Project-Based Science

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Launching Your Thinking about PBL

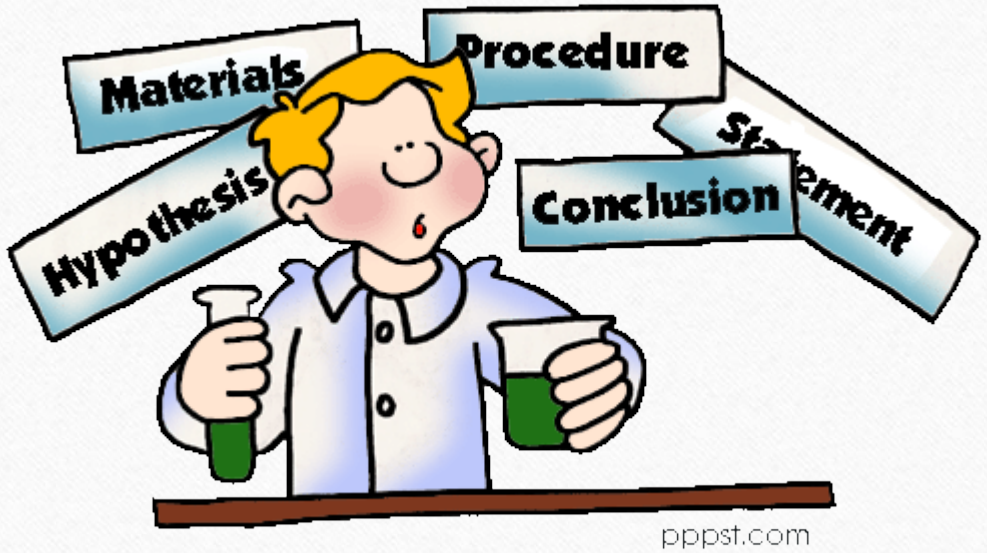
- Introductions
- College Credit
- 10:00 Special Guest
  - Melissa Bigge: Nutrients for Life
- Lunch
- Time to plan---1:30-2:30

Objectives for the Day

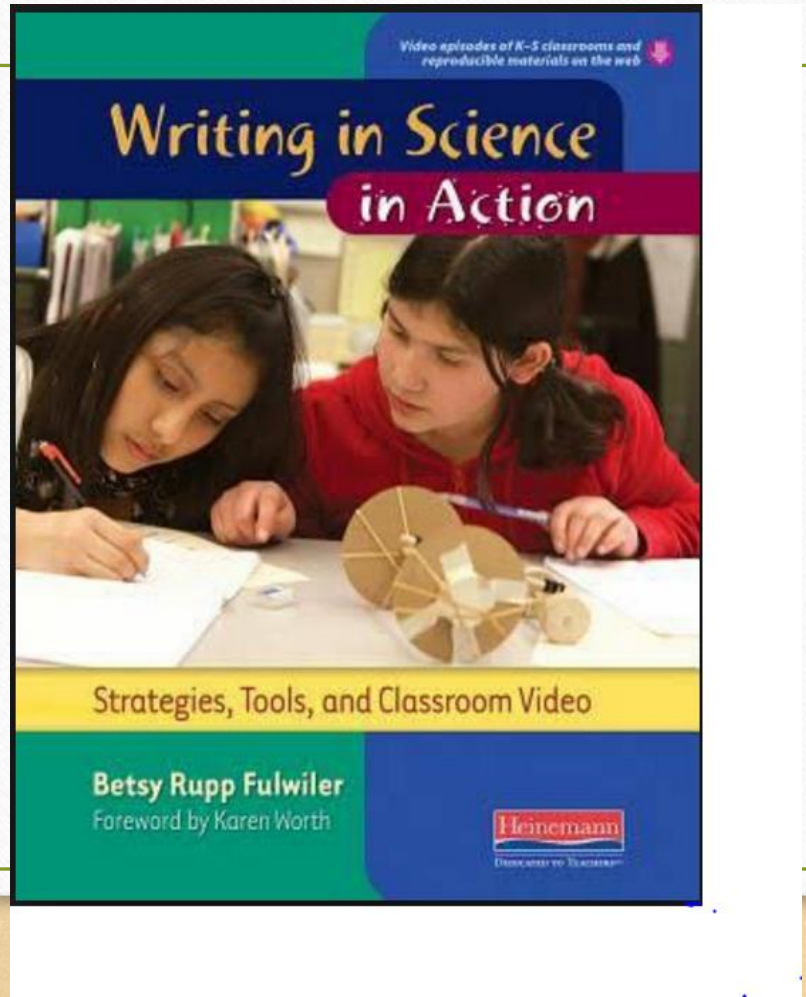
- Begin your thinking about Project-Based Learning
- Clarify some non-negotiables for PBL
- Build a community of learners who will continue to collaborate
- Begin to plan for at least one project for this spring or next fall

What has science looked like in the past?

