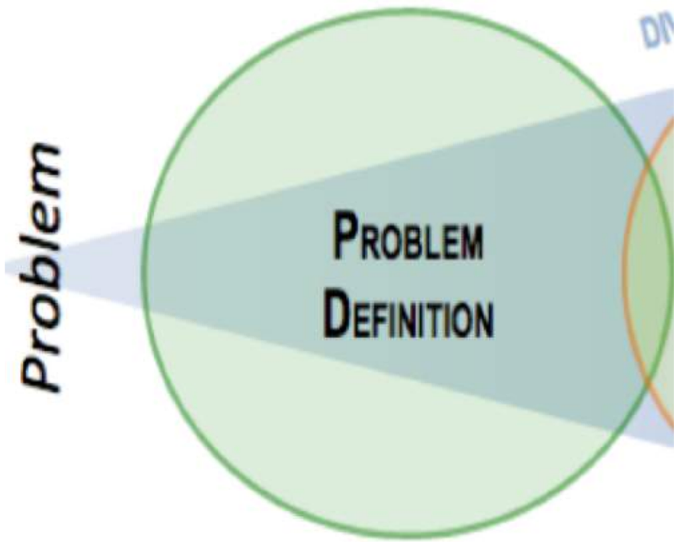

Electricity, Magnetism, and Power Production
Voices of
the World

Voices of the World - 1 Page Per

1. Get acquainted with the your role/identity your were given**, you want to be able to share your perspective without reading your card. **Note, this can be difficult if the person is different from you.
2. Now form medium sized groups of 6-9.
3. Then get acquainted with each other, spending about a minute to share your story.
4. Then listen to the stories of the other person you are with. Be sure to take notes in your packet.
5. Next form a new smaller group of 4-5 of mostly new people and repeat.

*Adapted from Bill Bigelow with Rethinking Schools, see his instructions here.

Getting a Handle on our Challenge



With some context from voices of the world and the charge to the Energy Plan Commission we need to define our problem.

Then, let us get a clear, focused statement of the design problem in our Engineering Portfolio.

We as (role) seek to (problem) that must address (goal) for (stakeholders).

K-W-L in Formative

What do you know about power production, electricity, and energy sources?

When you plug your phone into the wall, what is going on? Where does that energy come from?

What do you want to learn about power production, electricity, and energy sources?

Background Research on Power Production
What are the three main points?

Background Research on Power Production

Each of the energy strategies below are proven to b... thinking about our energy needs, there is no perfect solution... your group using the resource below fill out the chart below det... this activity you will need access to the internet. Go to st...

First:

Let us brainstorm considerations when thinking through energy sources -- that is, the top three criteria we will use to evaluate them.

Description:
Describe the energy strategy here.

Include any unique costs or benefits that are not listed in the columns to the right.

Energy Source				
Wind				
Solar Cells				

Background Research on Power Production

Each of the energy strategies below are proven to b… thinking about our energy needs, there is no perfect solution… your group using the resource below fill out the chart below det… r this activity you will need access to the internet. Go to st…

First:
Let us brainstorm considerations when thinking through energy sources -- that is, the top three criteria we will use to evaluate them.

Energy Source	Description	Criteria …		

Environmental Impact / Land Use: Describe how this energy strategy affects the land/water it is on or around. Does it need to be in specific locations?	**Climate Impact / Air Quality:** Describe any impact on CO_2 emissions or air quality associated with this strategy	**Lifetime Cost:** Describe any costs, both short and long term, directly and indirectly associated with this strategy.

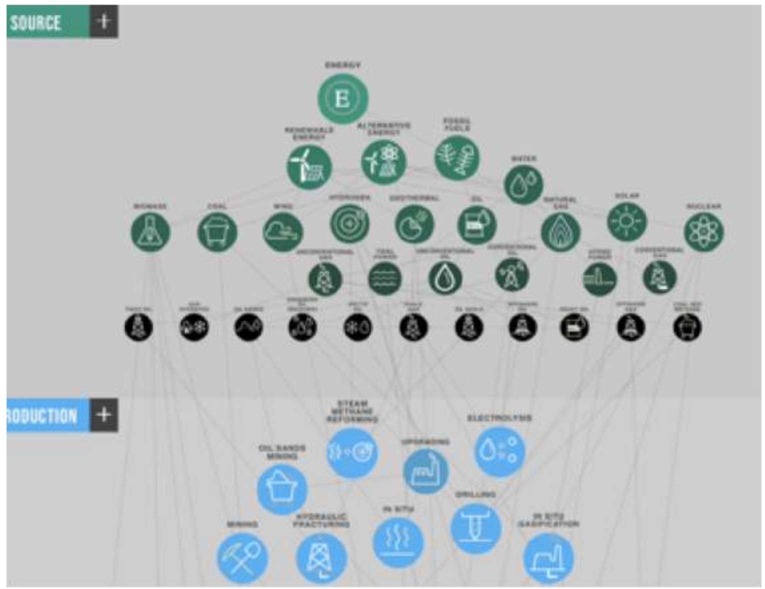
Background Research on Power Production

1. Everyone investigates Wind, Coal, Solar Cells (photovoltaics or PV) or Hydro.
2. Then you will be assigned one more Energy Source for Power Production.

Energy Source	Description	Criterion #1:	Criterion #2:	Criterion #3:
Hydro				
Coal				
Natural Gas				

Background Research on Power Production

www.studentenergy.org/map



Note: NIMBY means “Not in my Backyard” and refers to when people do not want a power plant of a certain type near where they live.

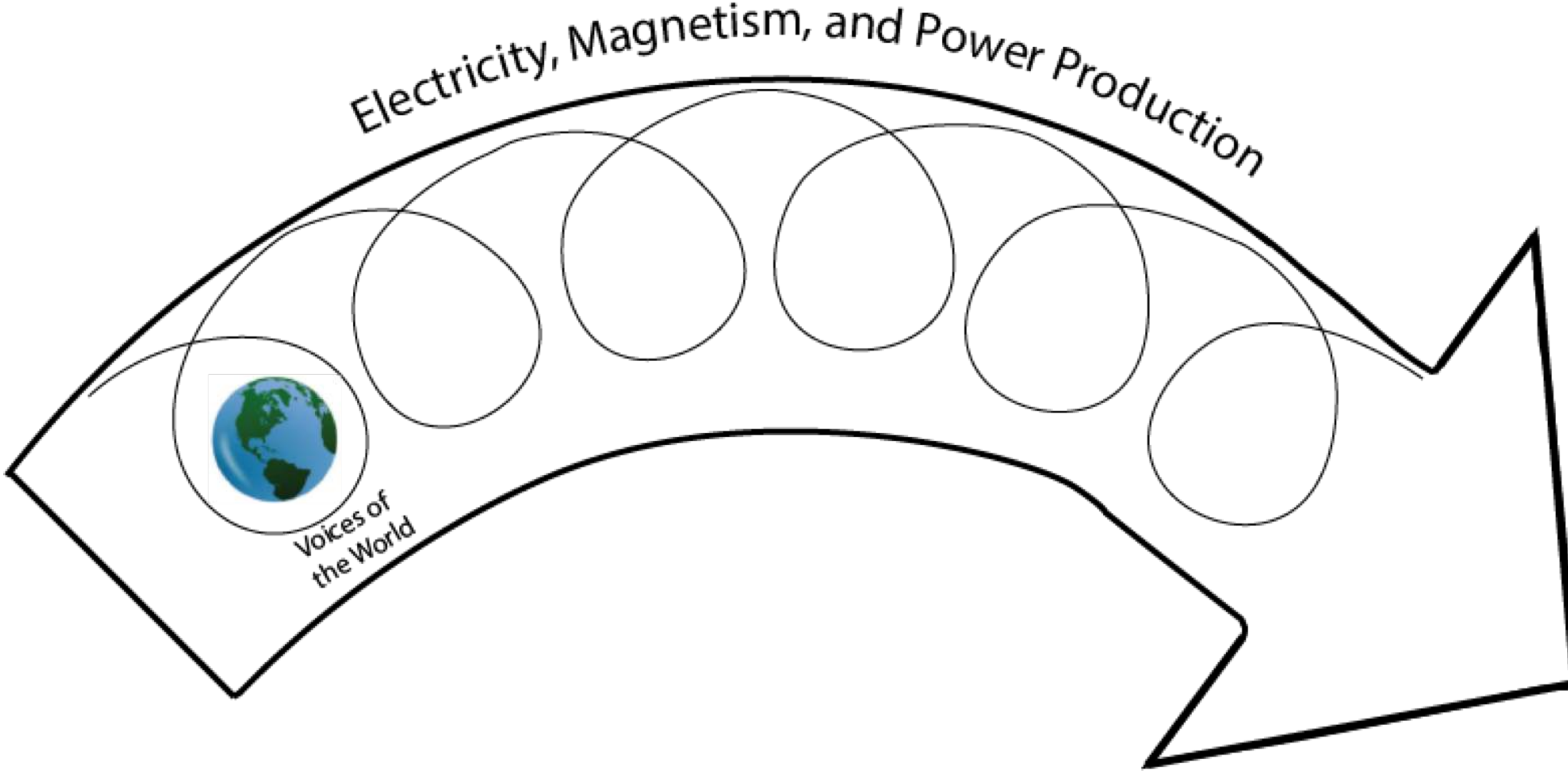
Check In:
You Should Be able to Answer:

Focus Question

What are the different perspectives on climate change?

Language Focus

Be able to convey important characteristics about different energy sources used for power production.


Electricity, Magnetism, and Power Production
Voices of the World

Electricity, Magnetism, & Power Production - Day 2

Agenda:

Finishing Background Research on Power Production

Exploring Engineering Solutions

Energy City Simulation

Upcoming

Due Next Class

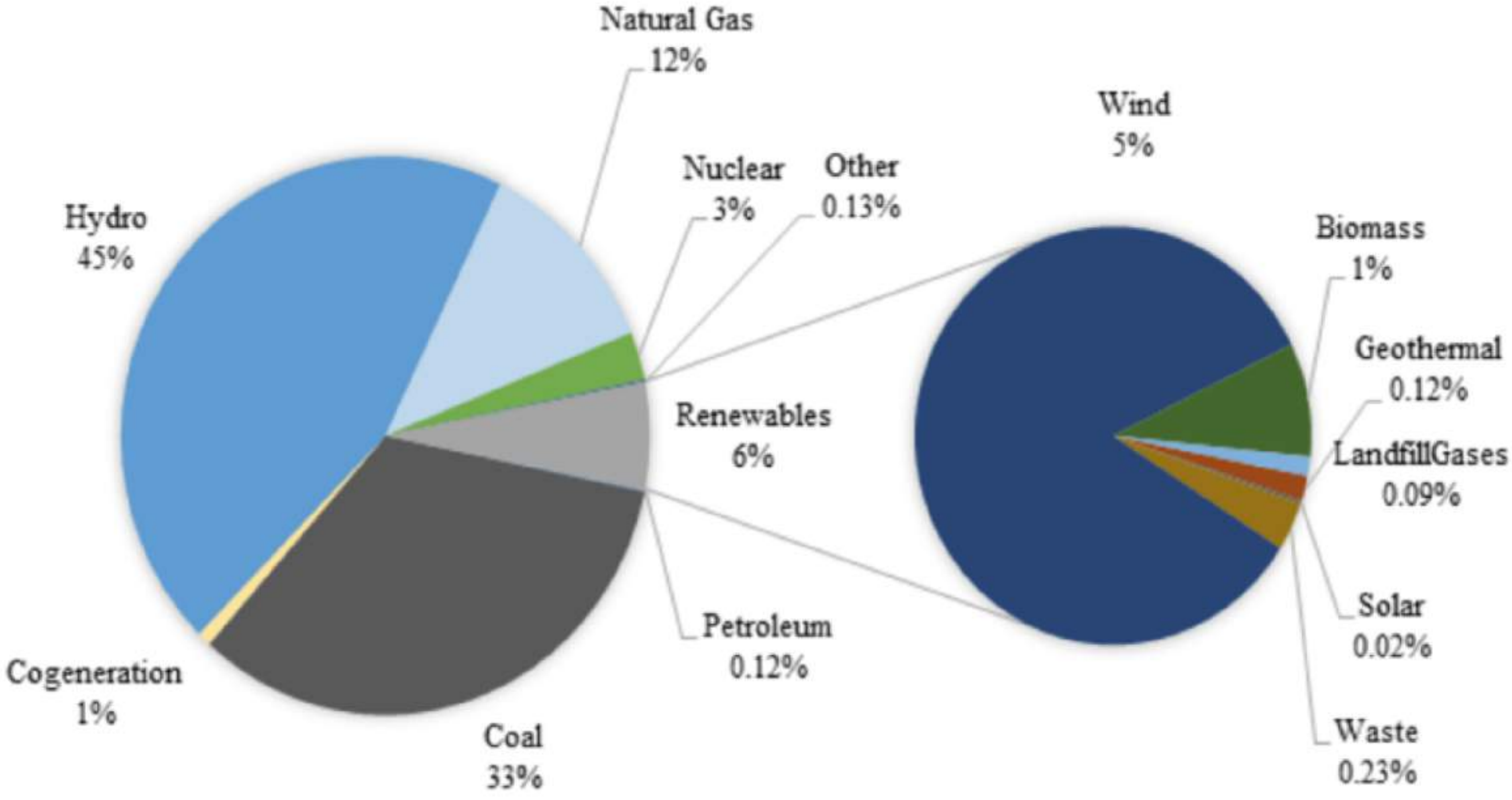
Due This Class

Complete Background Research

Warm Up Question:

Read the overview of Oregon's electricity mix on page 20 of State of Oregon Biennial Energy Plan 2015-17 (linked in your 6EP doc).

What did you notice or learn from reading the overview of Oregon's electricity mix on page 20 of State of Oregon Biennial Energy Plan 2015-17



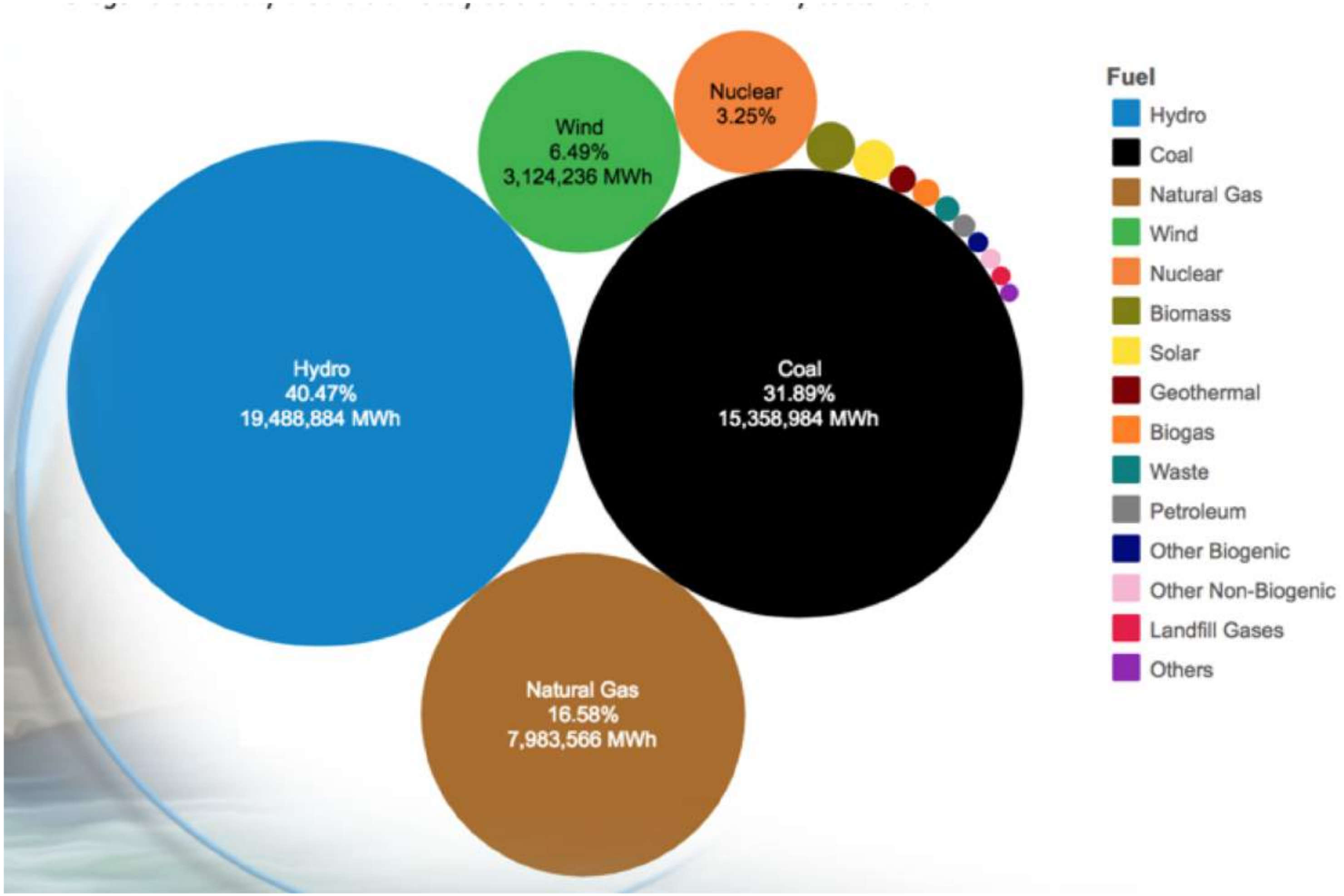
What did you notice or learn from reading the overview of Oregon’s electricity mix on page 20 of State of Oregon Biennial Energy Plan 2015-17

	Plant	Primary Energy Source	Operating Company	Net Summer Capacity (MW)
1	John Day	Hydroelectric	USACE Northwestern Division	2,160
2	The Dalles	Hydroelectric	USACE Northwestern Division	1,823
3	Bonneville	Hydroelectric	USACE Northwestern Division	1,093
4	McNary	Hydroelectric	USACE Northwestern Division	991
5	Hermiston Power Partnership	Natural Gas	Hermiston Power Partnership	615
6	Boardman	Coal	Portland General Electric Co	585
7	Beaver	Natural Gas	Portland General Electric Co	487
8	Klamath Cogeneration Plant	Natural Gas	Pacific Klamath Energy Inc.	470
9	Hermiston Generating Plant	Natural Gas	Hermiston Generating Co LP	464
10	Biglow Canyon Wind Farm	Wind	Portland General Electric Co	450

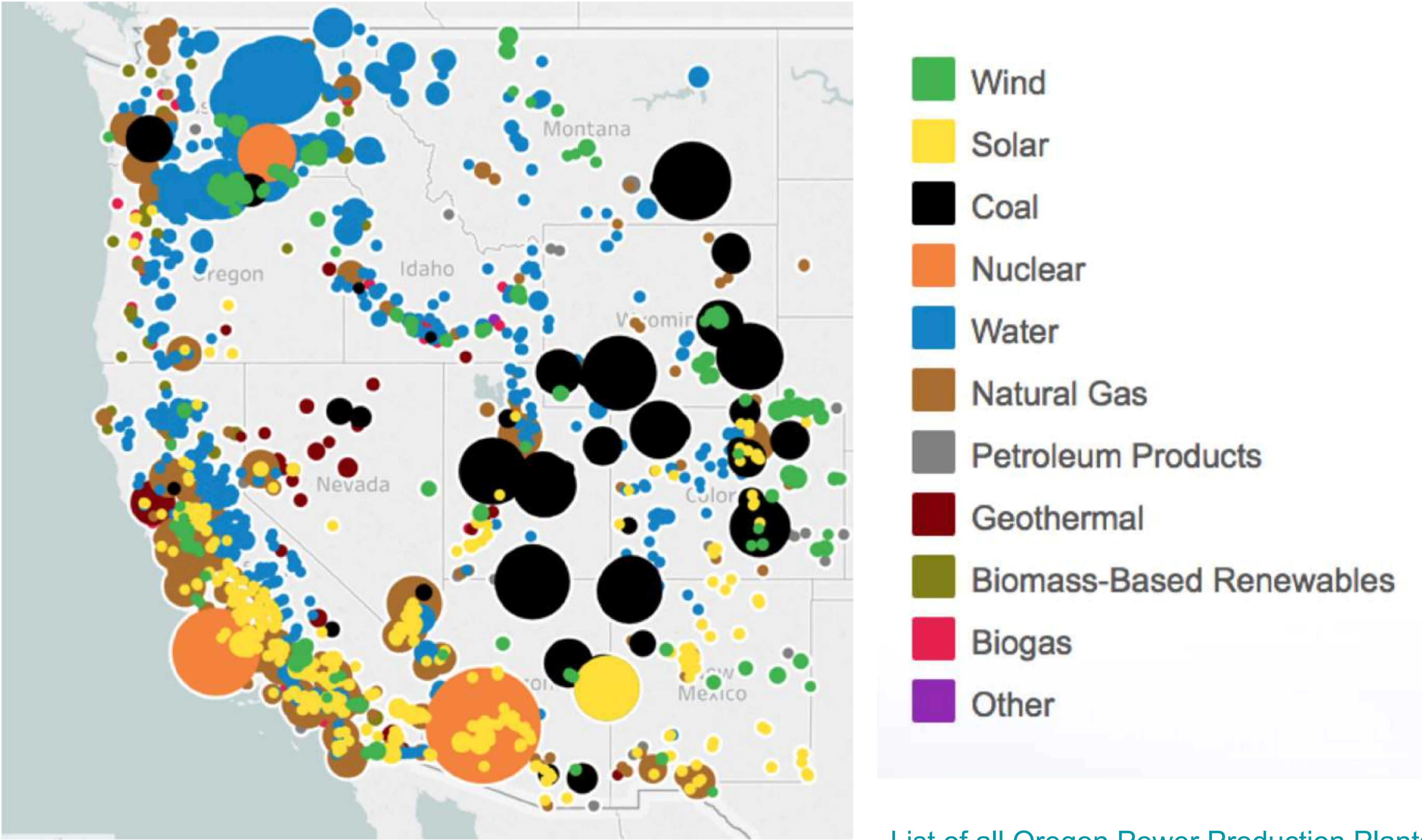
Source: U.S. Energy Information Administration, Form EIA-860, "Annual Electric Generator Report."

Figure 12: According to the U.S. Department of Energy’s Energy Information Administration, the top four electricity generators in Oregon are hydroelectric.

Hear is another similar representation Oregon Department of Energy now uses. What do you think?



Power Production in the West (map linked)



List of all Oregon Power Production Plants

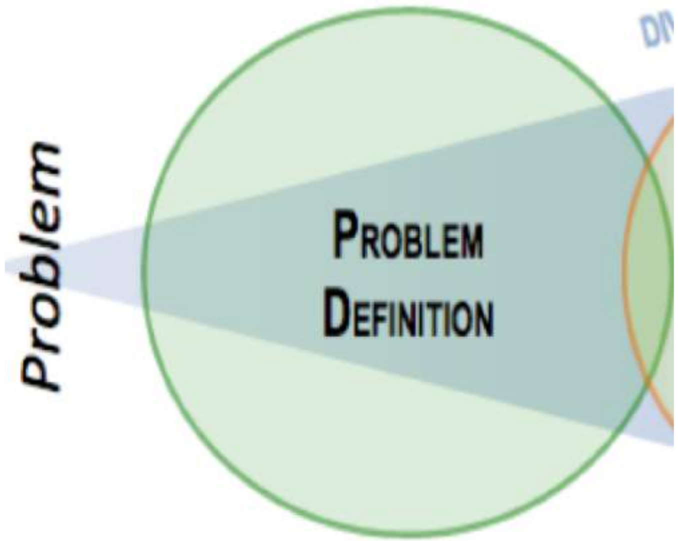
Jump Back to Finish your Background Research

Background Research on Power Production

Each of the energy strategies below is proven to be able to help meet our energy needs on a large scale. When thinking about our energy needs, there is no perfect solution and each of the energy strategy comes with trade-offs. Go to studentenergy.org/map and with your group, fill out the chart below detailing the energy strategies and their respective trade-offs. For this activity you will need access to the internet.

Energy Source	Description	Criterion #1:	Criterion #2:	Criterion #3:
Wind				
Coal				

Let's Get Focused

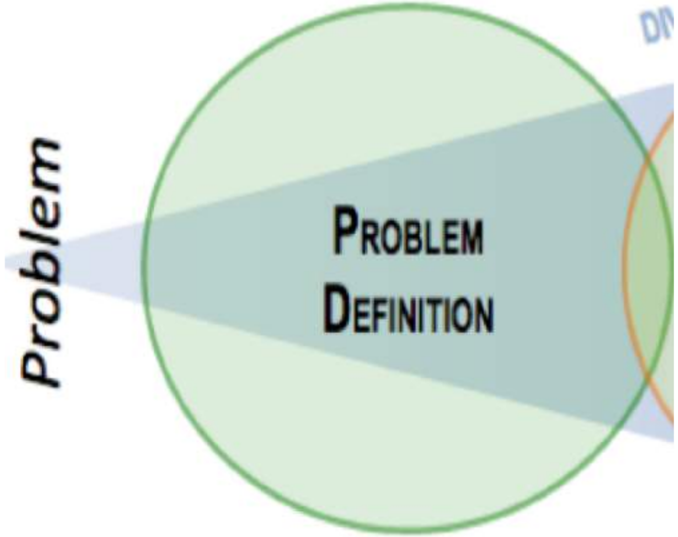


Now with more research into power production, we need to further explore our problem.

We already have our focused statement of the design problem in our Engineering Portfolio.

We as the Energy Plan Commision seek to create a 50-Year Energy Plan that must address the energy needs and environmental concerns of Oregonians.

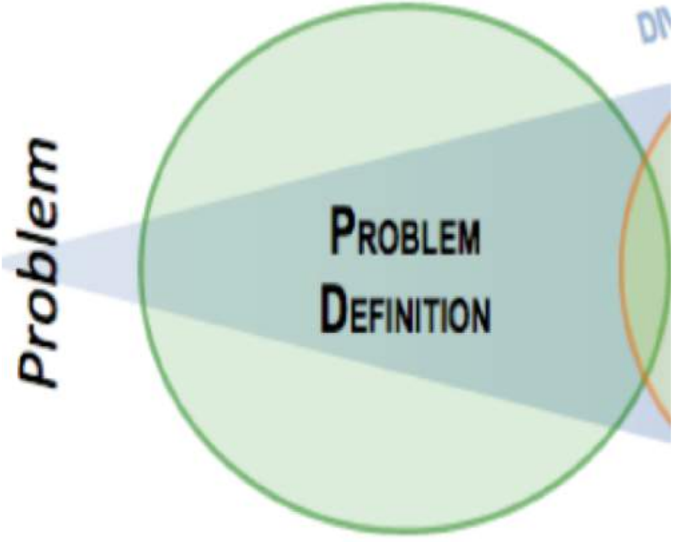
What are our Constraints in this Project?



Constraints for the 50 Year Energy Plan:

1. ClickHereToType
2. ClickHereToType
3. ClickHereToType

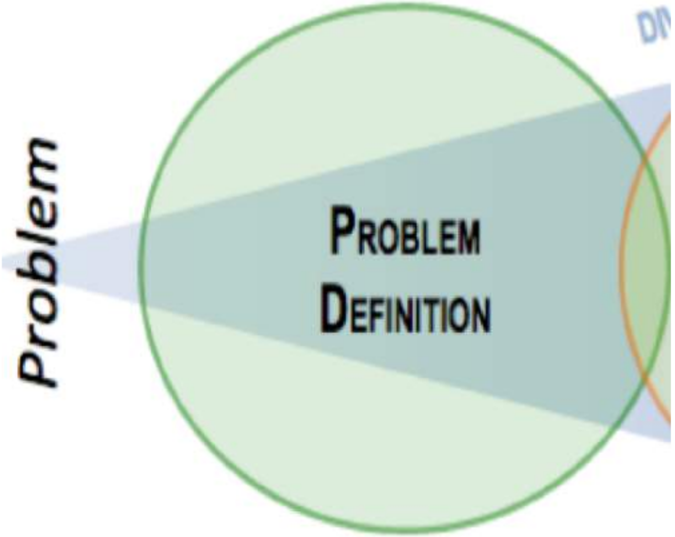
What are our Constraints in this Project?



Constraints for the 50 Year Energy Plan:

1. Must provide enough power to meet future demand/increase
2. Cannot use coal after 2035 (Clean Electricity & Coal Transition Act)
3. It is due by ClickHeretoType
4. Respond to the values of Oregonians (clean technologies, environment with focus on wildlife)

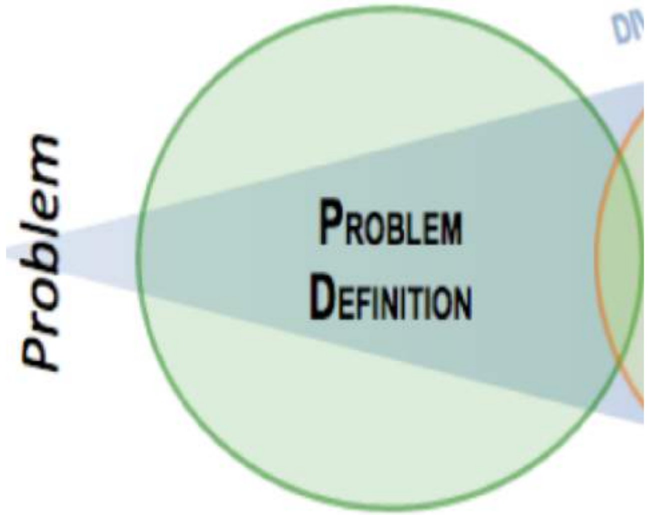
What are our Criteria in this Project?



Criteria that your energy source choices will be measured by:

1. ClickHereToType
2. ClickHereToType
3. ClickHereToType

What are our Criteria in this Project?

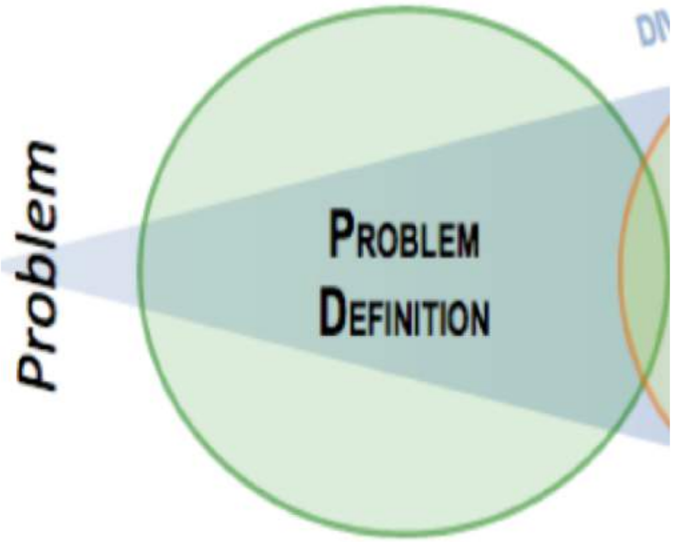


Criteria that your energy source choices will be measured by:

1.	2.	3.
Environmental Impact / Land Use: Describe how this energy strategy affects the land/water it is on or around. Does it need to be in specific locations?	**Climate Impact / Air Quality:** Describe any impact on CO_2 emissions or air quality associated with this strategy	**Lifetime Cost:** Describe any costs, both short and long term, directly and indirectly associated with this strategy.

To wrap our heads around this, let's try out a "wild guess"

Initial 50-Year Plan



	2010s		2020s		2030s		2040s		2050s		2060s	
% Energy Needed (% of current energy use)	100		105		110		115		120		125	
	%**	% Growth	%	% Growth	%	% Growth	%	% Growth	%	% Growth	%	% Growth
Hydro (Maxed)	43		43		43		43		43		43	
Coal	34		34		34		34		34		34	
Natural Gas	12		12		12		12		12		12	
Nuclear	3		3		3		3		3		3	
Biomass	3		3		3		3		3		3	
Wind	5		5		5		5		5		5	
Geothermal	0		0		0		0		0		0	
Solar	0		0		0		0		0		0	
Wave	0		0		0		0		0		0	
Smart Grid Technology	0		0		0		0		0		0	
Energy Storage	0		0		0		0		0		0	
Energy Needs Check	100 of 100		100 of 105		100 of 110		100 of 115		100 of 120		100 of 125	

Looking ahead to our Final Report

As always, you will be tasked with communicating the problem and evaluating your design solution as compared to others. However, as our last CER, we will be stepping up our sophistication with

1. Exploring Our Engineering Challenge (Claim)
2. Evaluating Competing 50 Year Plans (Evidence)
3. Reasoning about the Best Design (Reasoning)
4. Limitations of your Plan

Evaluating Design Solutions

Our focus for today is only

You will be tasked with commu ating the problem and evaluating your de n solution as compared to others. In this ther vill be four (4) sections.

1. Exploring Our Engineering Challenge (Claim)
2. Evaluating Competing 50 Year Plans (Evidence)
3. Reasoning about the Best Design (Reasoning)
4. Limitations of your Plan

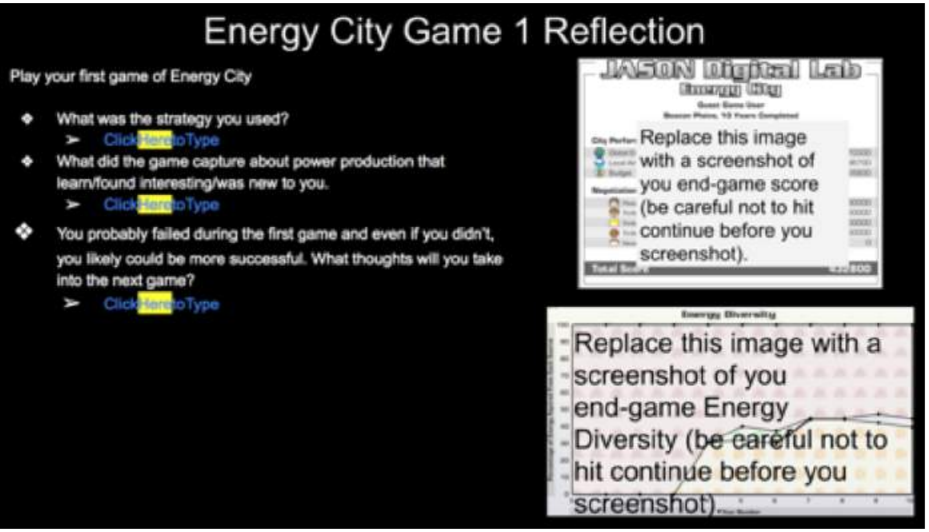
Preparing for the first paragraph of your essay: Graphic Organizer

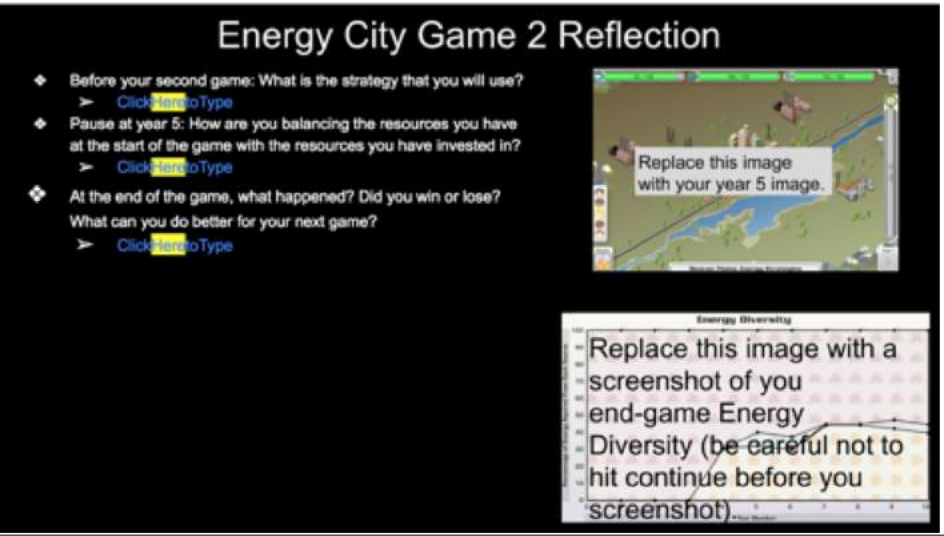
Exploring Our Engineering Challenge		
Problem Statement: What is the problem that you are trying to solve?		
Describe the Constraints for your Energy Plan:		
Constraint 1	Constraint 2	Constraint 3
Describe the Criteria for Each of the Energy Sources		
Criterion 1	Criterion 2	Criterion 3
Make a claim: Which of the criteria above is your highest priority, and why? (This will help develop your strategy.)		
What possibly might happen if you do not solve the problem?		

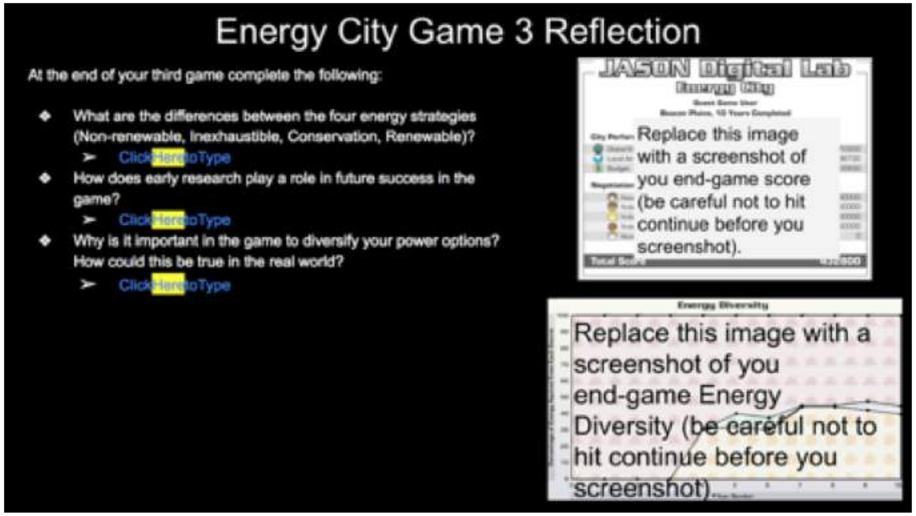
Kick Off Playing [Energy City]

6Simulation - Energy City Strategy and Reflection

Energy City Reflection Slides







Electricity, Magnetism, & Power Production - Day 3

Agenda:

In-Class Essay: Exploring Our Engineering Challenge

Diving into the Physics of Power Production

Making Speakers

Due Next Class

Due This Class

Warm Up Question:

Given two batteries, two wires, and a light bulb:

Make three observations as you play with the materials.

Write down two things you wonder.

6CER - Part 1
In-Class Essay:
Exploring Our Engineering Challenge

By the End of this Day You Should Be able to Answer:

Focus Question

What is going on with electricity?

Language Focus

Be able to use the technical language to describe electricity, power, and power production.

From the Need to How It Works

Learning from Multiple Sources

What are the three big ideas of the following video?

The need for Large Scale Power Production
is the need for Large Scale Energy Transformations

From the Need to How it Works

Learning from Multiple Sources

Need Energy for:

$E_{thermal}$ for heat

$E_{mechanical}$ for transportation

$E_{electricity}$ to power things

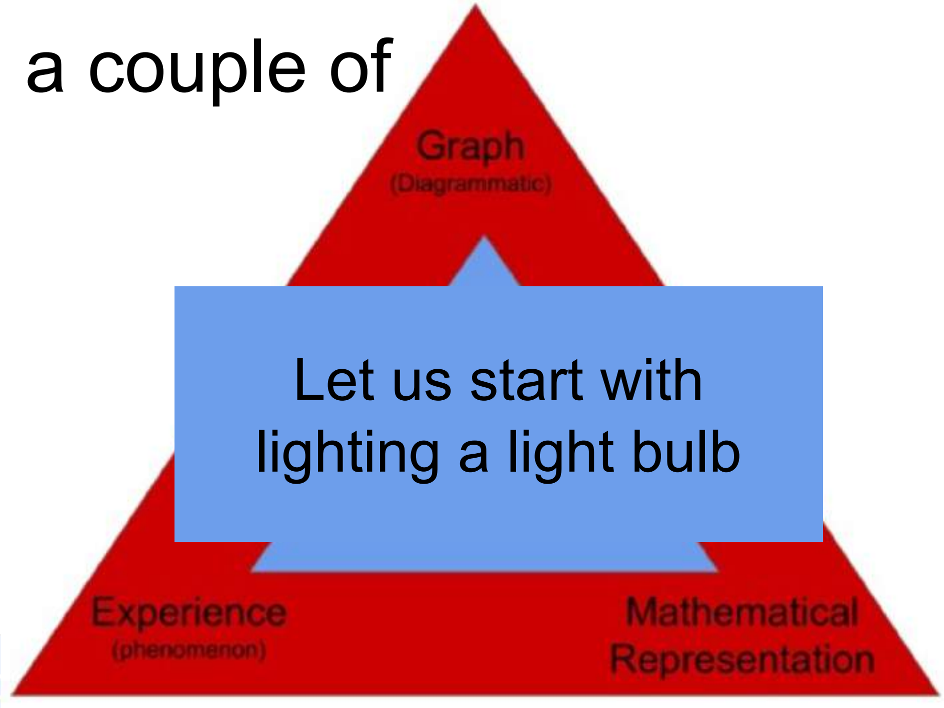
At the heart of nearly all $E_{electricity}$ is motion of a turbine

Power Production then is really about Energy Transformations

Let's Be Playful with our Inner Scientist

From our KWL on power production, electricity, and energy sources you clearly already know a lot, but let's push the use of some of our tools from our physics toolbelt to explore deeper:

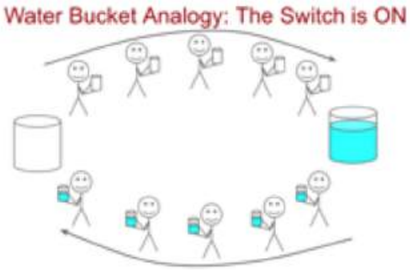
- start with thinking through a couple of easy, concrete examples
- make observations
- create useful diagrams
- walk the Triangle



Teacher Note: Water Bucket Analogy

Key terminology in electricity: energy, voltage, current, electron, and power.