- Textbooks
- Films/videos
- "Experiments"
- THE Scientific method
- Tests that emphasize memorizing



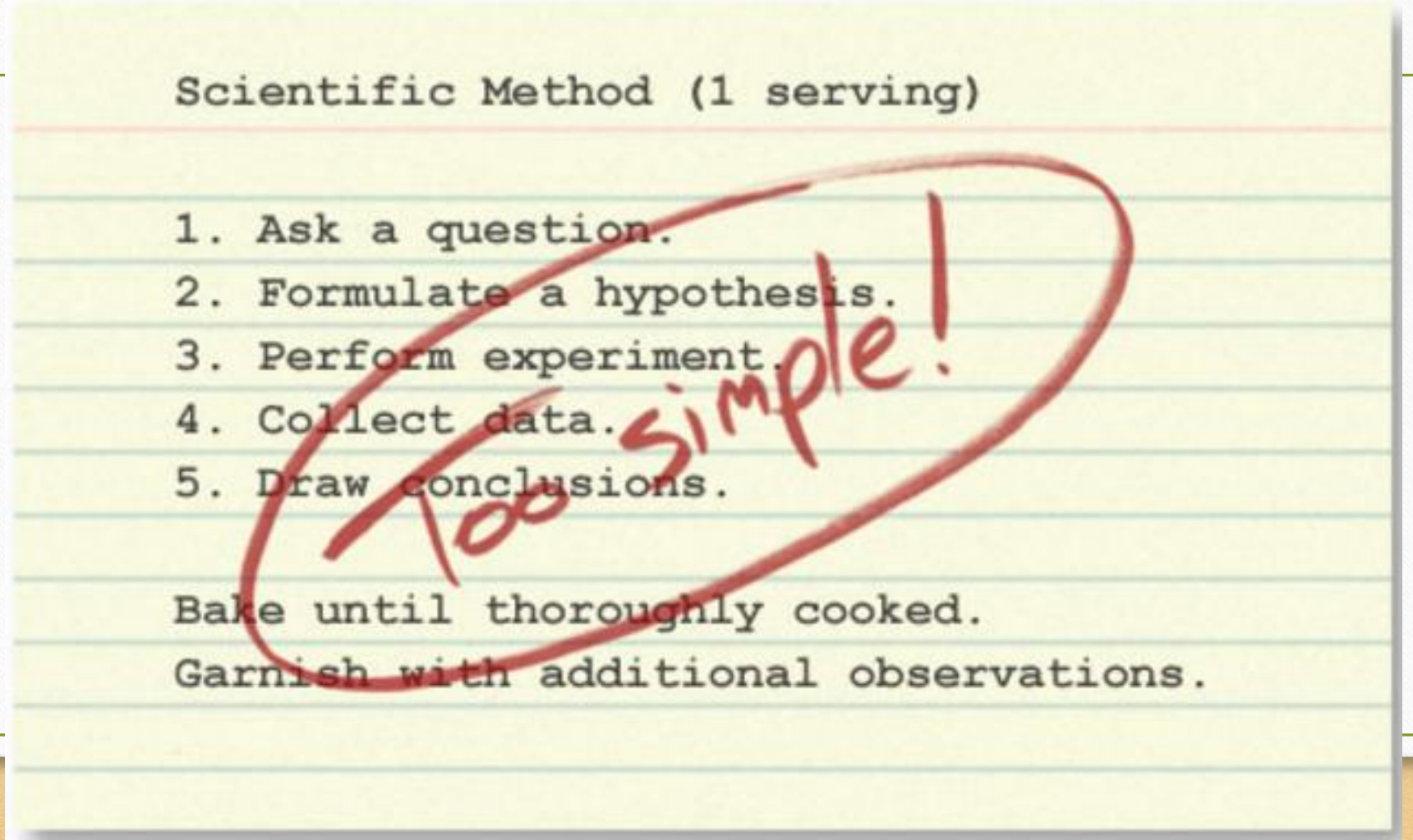
What COULD a science class look like?