Materials for each Scenario: .



Real Life: Analogy:

battery AA, D, 9V 1st bucket, bigger bucket

energy

colored water

wires taped

path on floor

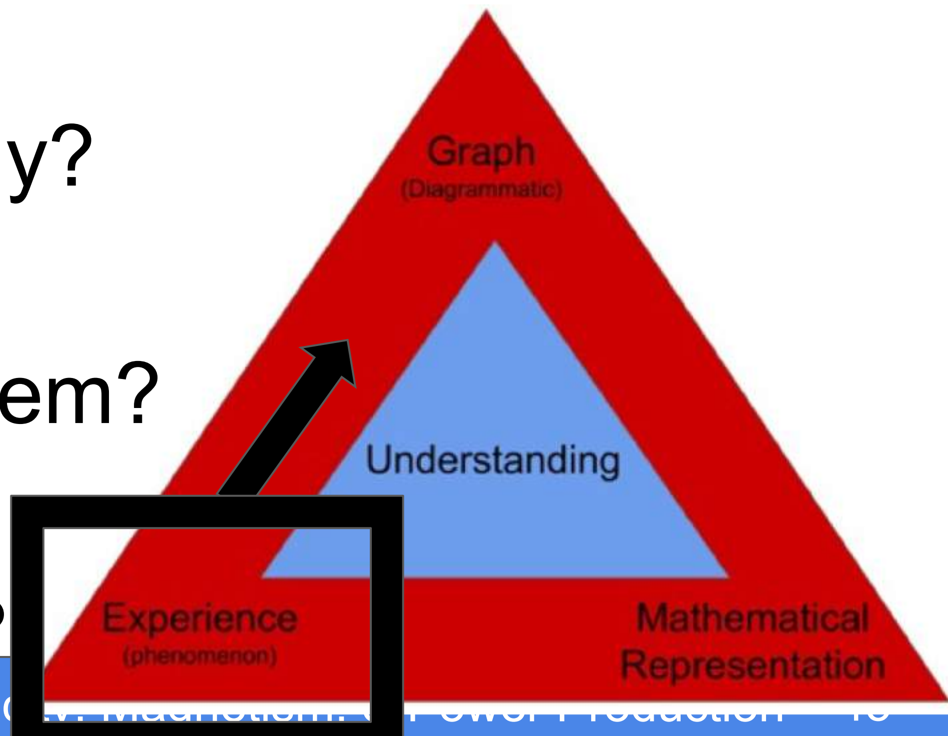
Let's Be Playful with our Inner Scientist

Connect what you observe to what you know

1. What is our system?
2. What does it take to light the light bulb?
3. What is in the battery?
4. What is in the wire?
5. What is the value in creating an analogy?

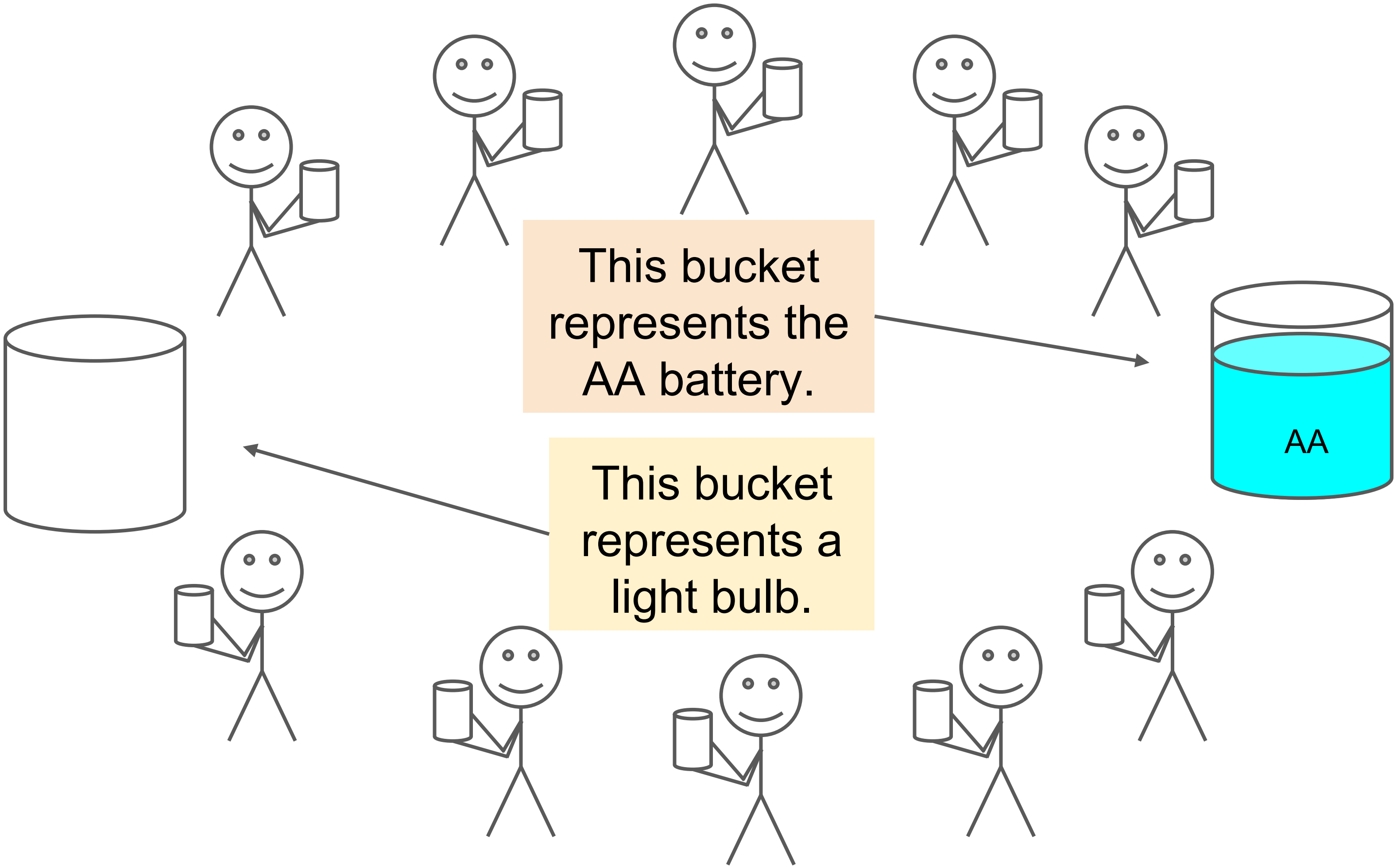
1. Brainstorm ways to represent this system?

6. How should we diagram this?



Moving from Our Experience to a Diagram

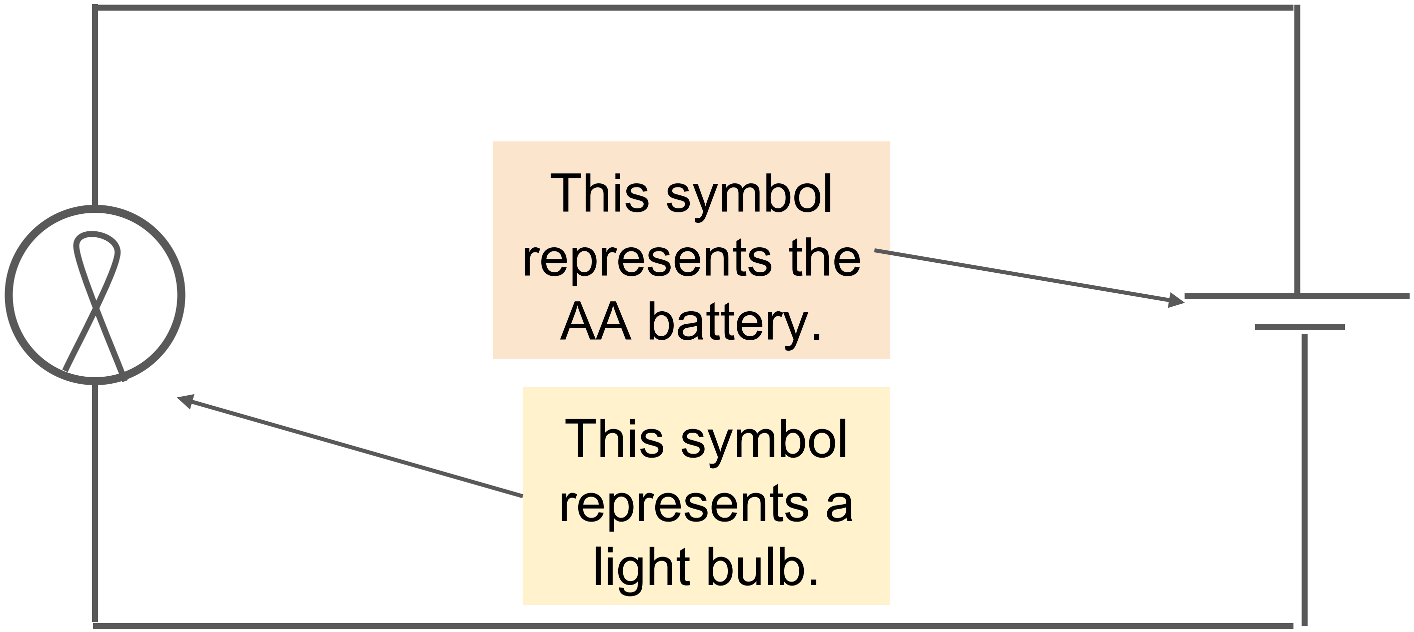
Diagram of Analogy



This is on page 7 of your packet.

Moving from Our Experience to a Diagram

Diagram of Circuit



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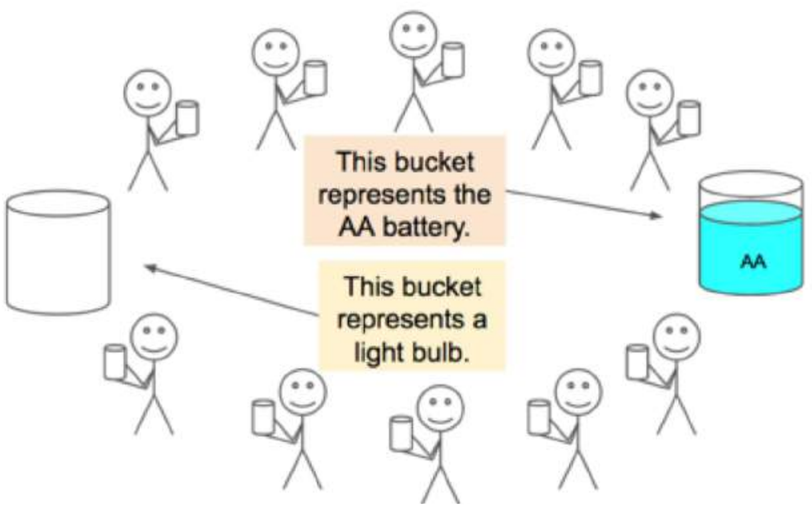
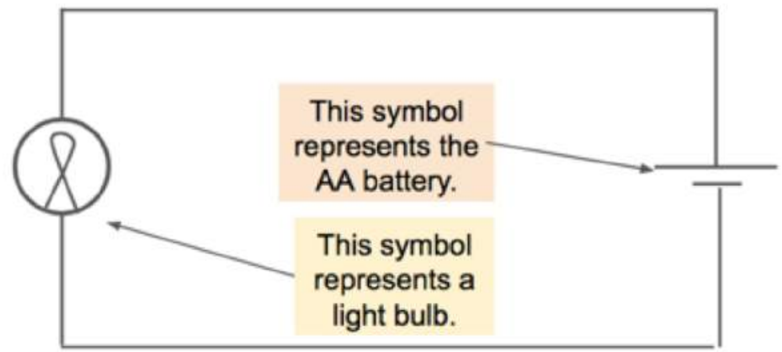
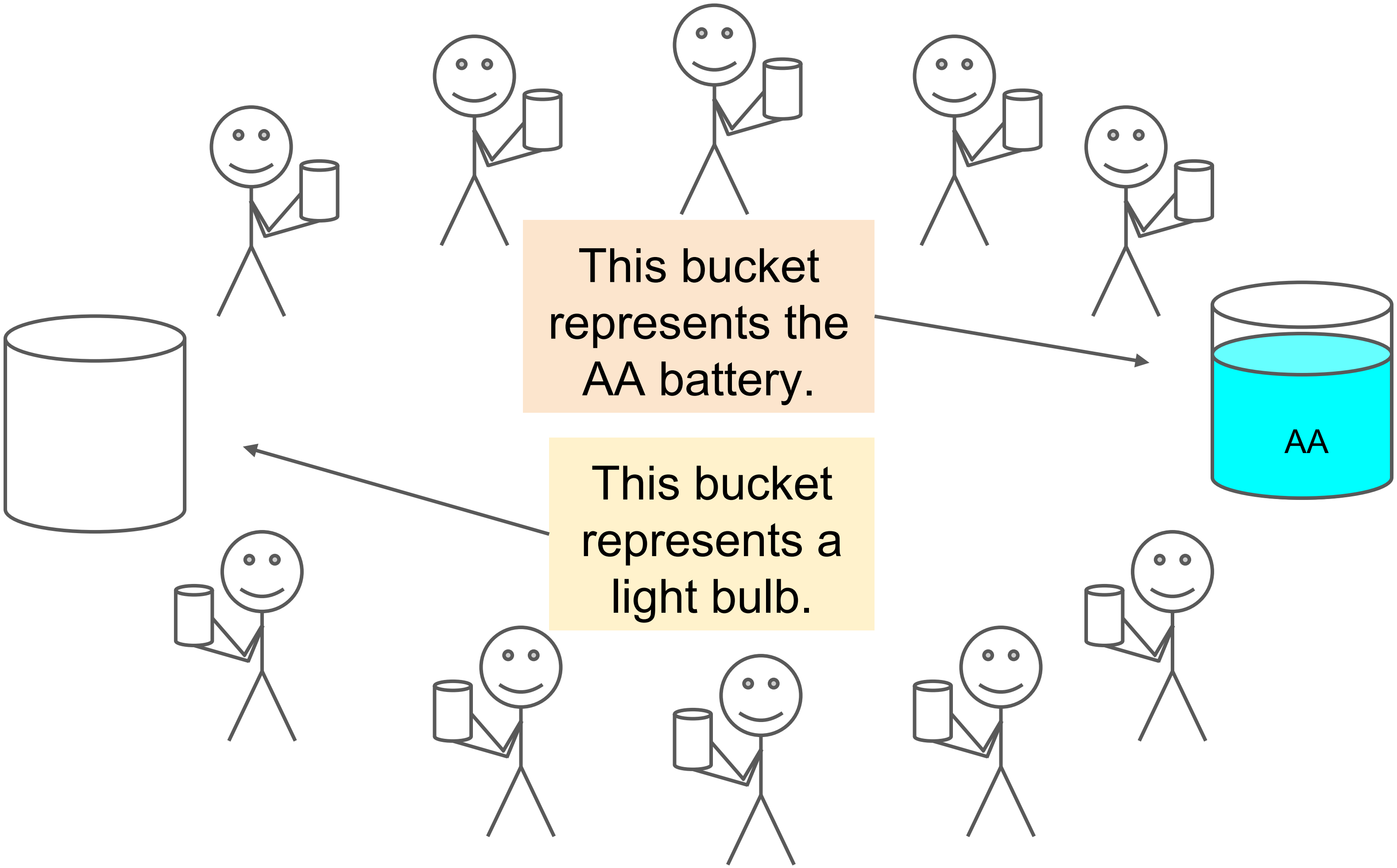
Moving from Our Experience to a Diagram

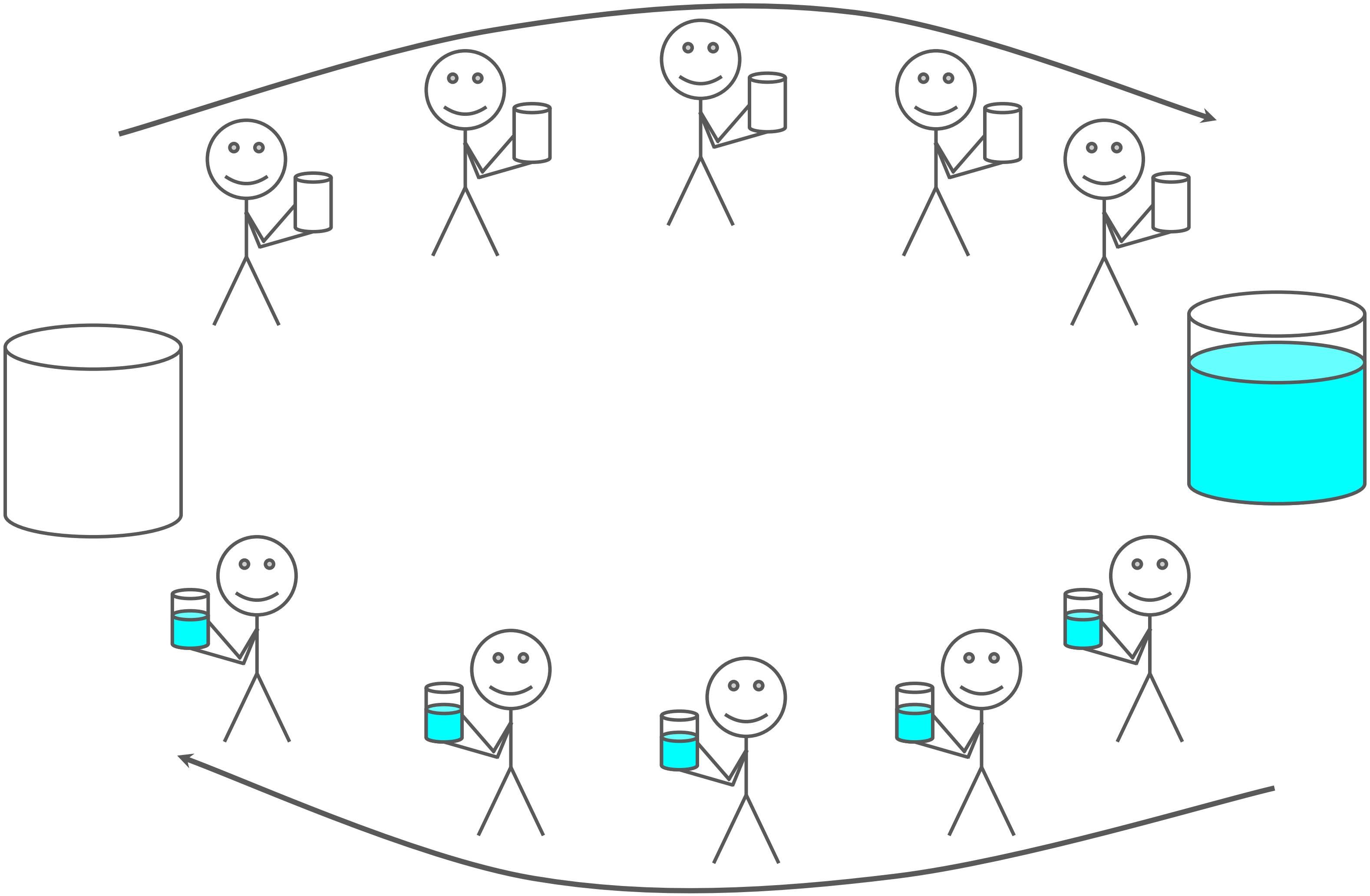
Diagram of Analogy	Diagram of Circuit
	

This is on page 7 of your packet.

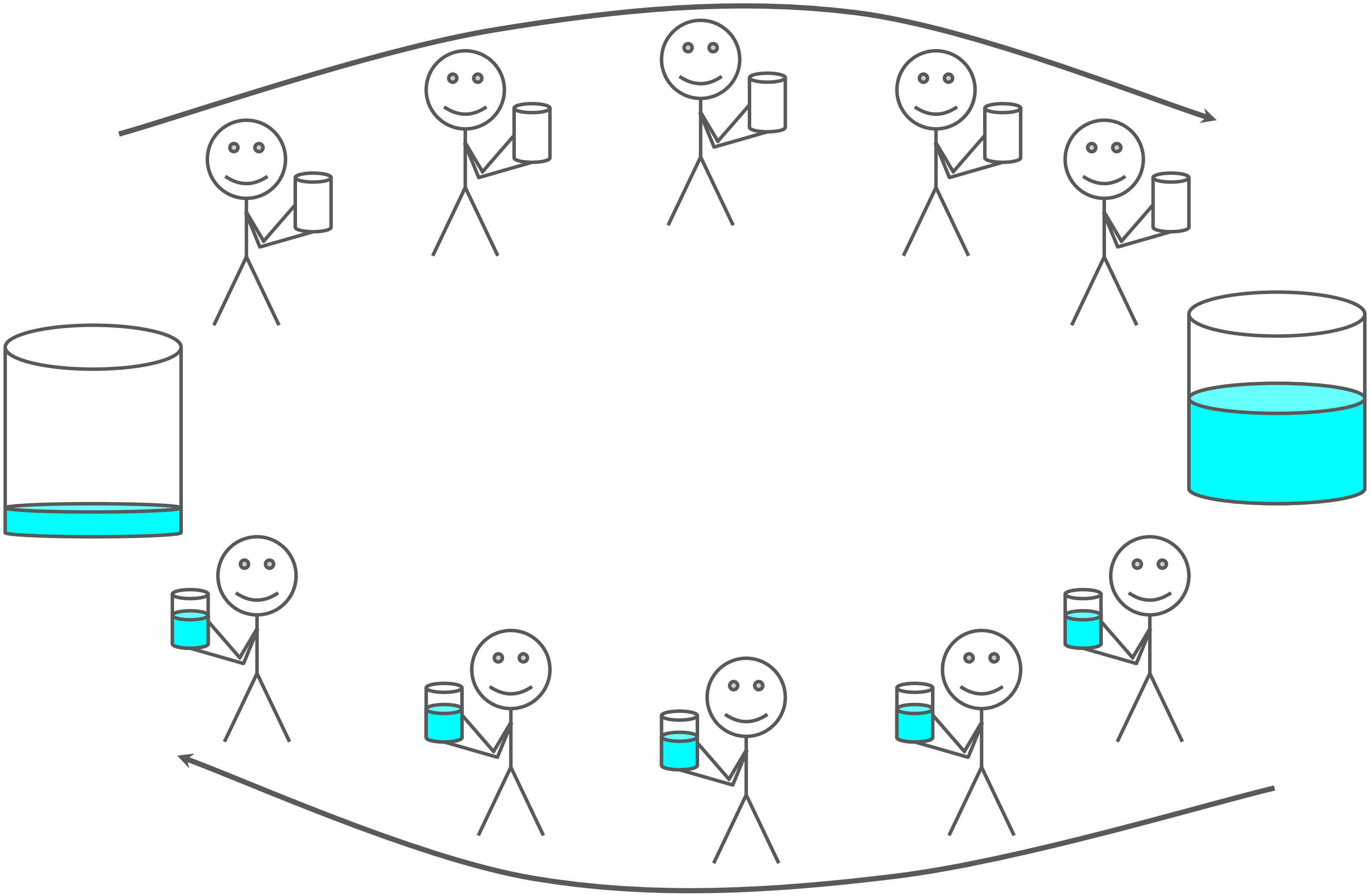
Water Bucket Analogy: The Switch is Off time = 0 s



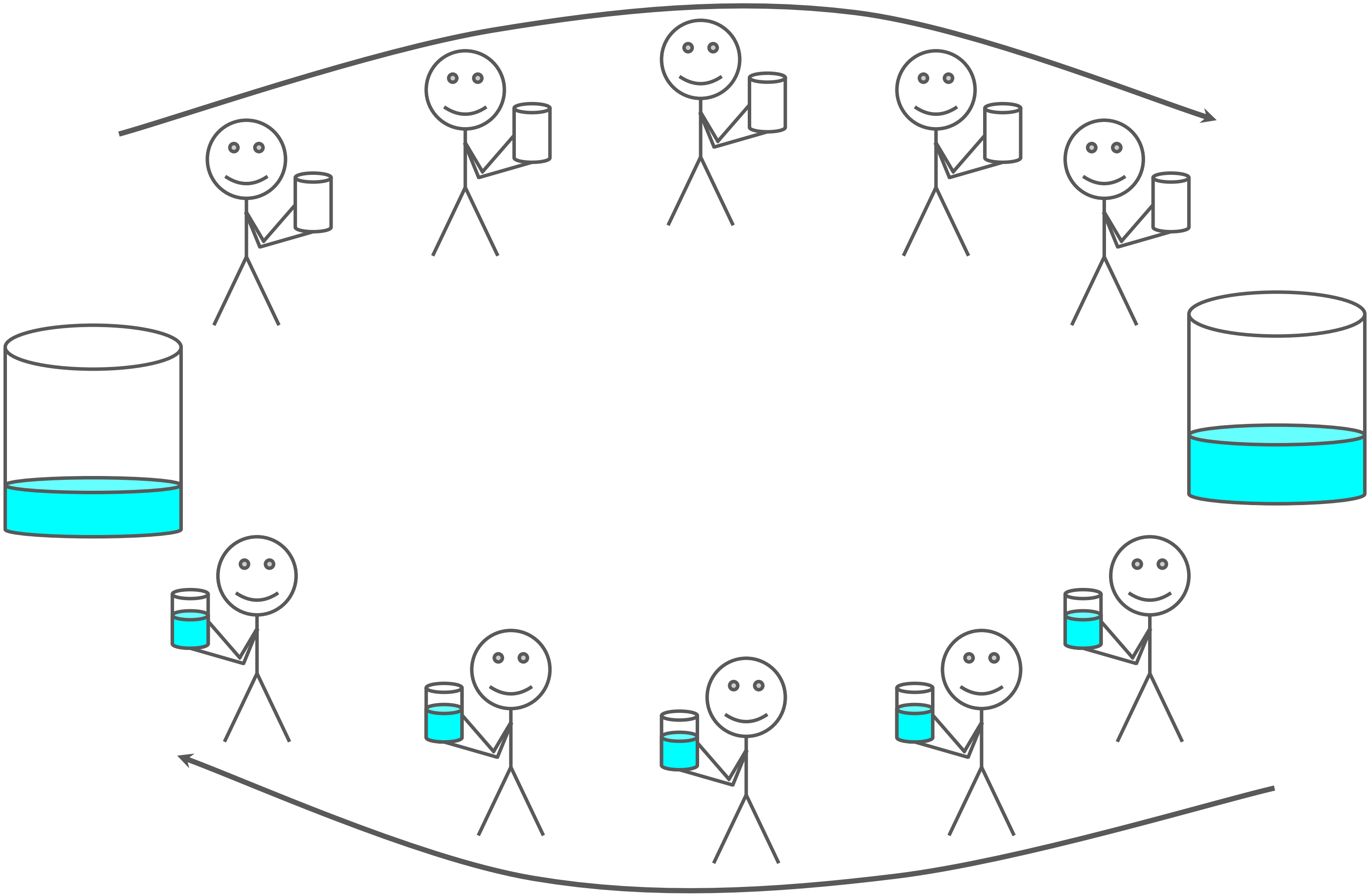
Water Bucket Analogy: The Switch is On
time = just after 0 s



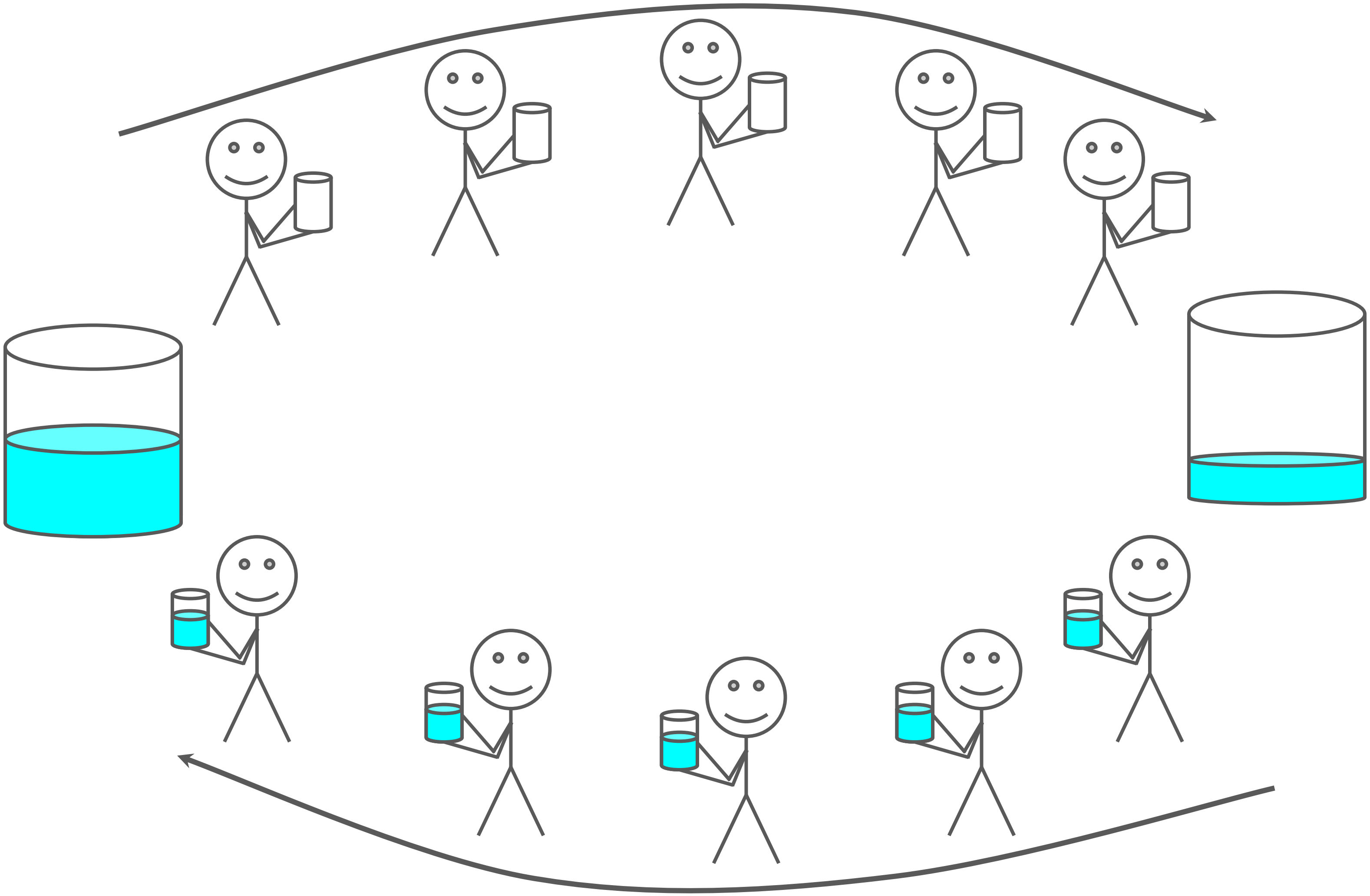
Water Bucket Analogy
time = 1 s



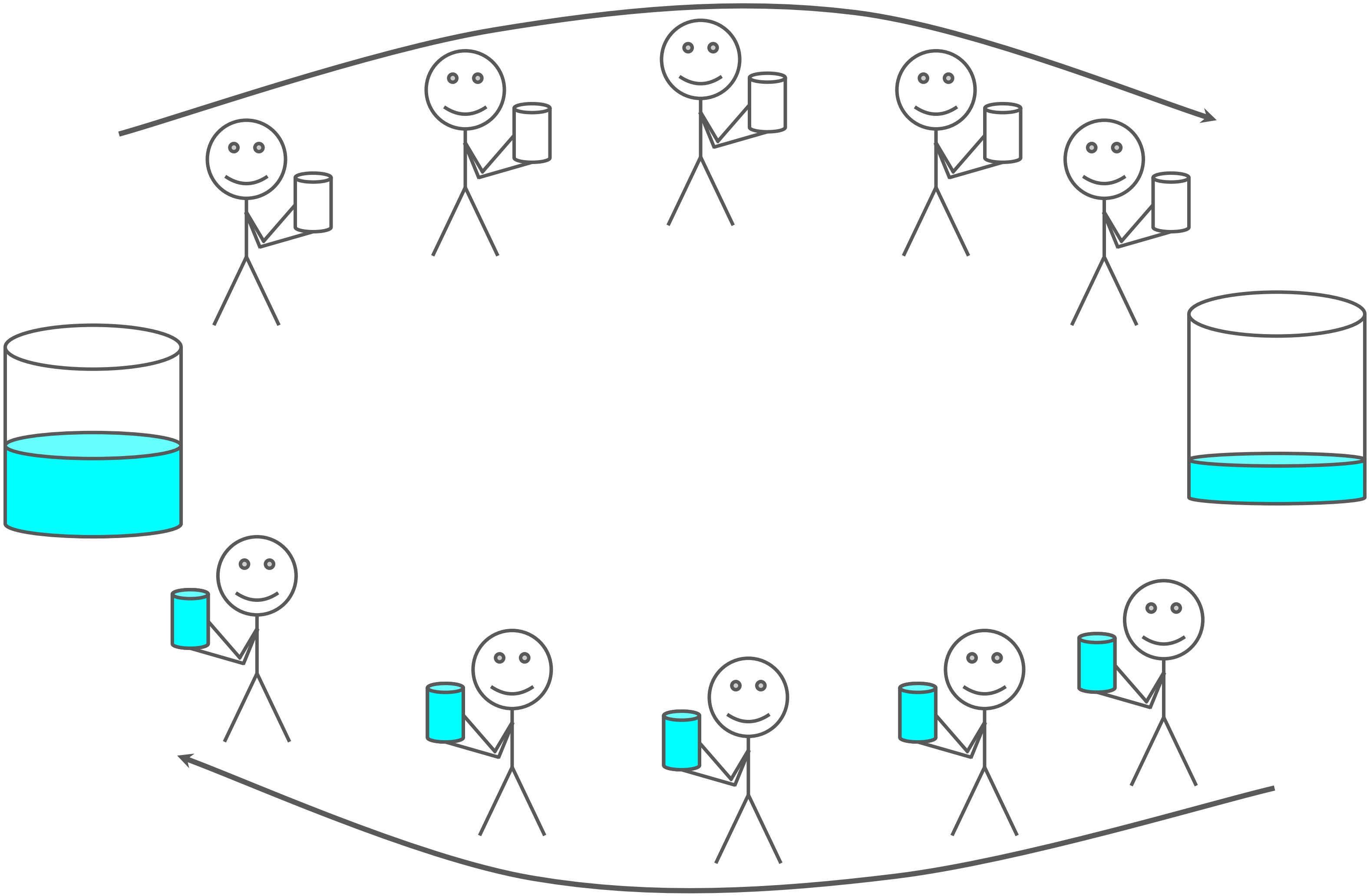
Water Bucket Analogy
time = 2 s



Water Bucket Analogy
time = 3 s



Water Bucket Analogy
Repeat with 9 V



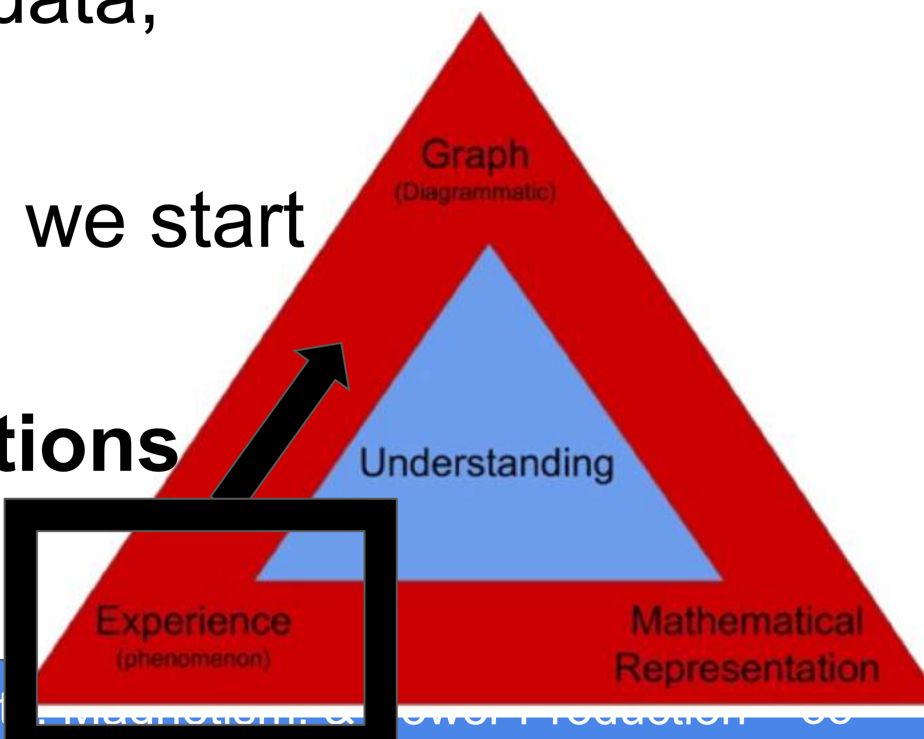
Let's Be Playful with our Inner Scientist

Connect what you observe to what you know

1. **Experience:** How does our real system match up to the analogous one? What signifies what*?

*using words we understand to technical terms

2. **Graph:** Let us use one of our best tools to visualize patterns in data, let's graph it.
3. **Mathematical** How can we start to quantify this system?
4. Then let's make **predictions** about the system to test our hypotheses.



Experience: How does our real system match up to the analogous one? What signifies what*?

*using words we understand then technical terms

Water Bucket Analogy	Real Circuit
What does the water represent?	Energy. It starts as electrical energy in the battery and gets transformed to light in the light bulb.
What do the students represent?	Electrons. Electrons carry the electrical energy around the circuit.
The path that the students are walking.	What would represent the wires?

This is on page 7 of your packet.

Water Bucket Analogy: Definitions

Word	Definition
Voltage	• Energy per electron. • Represented by the amount of water in each cup.
Current	• Electrons per second. • Represented by the moving people.

This is on page 7 of your packet.

Water Bucket Analogy: Definitions

Word	Definition
Voltage	• Energy per electron. • Represented by the amount of water in each cup.
Current	• Electrons per second. • Represented by the moving people.

What happens when we increase the "voltage" in our analogy?

This is on page 7 of your packet.

Water Bucket Analogy: Definitions

Word	Definition
Voltage	• Energy per electron. • Represented by the amount of water in each cup.
Current	• Electrons per second. • Represented by the moving people.

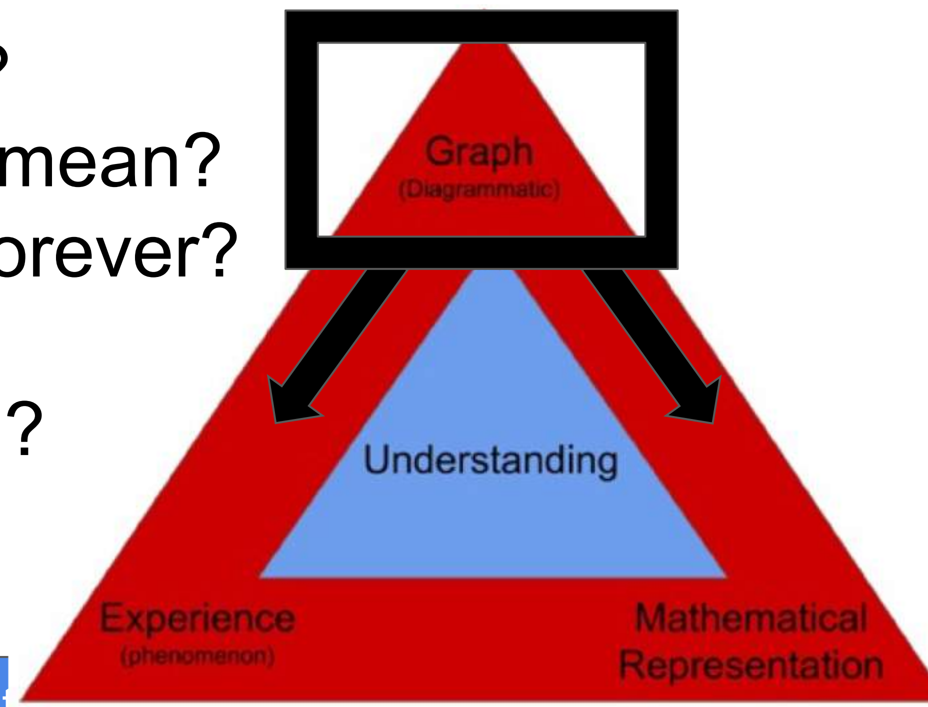
What happens when we increase the “current” in our analogy? The wire doesn’t get more electrons, so how do you get more electrons per second going through the light bulb?