Cognitive Dissonance

- **Controlled investigations**
  - Experiments as we have known them in the past (variables, etc.)
- **Open investigations**
  - Discuss examples

The Nature of Science



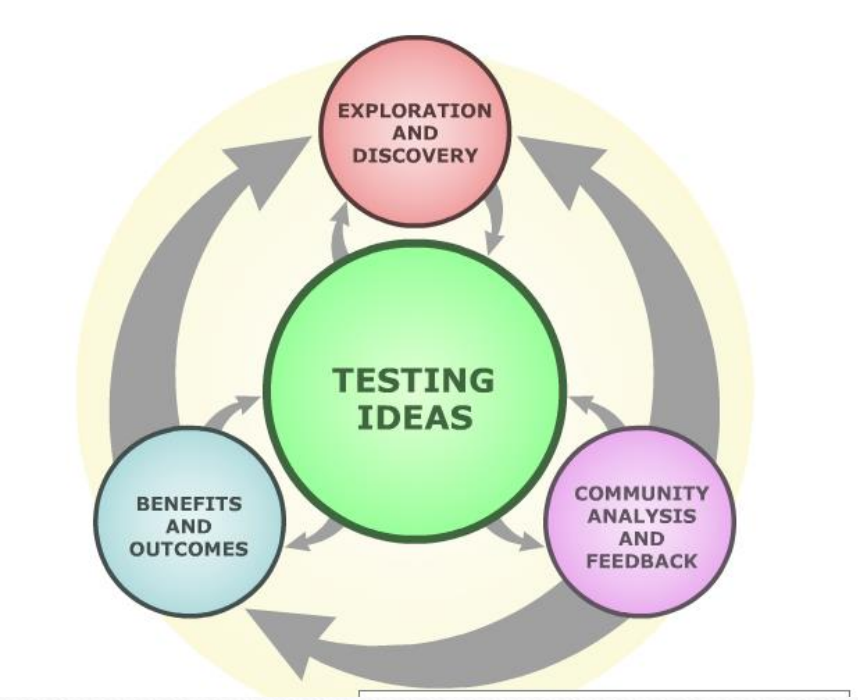
Nature of Science

- Science is a way of knowing
- Science is a human endeavor
- Science addresses questions about the natural and material world
- **Scientific knowledge is based on a variety of methods**

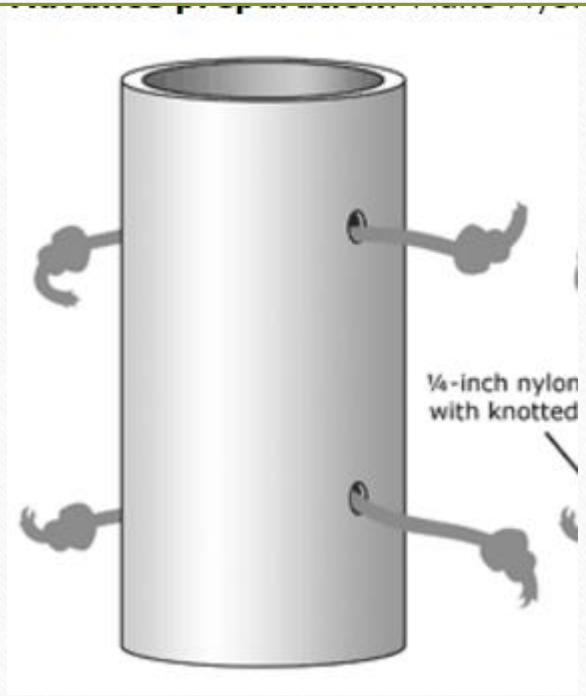
- Science laws, models, mechanisms, and theories explain natural phenomena
- Scientific knowledge is based on empirical evidence
- Scientific knowledge is open to revision in light of new evidence
- Scientific knowledge assumes an order and consistency in natural systems

http://undsci.berkeley.edu/article/0_0_0/howscienceworks_02

- Take a look at each of the circles
- Take a look at the grade-span lessons bottom right side