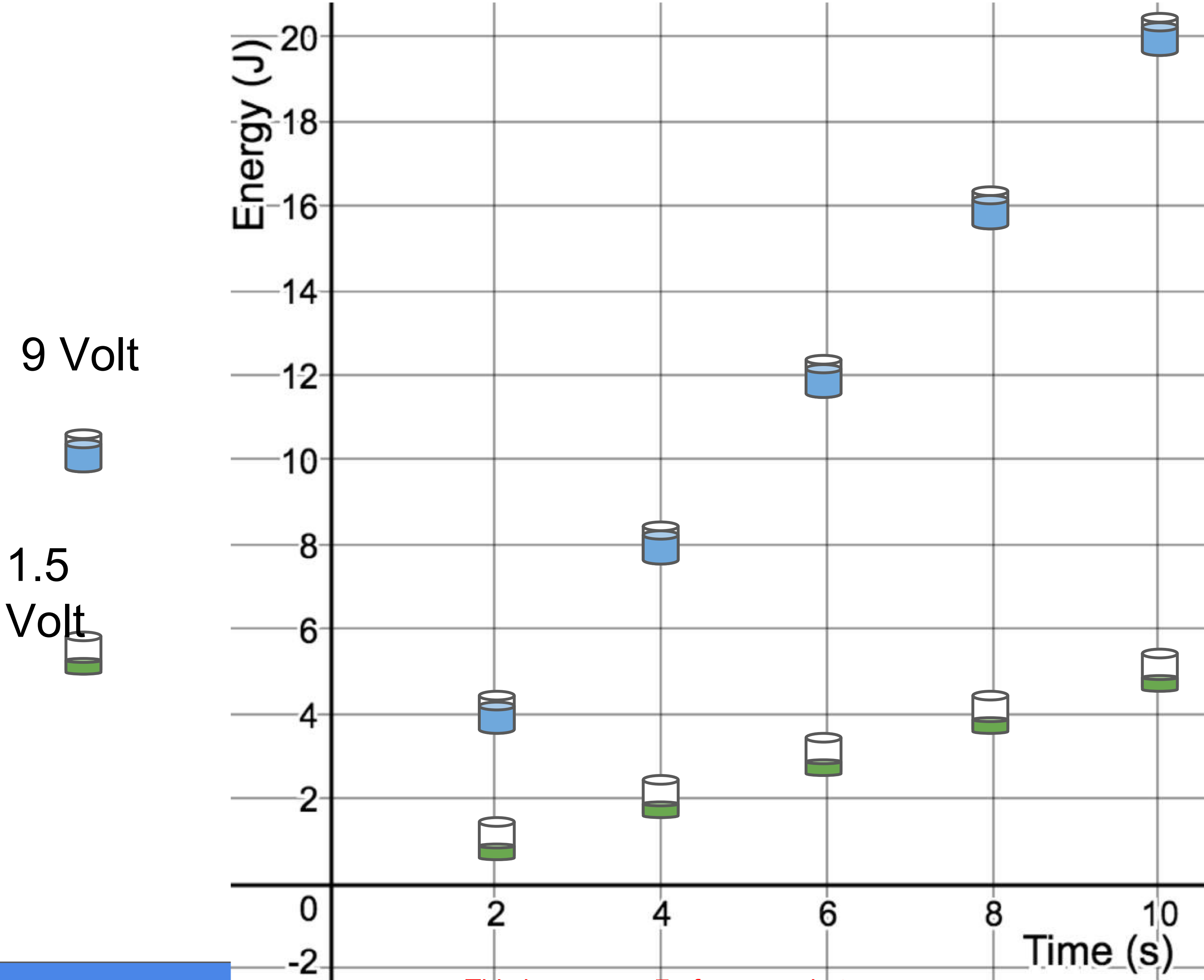
T

Returning to our Inner Scientist

Let us use one of our best tools to visualize patterns in data, let's make a graph.

1. Let us rerun the 1.5 V set up and plot Energy vs time.
1. Now let's repeat this process for a 9 v battery.
2. Let's walk the triangle.
   a. why a zero y-intercept?
   b. what does the A value mean?
   c. will the lines continue forever?
   d. what is the mathematical model?

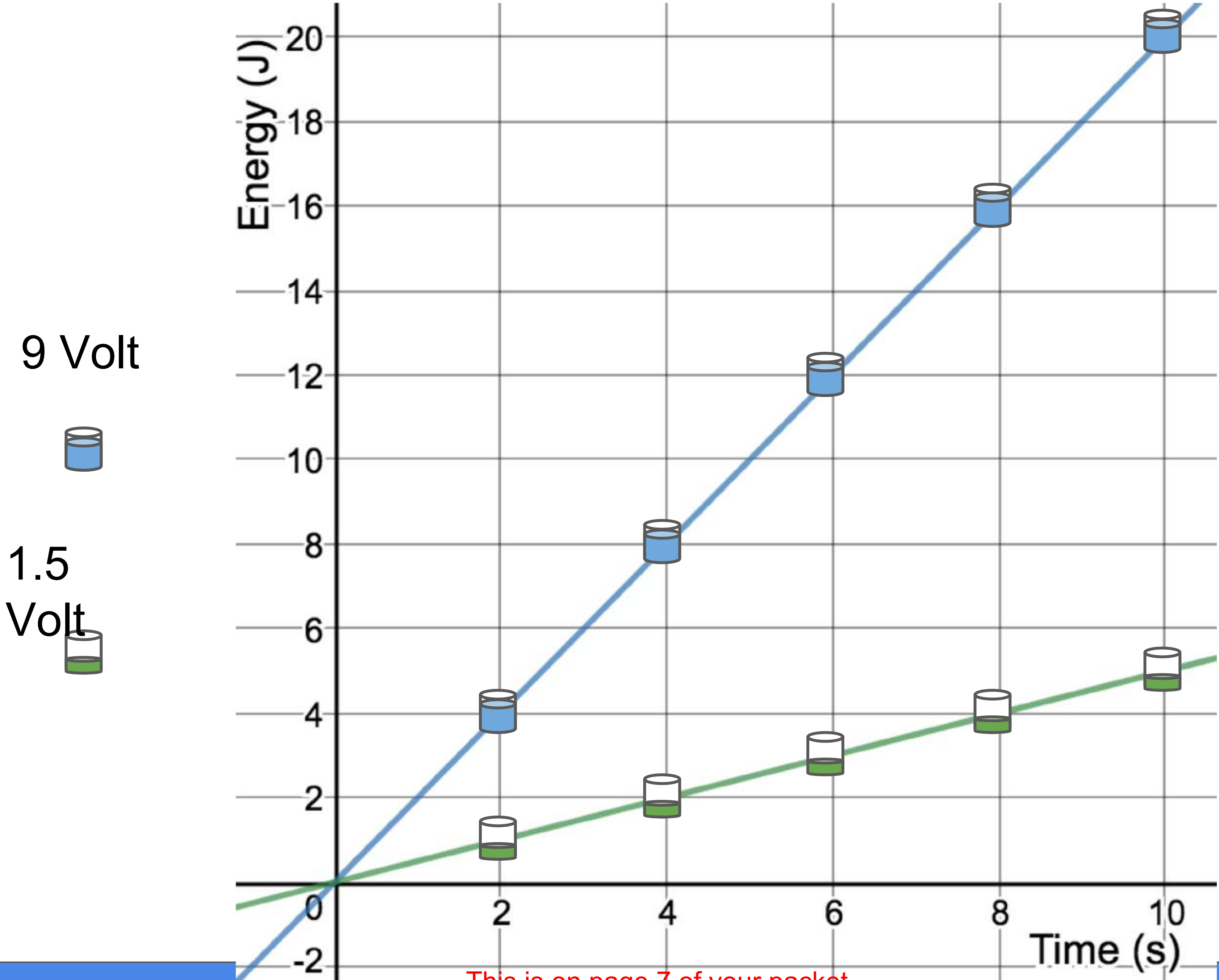




This is on page 7 of your packet.

9 Volt

1.5 Volt

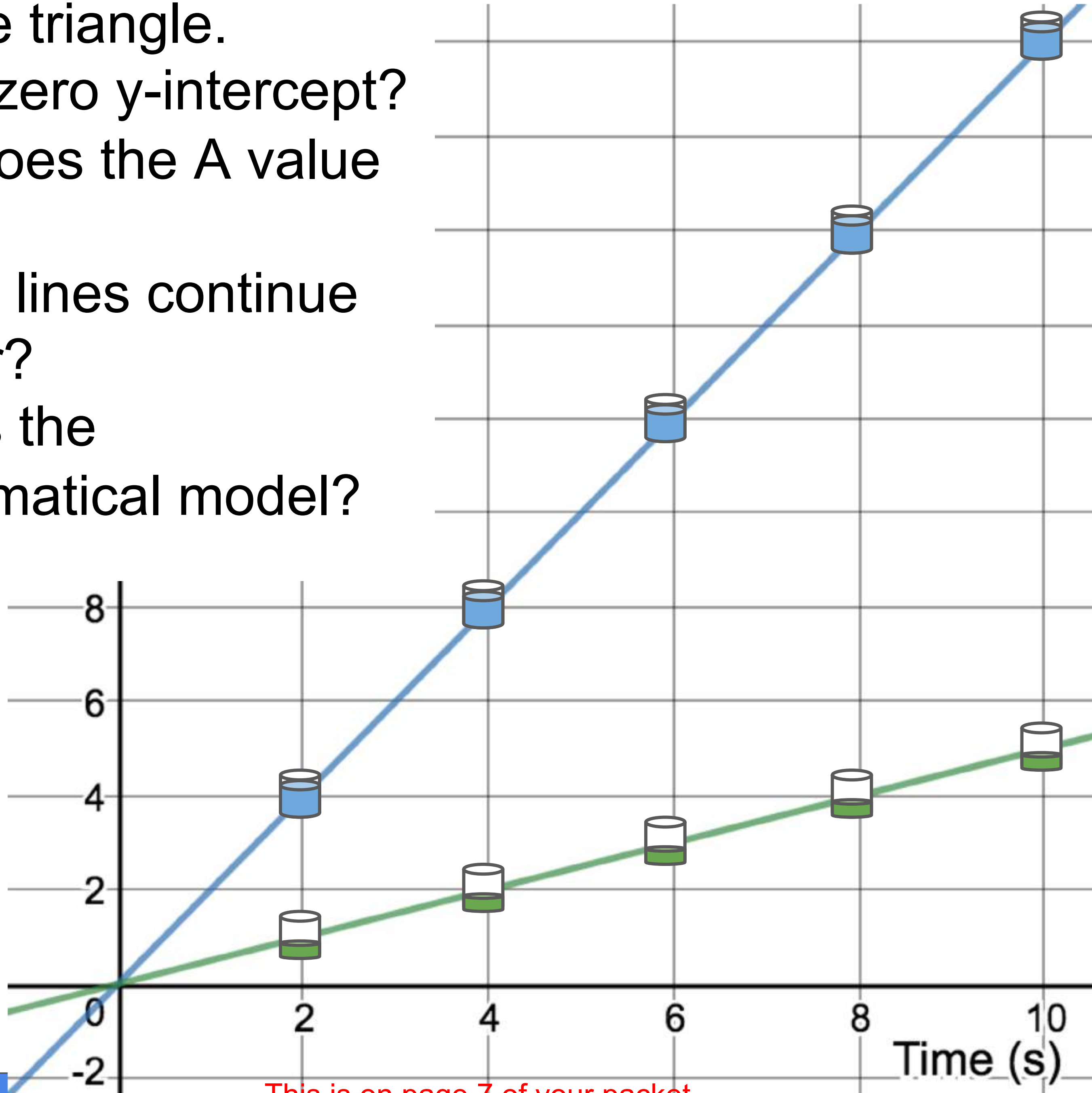


This is on page 7 of your packet.

Let's walk the triangle.

a. why a zero y-intercept?
b. what does the A value mean?
c. will the lines continue forever?
d. what is the mathematical model?

1.5 Volt



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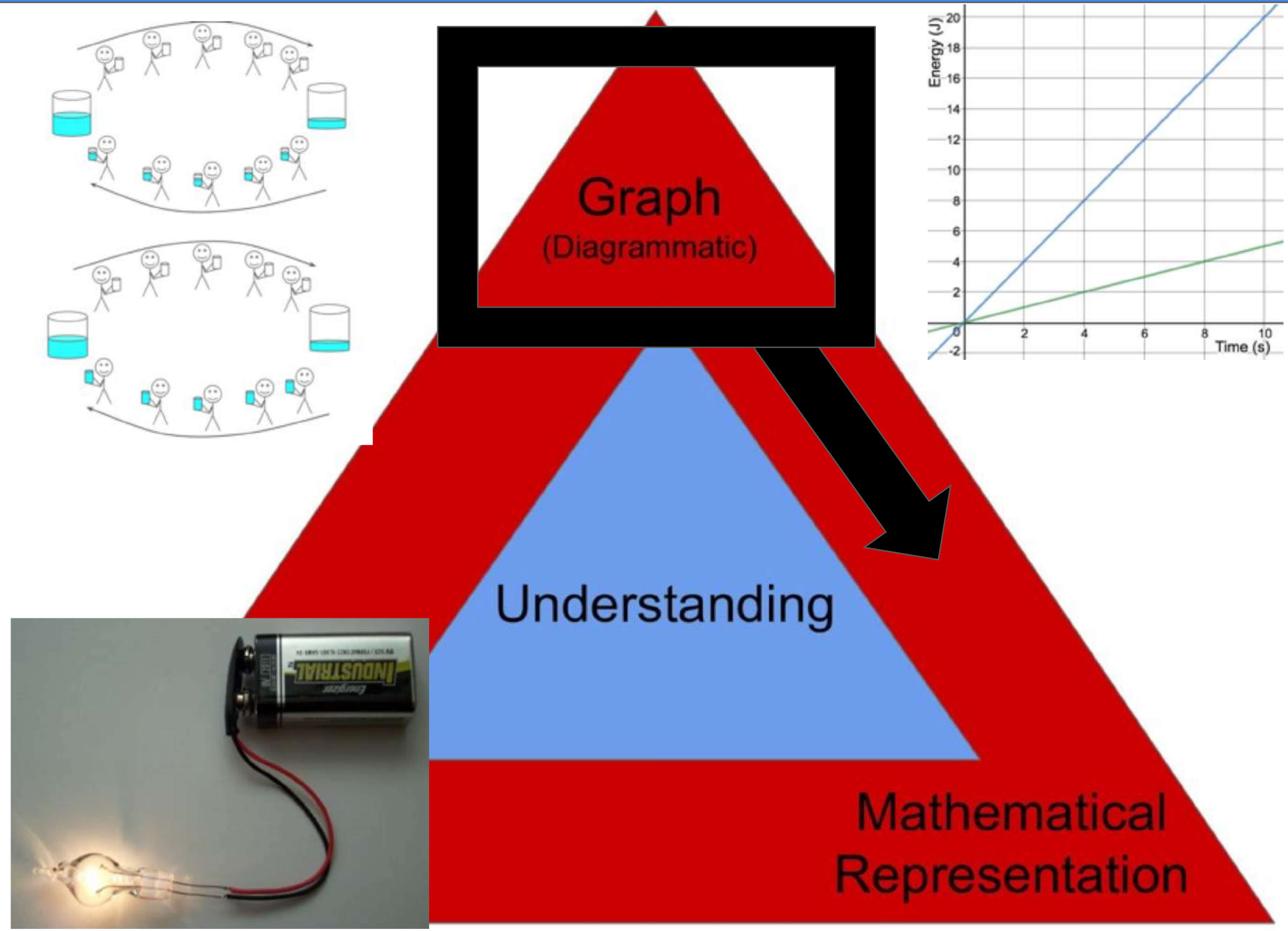

Graph
(Diagrammatic)
Understanding
Mathematical
Representation
Energy (J)
Time (s)

With our focus on Power Production

From our graph →

Equation 1	Equation 2
Energy = Power * time	$P = \frac{Energy\_Transferred}{time}$

Word	Definition
Voltage / current above	Voltage / current definitions above
Power	• Energy transferred per second • Represented by how fast the bucket fills

This is on page 7 of your packet.

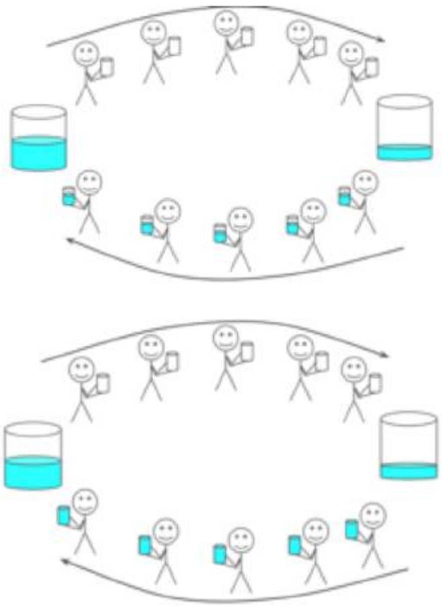
With our focus on Power Production

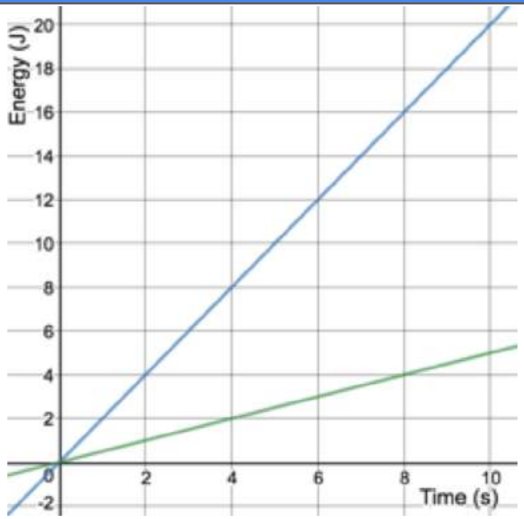
Power:

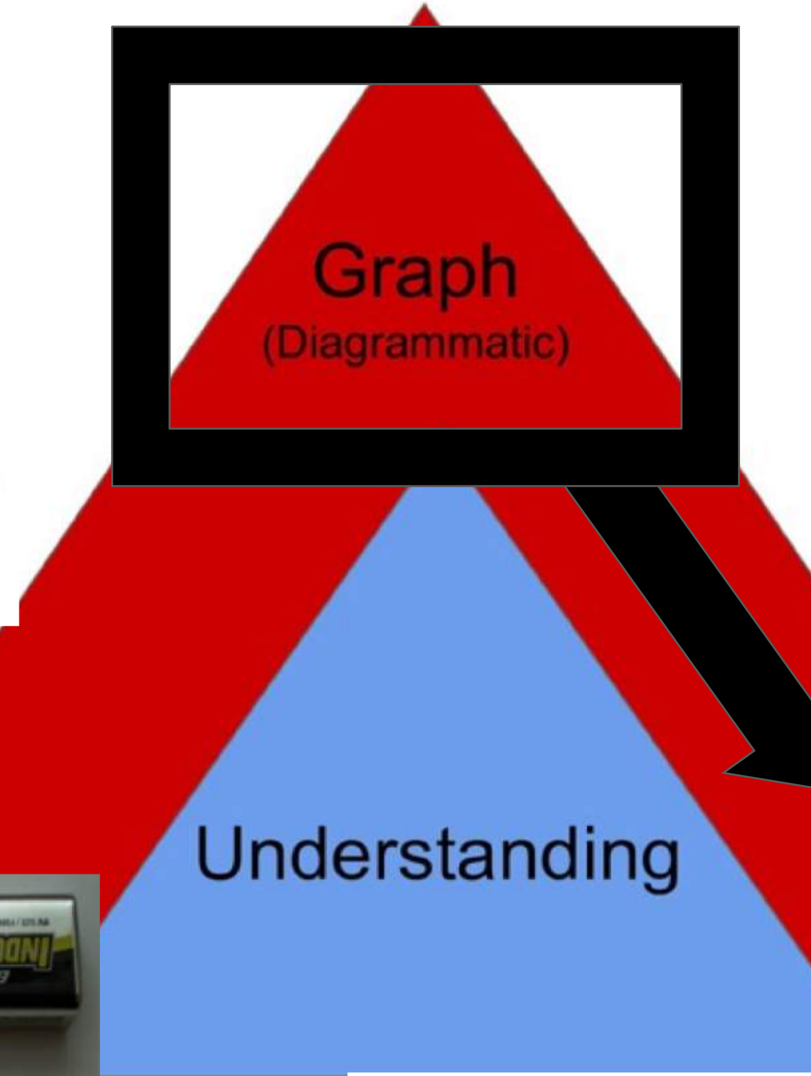
- In terms of our analogy it is the combination of how many cups transfer their water times how much water is in each cup.
- How then can we increase the power?

Equation 3
Analogy Power = cups per second * energy per cup
Mathematical Power = Current * Voltage

This is on page 7 of your packet.



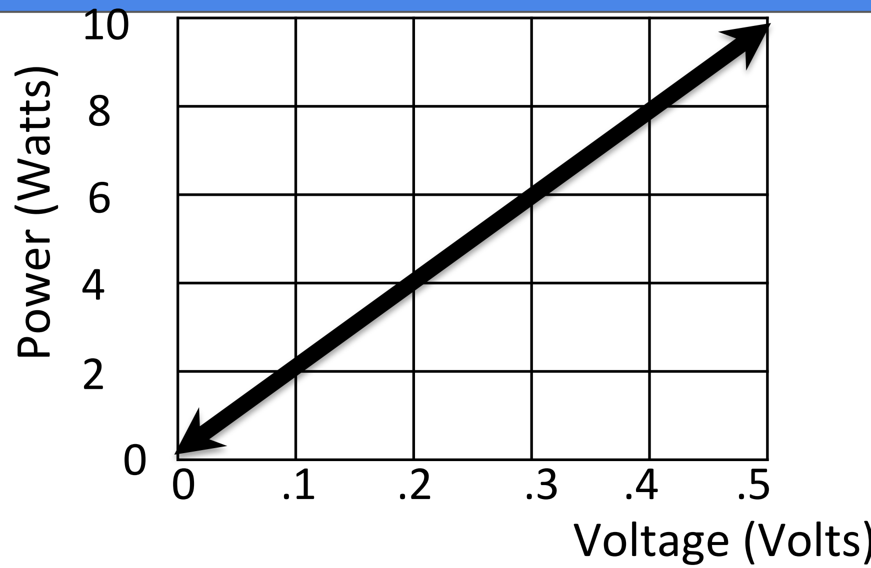




Energy = Power * Time

Power = Current * Voltage

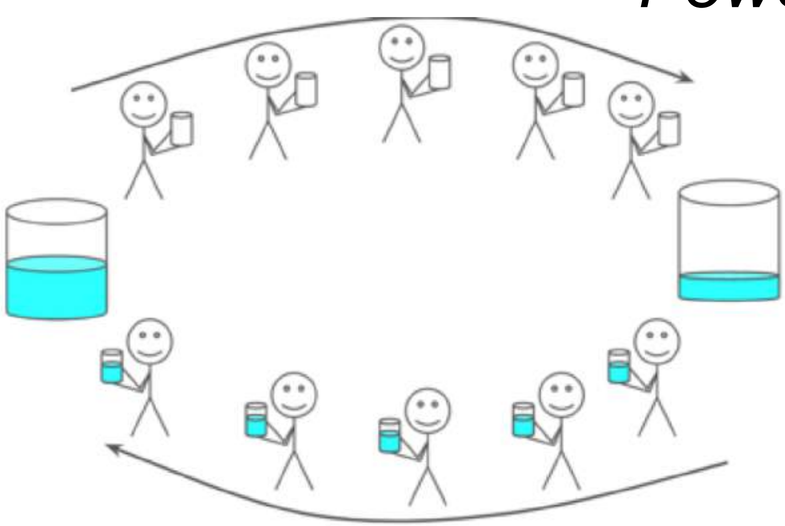
V	P
0.0	0
0.1	2
0.2	4
0.5	10



$P = IV$

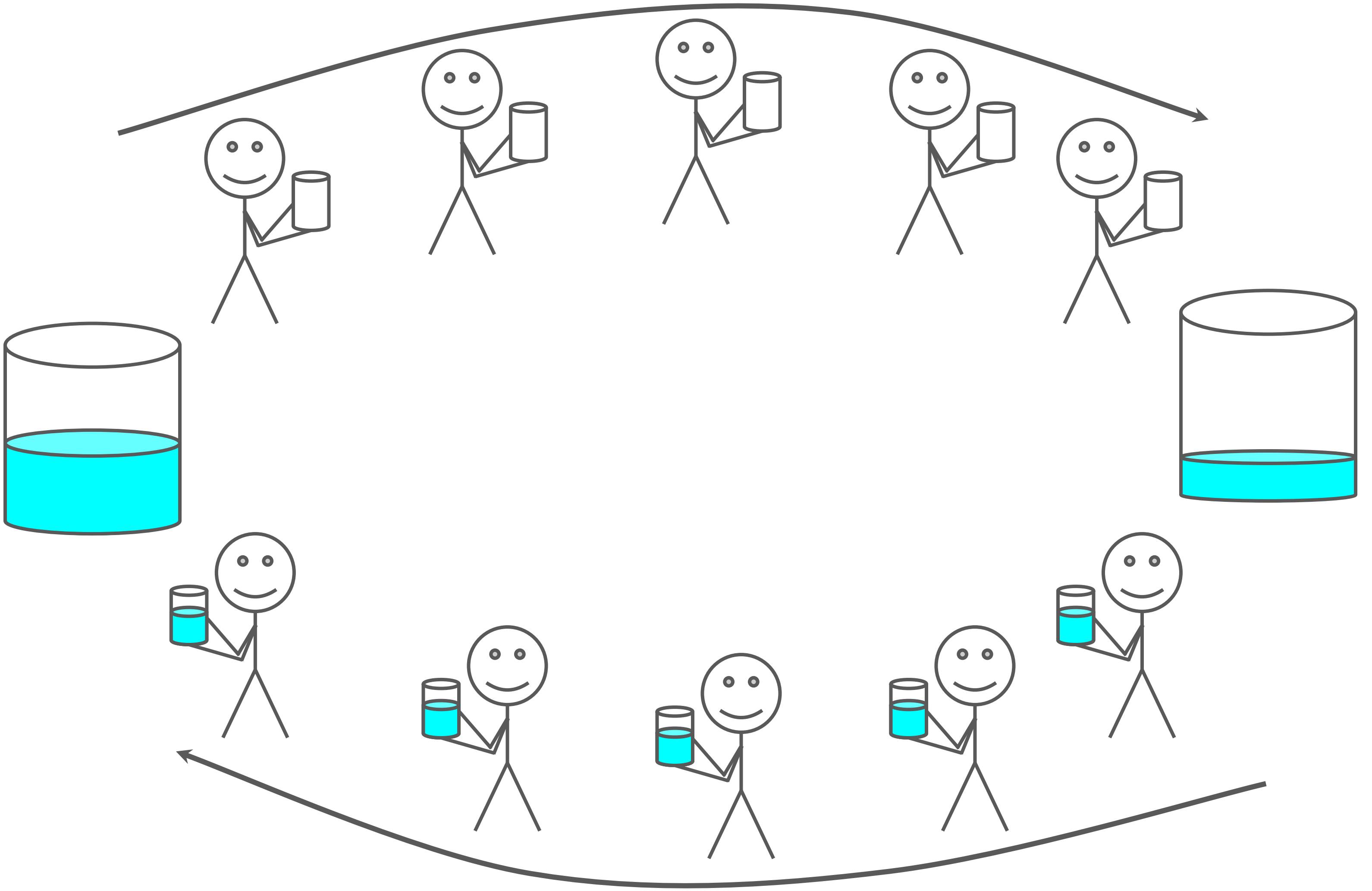
Power

*Power = current * voltage*

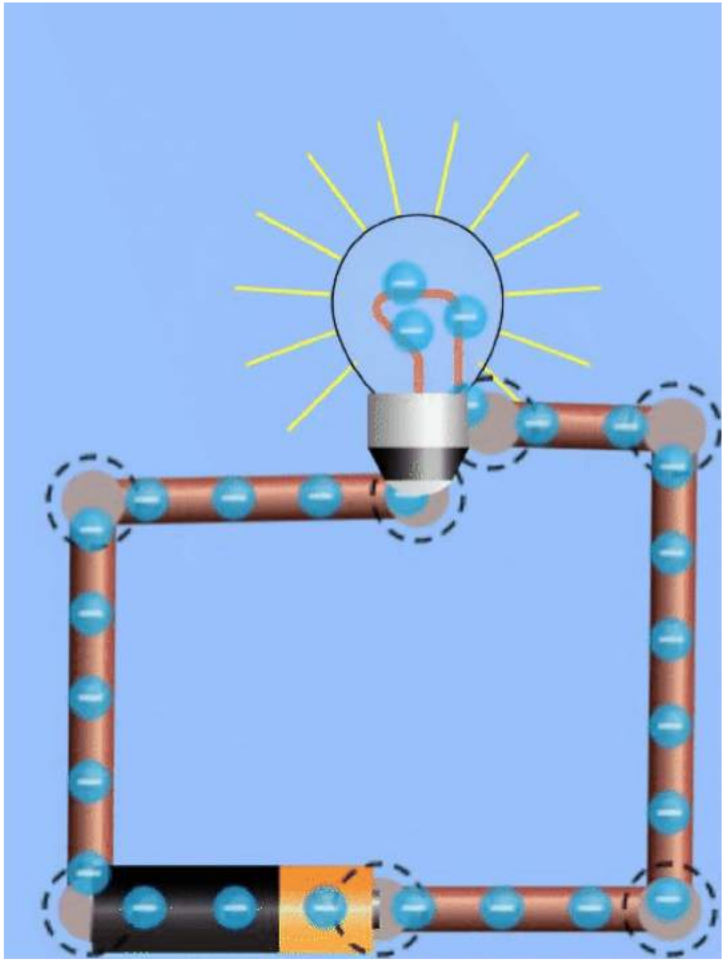


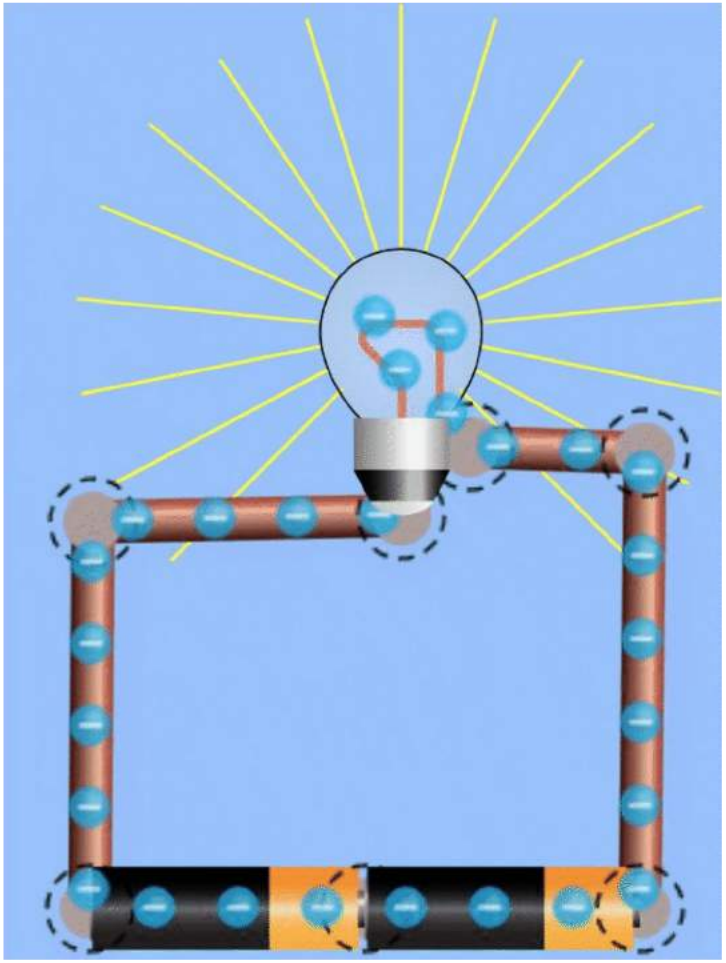
When:
voltage doubles
⇩
the energy per second doubles

Let’s Make some Predictions Question 3
Repeat with two AA V batteries in series

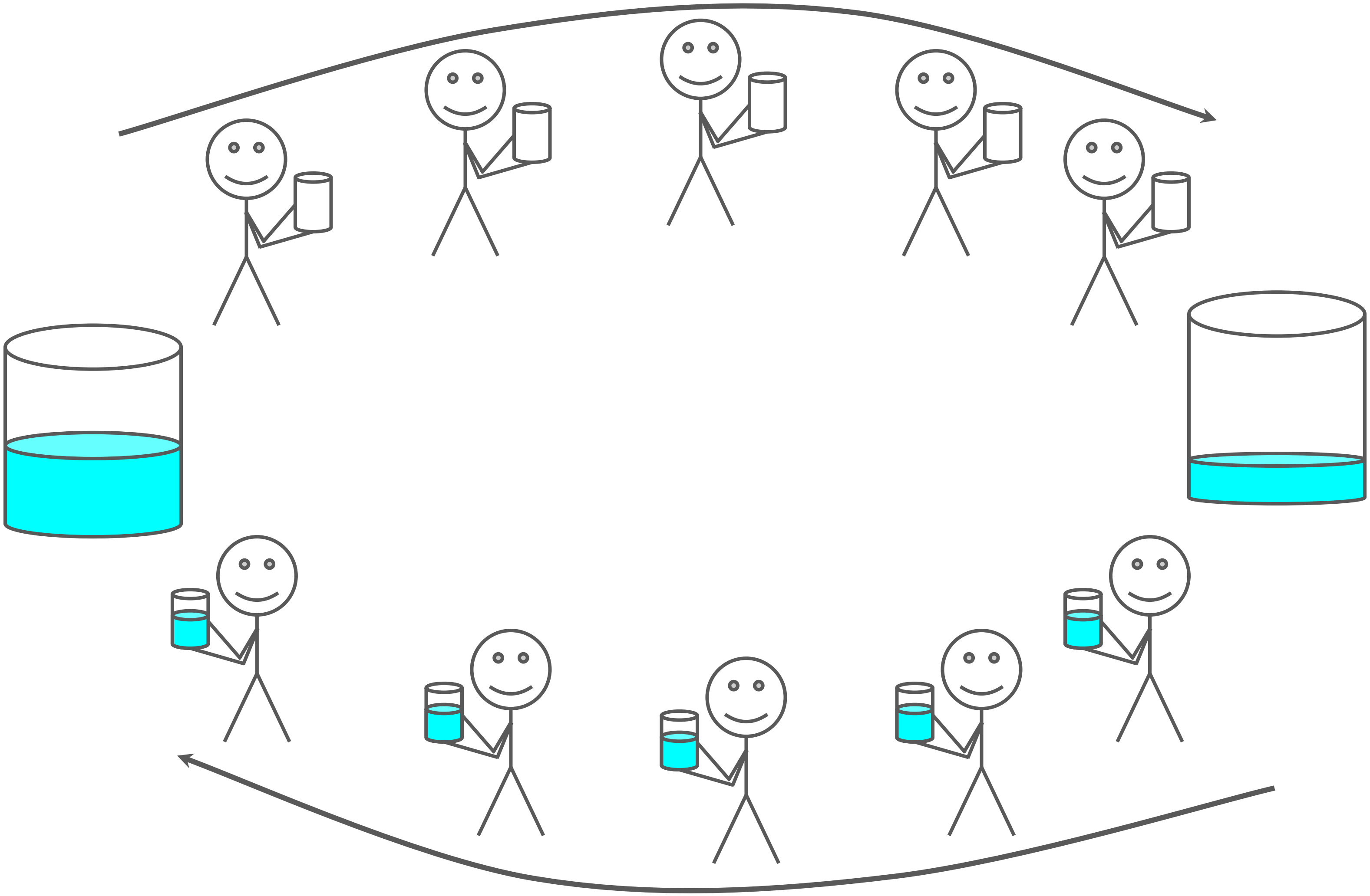


One battery vs two in series

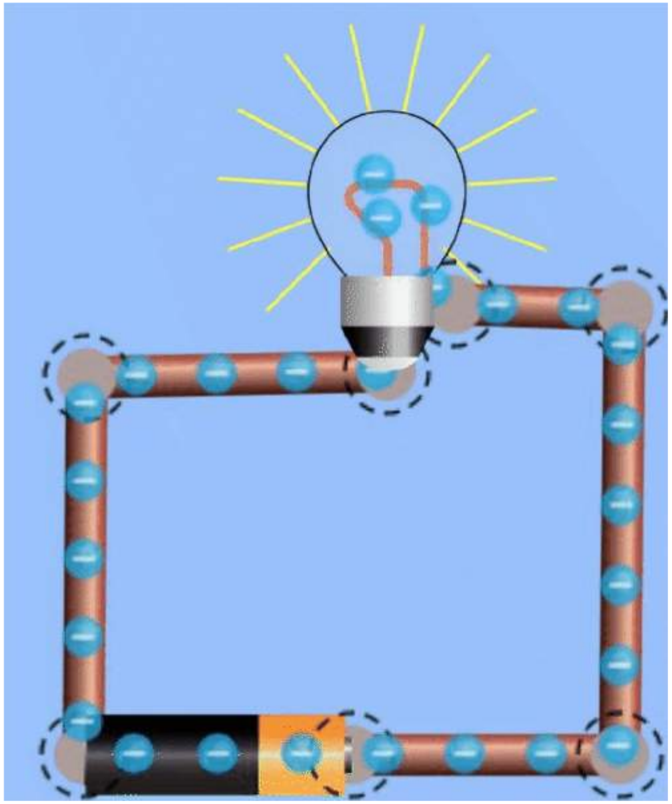


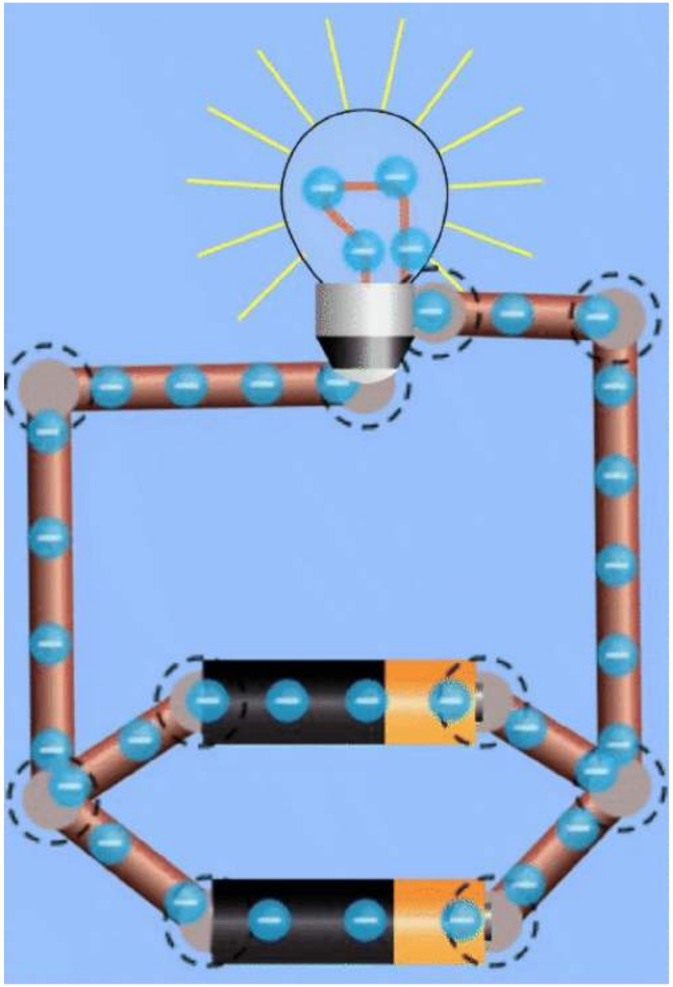


Let's Make some Predictions Question 4 Repeat with two AA V batteries in parallel



One battery vs two in parallel





Check In:
You Should Be able to Answer:

Focus Question

What is going on with electricity?

Language Focus

Be able to use the technical language to describe electricity, current, voltage, and power.

With Our Built-Up Background Let's Dive Deeper

Beyond all the cool things you can understand through current, voltage, and power, there is another fascinating property of electricity we need to understanding for power production.