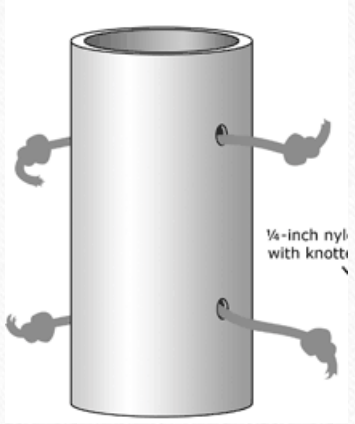


Mystery Tubes



Mystery Tube

- Focus question: **What does the inside of the tube look like?**
- Record observations about these tubes **(Create a chart)**
- From your observations, **draw the inside of the tube.**
- Are you doing science?
- Are all the tubes alike?



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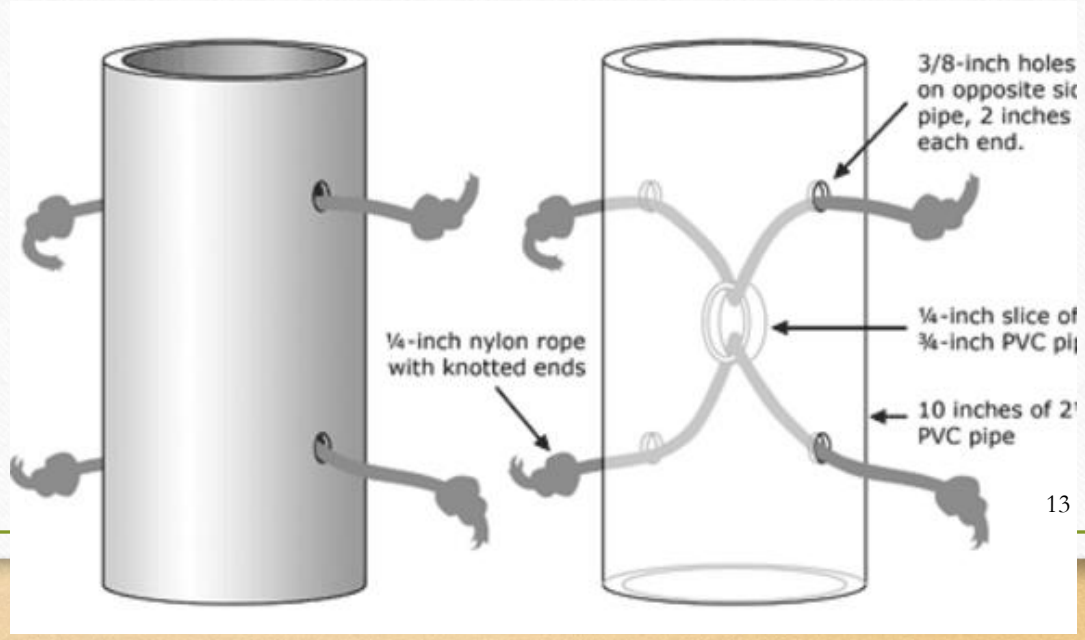
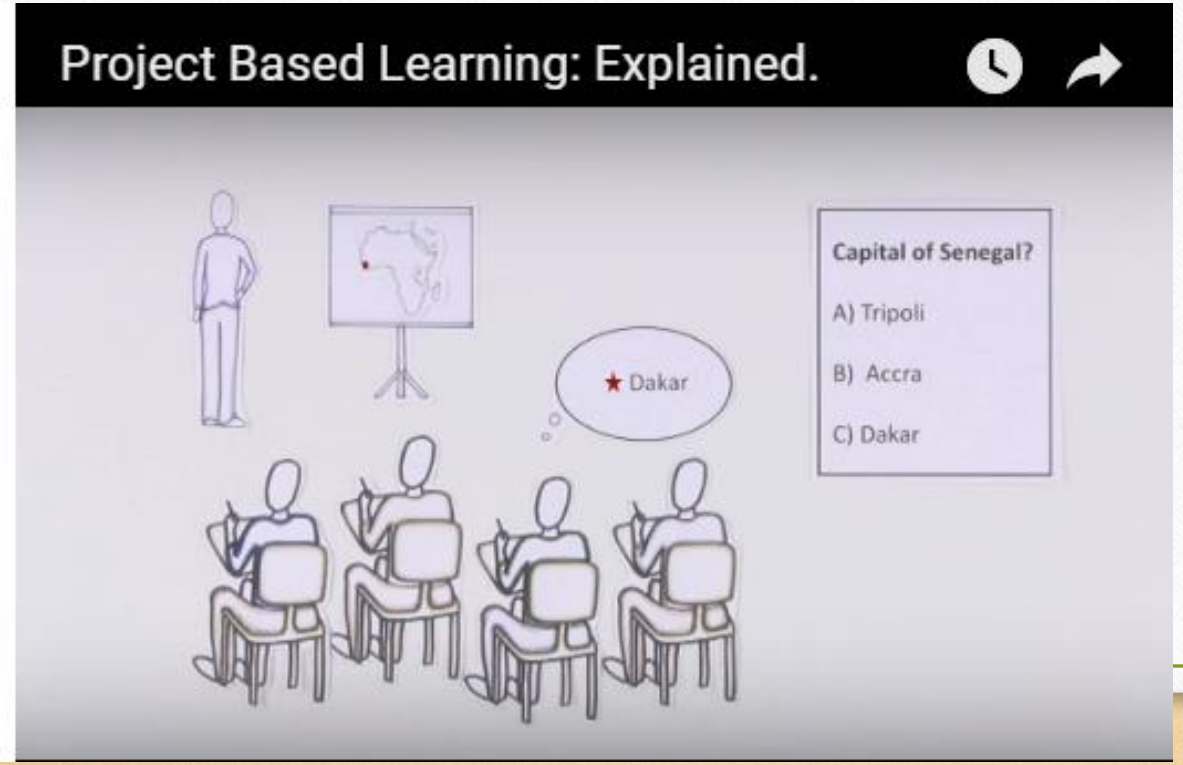


Consider Guided Writing

- I observed_____.
- I think that _____ because_____.
- I also think_____.
- In addition I think_____.
- My evidence is _____.

So what is Project-Based Learning? From the Buck Institute for Education

- https://www.bie.org/object/video/project_based_learning_explained



Why Project Based Learning (PBL)?

- https://www.bie.org/about/why_pbl
- **Main points from the article:**
  - Backed by research
  - Improves learning—makes school more engaging
  - Makes students college, career, and world ready
  - Addresses standards
  - Encourages use of technology
  - IT IS JUST FUN!

How is this different from a typical class project?

7 steps to successful PBL

STEP 1: Involve your students from the beginning

STEP 2: Break down the topic into well defined tasks

STEP 3: Plan well, set goals, define outcomes

STEP 4: Divide your class into working groups with well defined tasks

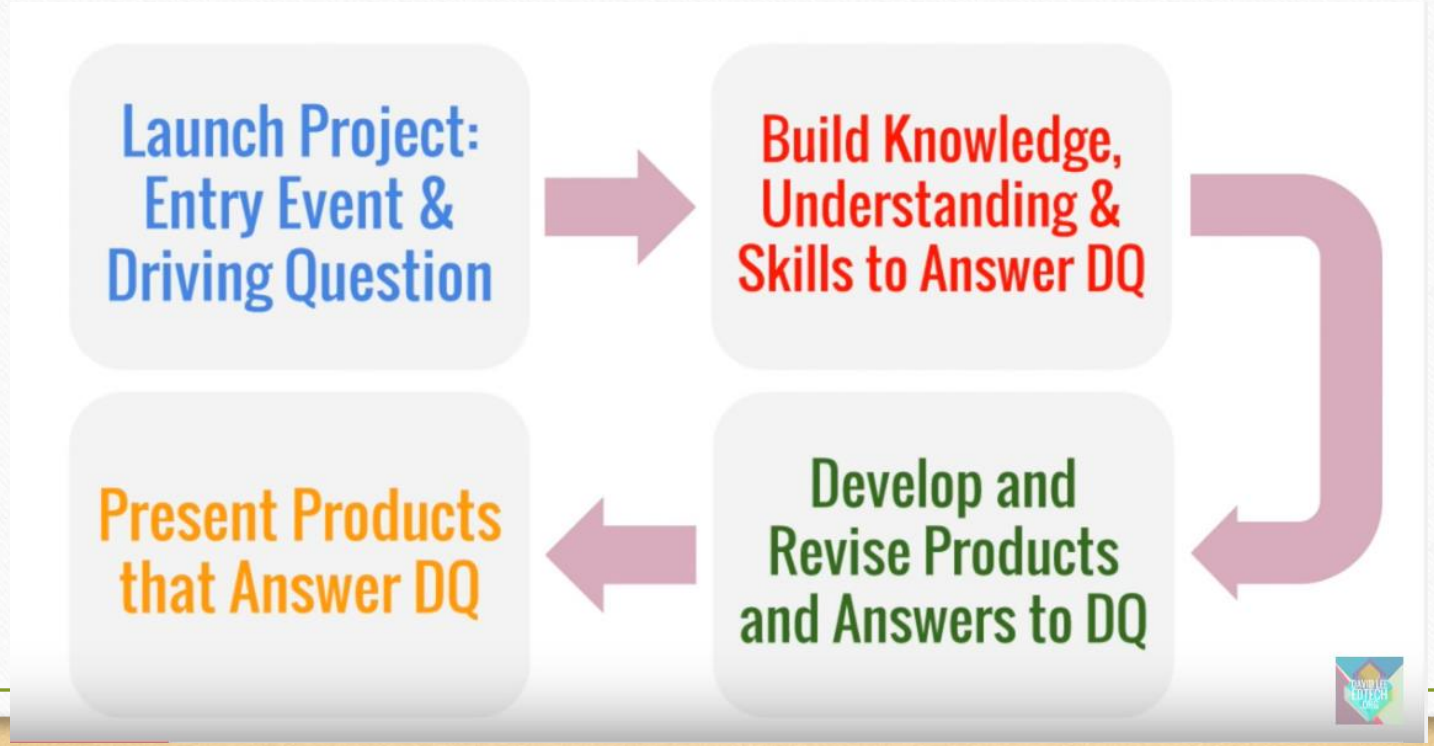
STEP 5: Create a tangible artifact as an outcome

STEP 6: Arrive at a conclusion

STEP 7: Document and present to a public audience

Kindergarten and NGSS

- https://www.youtube.com/watch?v=08D0dBGIzYQ 6:28



Forces and Interactions
K-PS2-2

- Rollin' Rollin' Rollin'
  - Focus question: How can we make the ball roll in different directions?

Watch and Think
Signal if you want to stop!

- https://www.youtube.com/watch?v=hnzCGNnU_WM Key component for PBLs also talks about formative assessment 6:30 minutes
- https://www.youtube.com/watch?v=mAYh4nWUkU0 Inquiry science
- Look at Cross Cutting Concepts Matrix Handouts (http://nstahosted.org/pdfs/ngss/MatrixOfCrosscuttingConcepts.pdf)