Demonstration of a Phenomenon

credit and description: https://www.exploratorium.edu/snacks/motor-effect

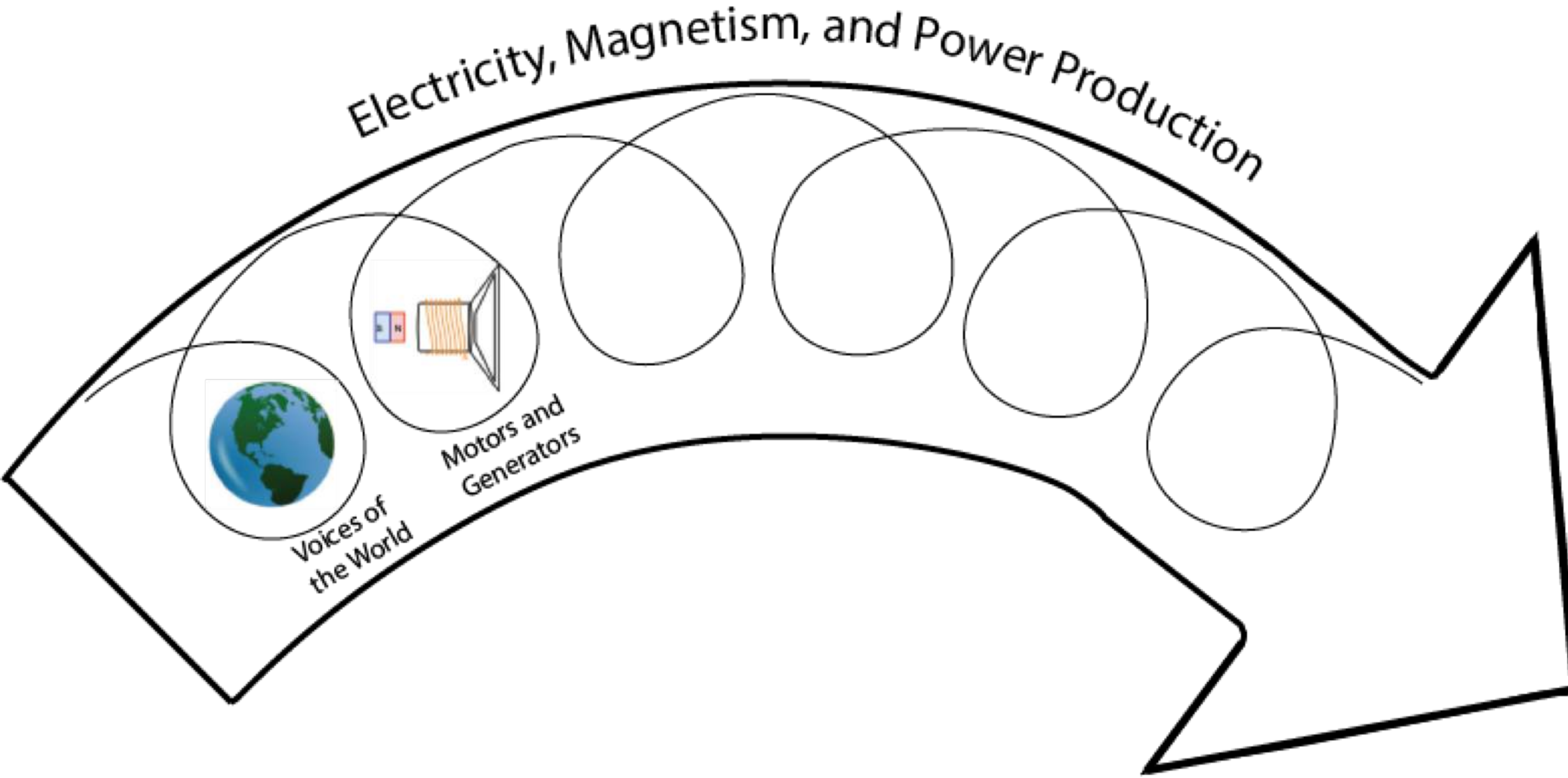
By the End of this Activity You Should Be able to Answer:

Focus Question

How do speakers work?

Language Focus

Be able to our technical terms from electricity and new ones we discover to explain the basic physics of how speakers work.


Electricity, Magnetism, and Power Production
Voices of the World
Motors and Generators

Exploring, Reverse Engineering Speakers

Let us use our Engineering Toolbelt:

First things First:

What is the most basic physics of speakers?

They are motors

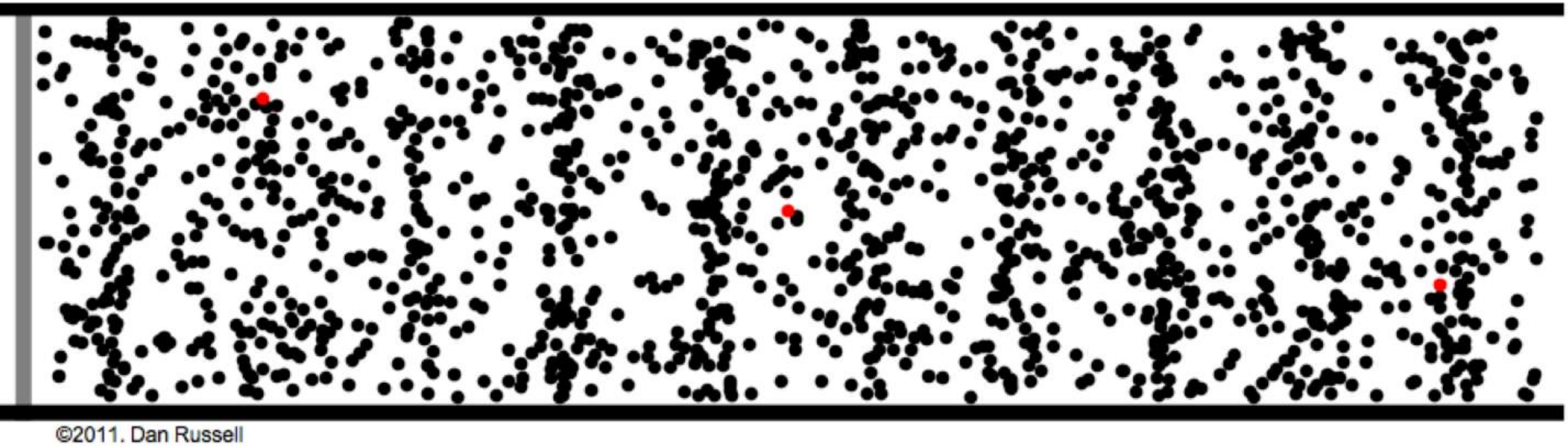
and motors transform electricity into motion

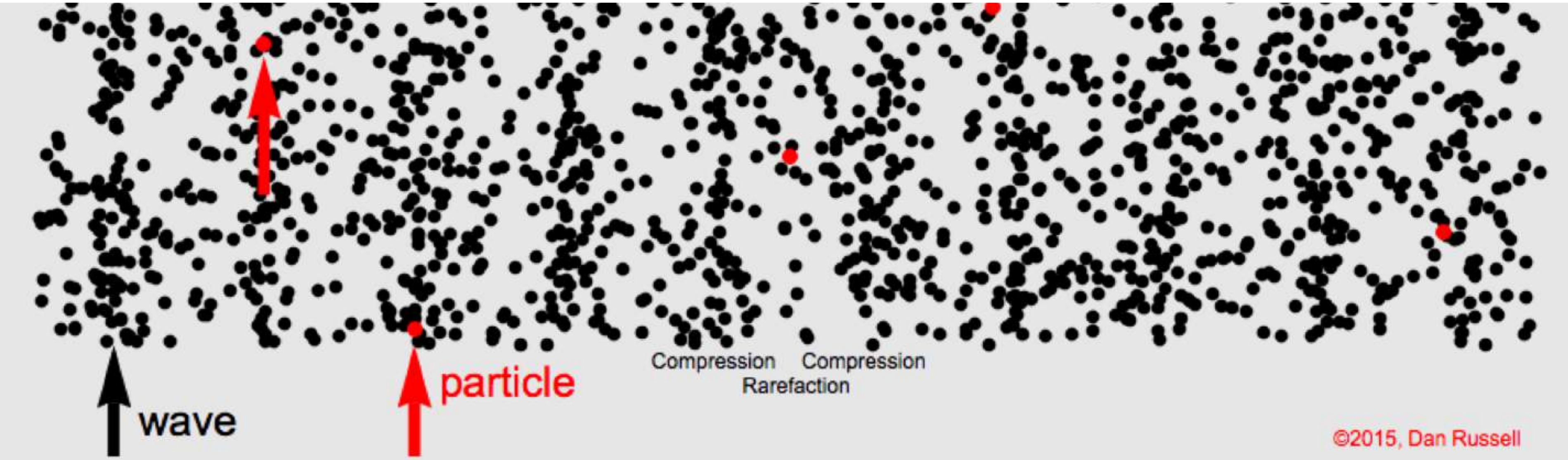
Exploring, Reverse Engineering Speakers

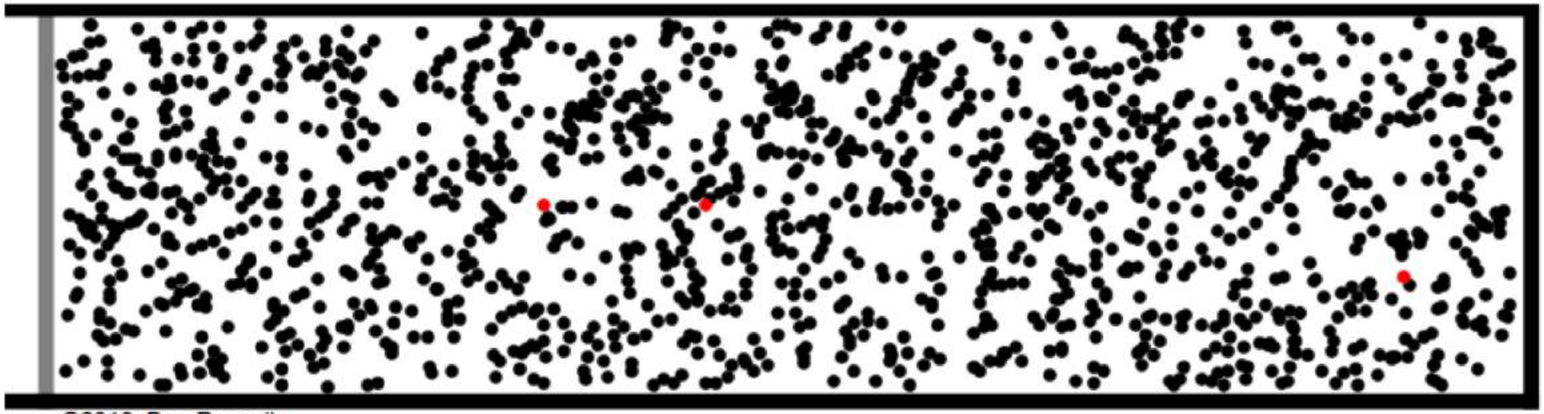
Let us use our Engineering Toolbelt:

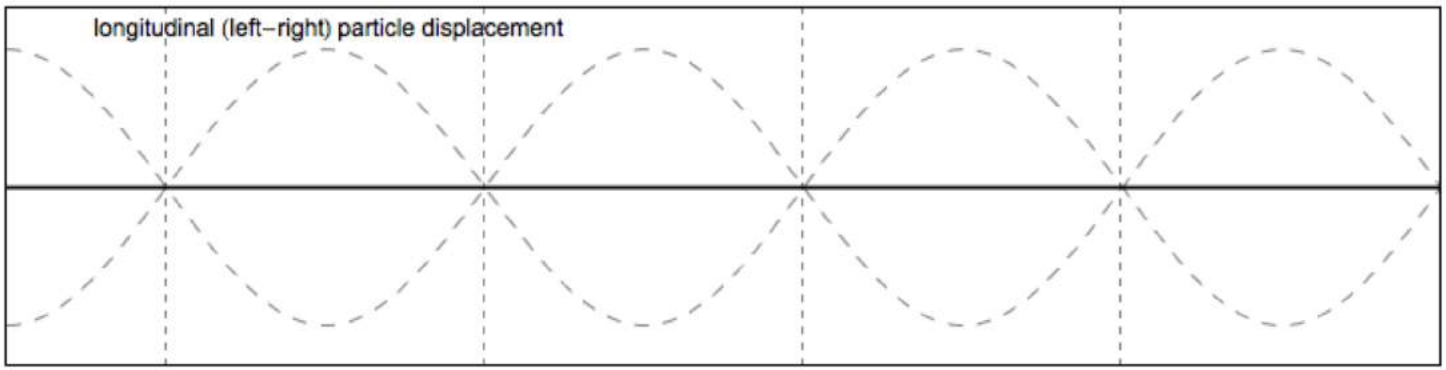
1. Let us look at some working speakers, what is going on? Tool: observation
2. Let us get a drawing. Tool: diagramming
3. Let us deconstruct some speakers and observe a little more. Tool: observation
4. Let us improve our drawing. Tool: iteration
5. What do you think, how do they work? Tool: reasoning

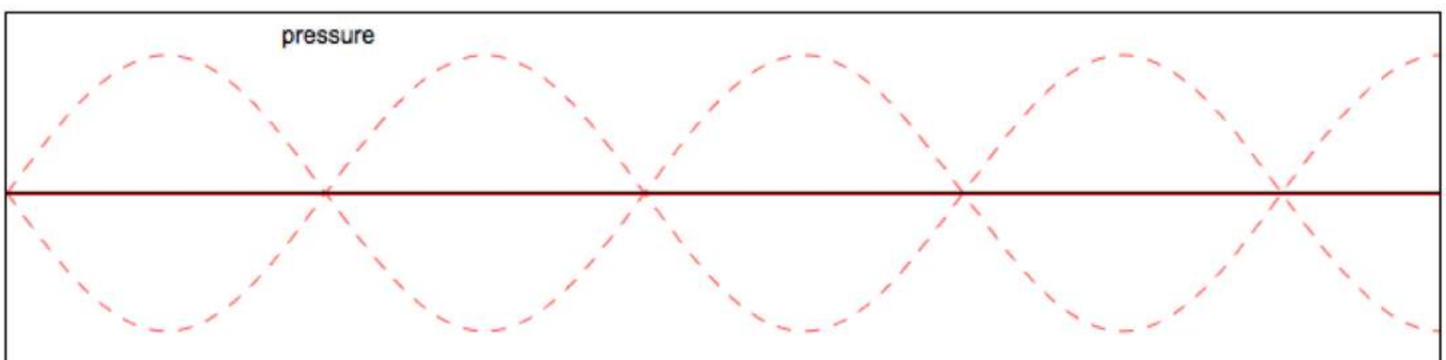
Visuals for Sound Waves in Air





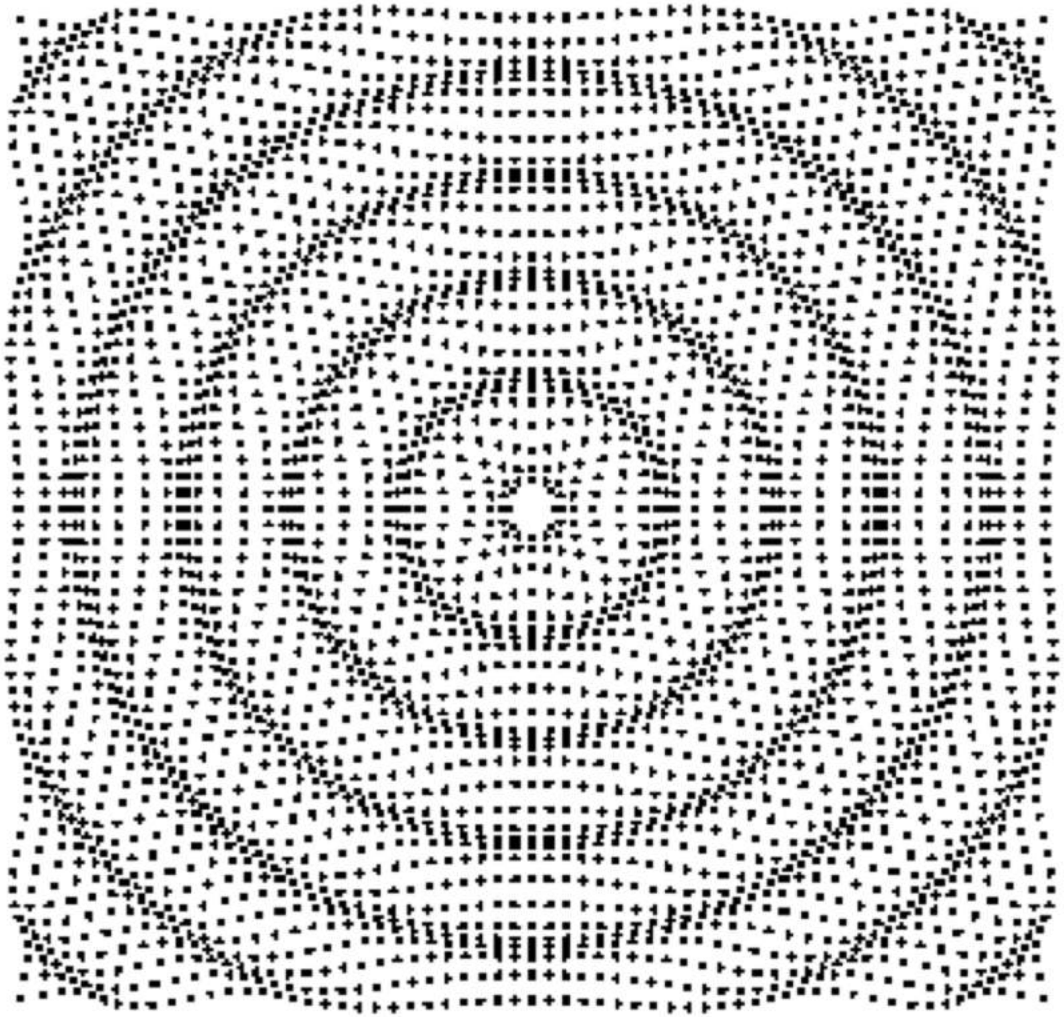



longitudinal (left–right) particle displacement


pressure

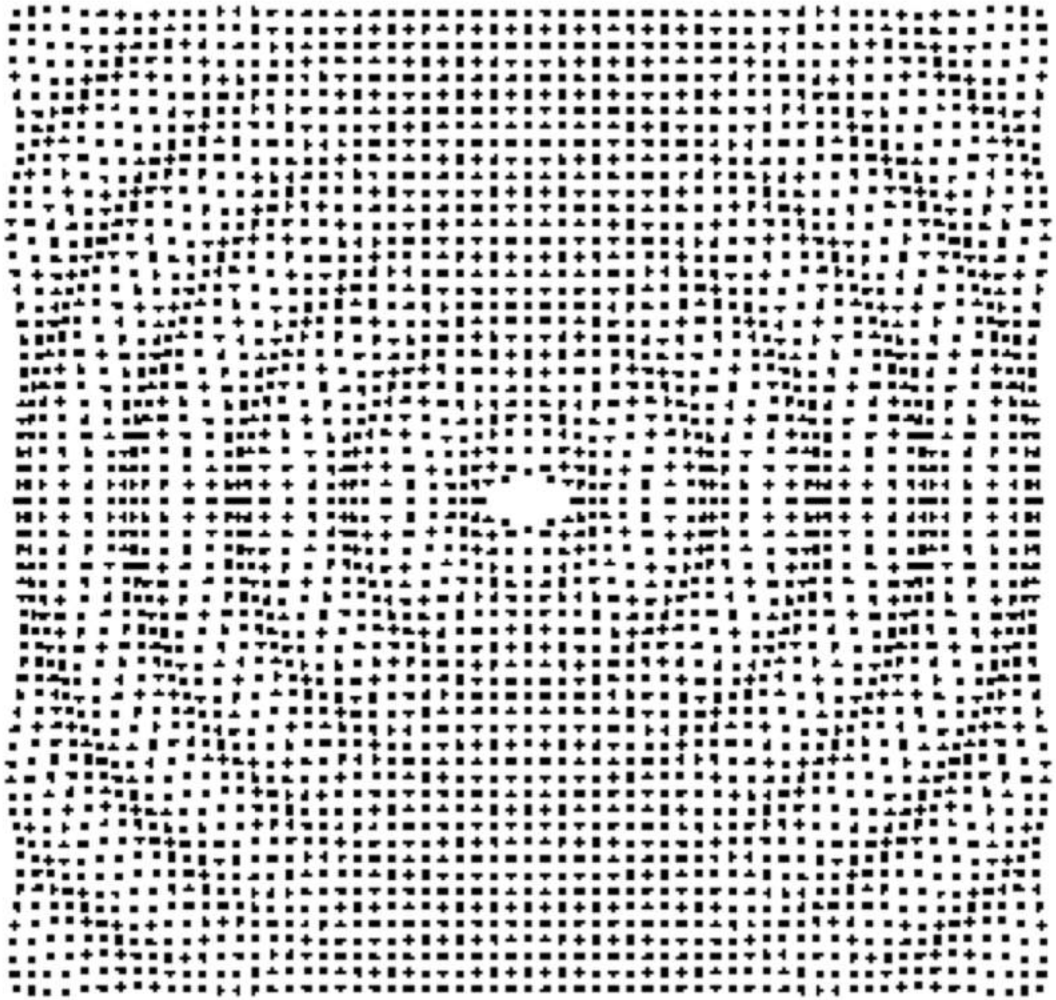
Visual for Sound Waves from a Speaker

Dan Russell



Visual for Sound Waves from a Tuning Fork

Dan Russell



Let’s Plan an Investigation to Provide Evidence that it works the Way You Think

1. Let us build a speaker
2. See instructions at bit.ly/makeyourownspeaker
3. Carry out your experiment to collect evidence and build an argument for how speakers work.

Electricity, Magnetism, & Power Production - Day 4

Agenda:

Investigating Speakers

Going Electric!

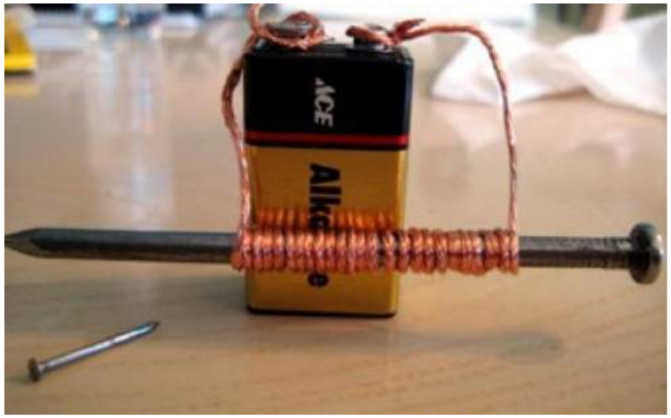
Due Next Class
Quiz on Motors and Generators

Due This Class

Warm Up Question:

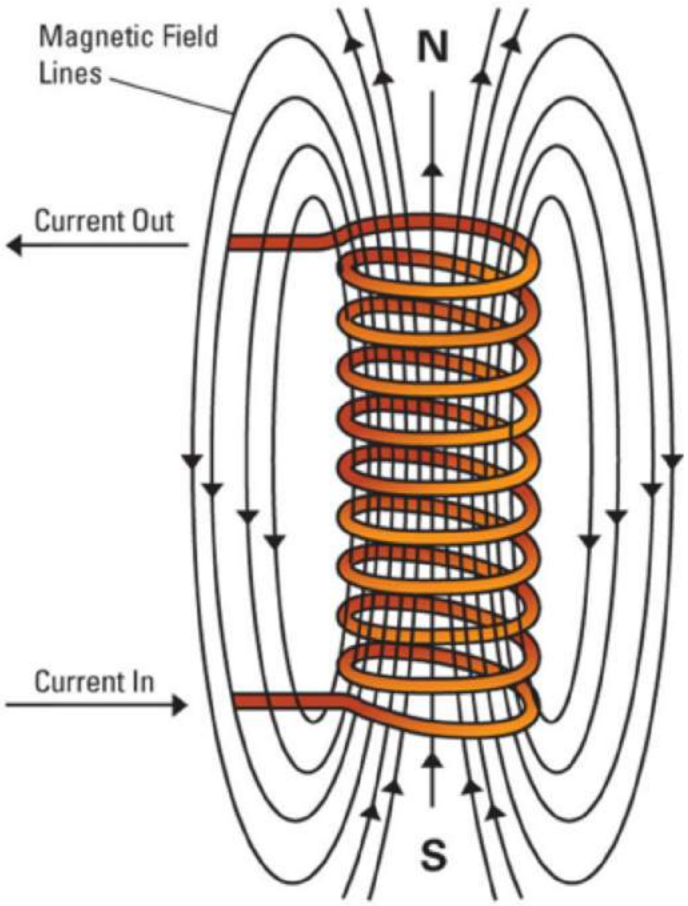
What will happen if we hold this electromagnet up to a compass?

How do we get it to attract the south end of the compass?

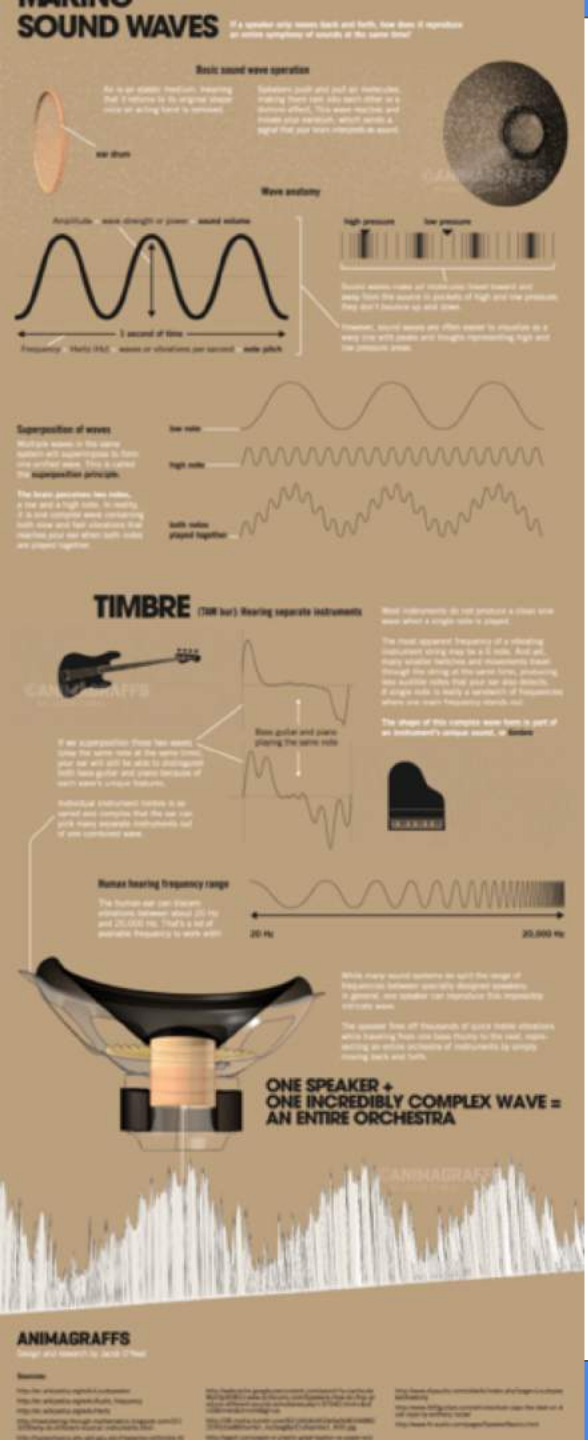


Technically we don't even need the nail.

Let's try it with a compass



credit: https://animagraffs.com/loudspeaker/



Background Research

bit.ly/backgroundonspeaker

Survey the text - What looks familiar

Questions you have

Predict what you will understand after reading

Read for understanding, **Chunk by Chunk**

Respond: answer your questions, evaluate it

Summarize what you read.

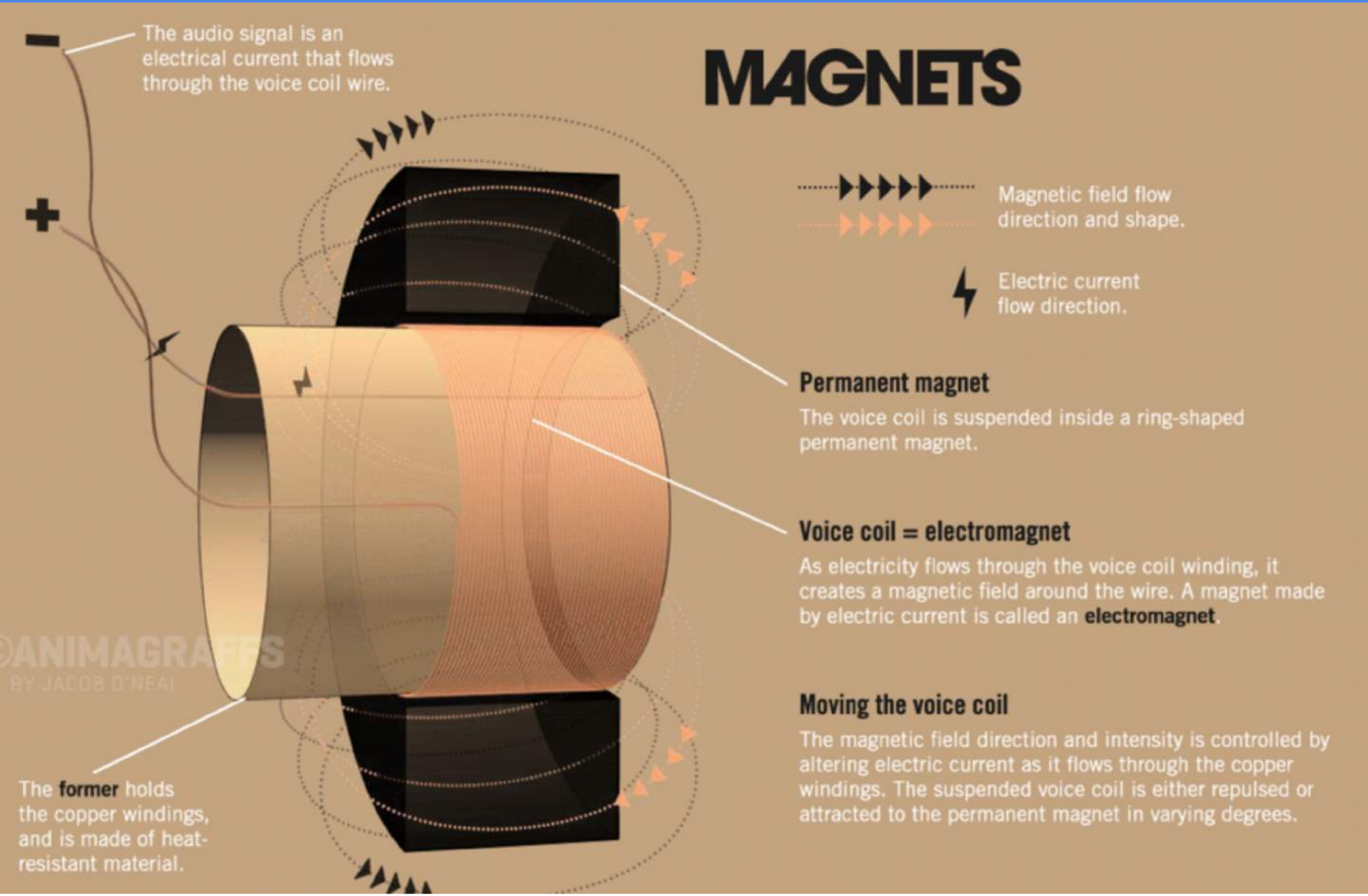
Let's *revise* our Plan *and Conduct* an Investigation to Provide Evidence that it works this Way

If needed:

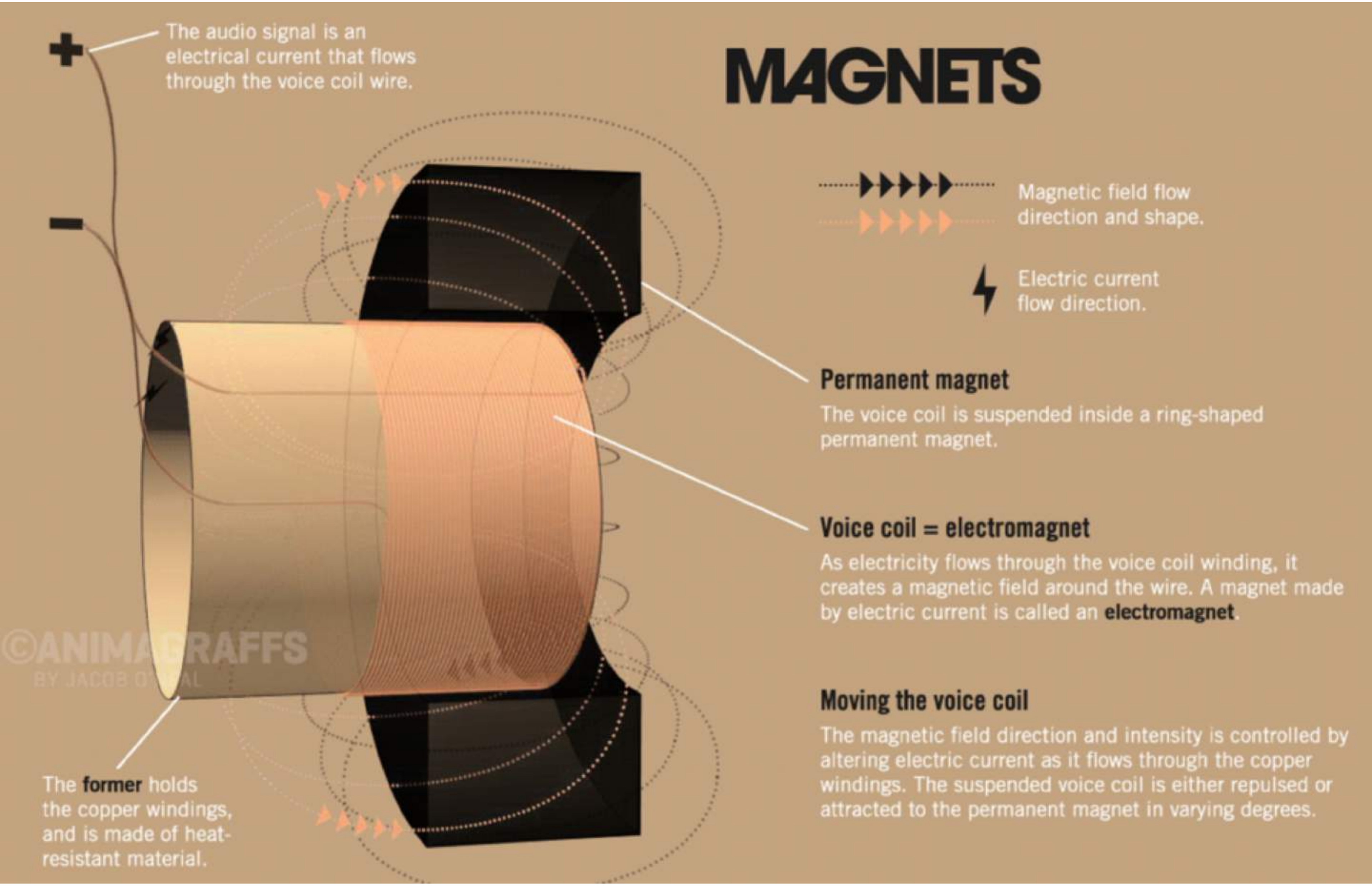
1. Build a speaker
2. See instructions at bit.ly/makeyourownspeaker
3. Carry out your experiment to build an argument from evidence.

Debrief Your Investigation

credit:
https://animagraffs.com/loudspeaker/



credit: https://animagraffs.com/loudspeaker/



credit: https://animagraffs.com/loudspeaker/

Use the Big Ideas of Science we Discovered to Explain how Speakers Work

See Packet Page 8

Electric Currents producing Magnetic Fields, the basis for electric motors, is definitely a Big Idea in Science.

Playing with this idea, what are wonderings that come to mind?

Let us brainstorm applications of this big idea in science?

Design Solutions: How might we want to modify our motor for other applications?

Electric Currents producing Magnetic Fields, the basis for electric Motors, is definitely a Big Idea in Science.

For cars, blenders, drills we need a circular motor.

Design Solutions: How might we do this?

bit.ly/makeyourownmotor

Check-In: How Does a Speaker Work?

Check In:
You Should Be able to Answer:

Focus Question

How do speakers work?

Language Focus

Be able to our technical terms from electricity and new ones we discover to explain the basic physics of how speakers work.

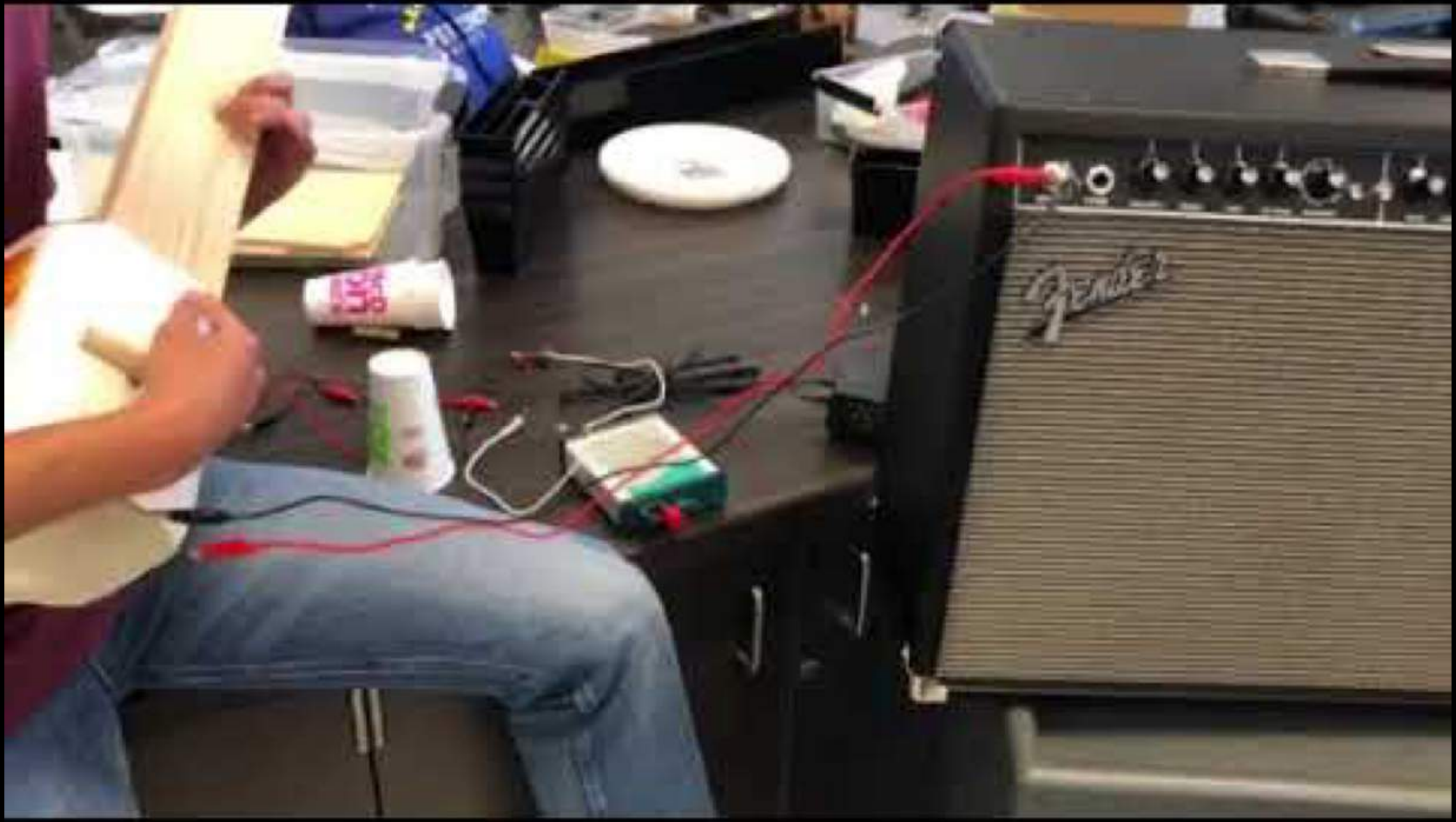
Electric Currents producing Magnetic Fields, the basis for electric Motors, is definitely a Big Idea in Science.

Follow up questions.

Demo: Gencon to Gencon. Wait?!

Electric cars use battery to turn wheels, but then use turning wheels to charge battery (regenerative braking).

The Phenomenon



Alternate or Additional Phenomenon

By the End of this Activity You Should Be able to Answer:

Focus Question

How do electric guitars work?

Language Focus

Be able to our technical terms from electricity and new ones we discover to explain the basic physics of how electric guitars work.

An Electric Guitar using our Speaker Coil
-- Generator to Amp to Motor --