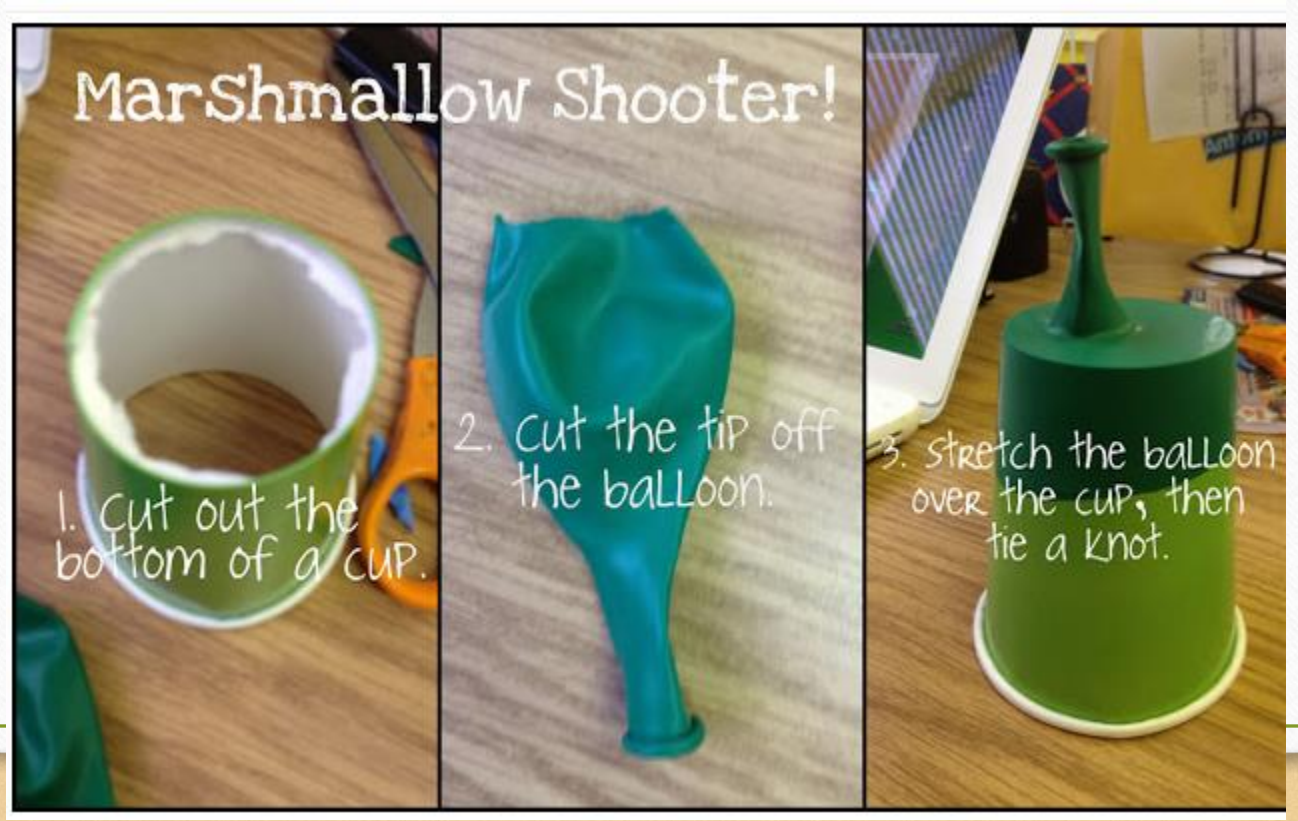
Cross Cutting Concepts

- Patterns.
- Cause and Effect.
- Scale, Proportion, and Quantity.
- Systems and System Models.
- Energy and Matter: Flows, Cycles, and Conservation.
- Structure and Function.
- Stability and Change of Systems.

Where do I get the driving questions? Where do I get ideas for projects?

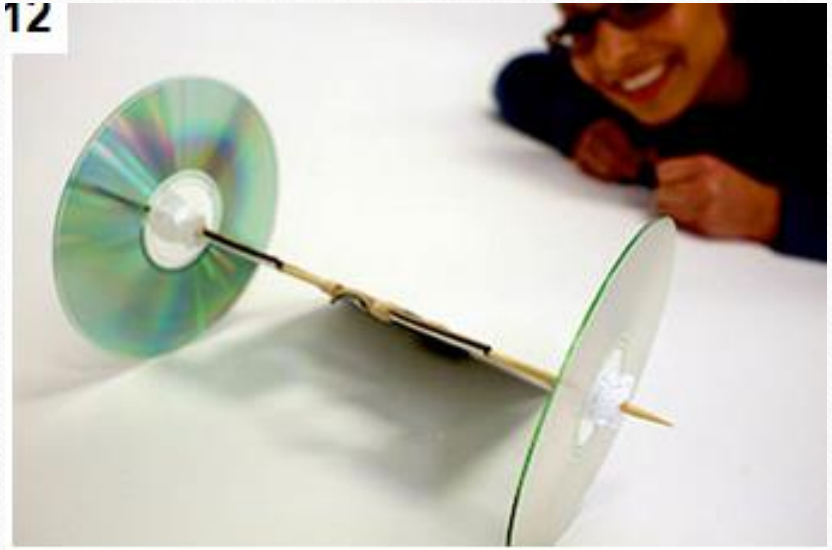
- From the kids----What is a bird's favorite color?
- From Sharon Springs---What will it take to make our restroom ADA compliant?
- www.newsela.com
- Tweentribune
- Mystery Science—aligned
- AC2E Science Notebooks

Forces and Interactions
3-PS2-1
How does force impact an object?



Energy
4-PS3-4

- http://pbskids.org/designsquad/build/rubber-band-car/
- What questions could you explore?



From NSTA Reports

- See Blick on Flicks
- http://www.nsta.org/publications/blickonflicks.aspx
- Inside out
- The Martian
- The Ant-Man
- Hidden Figures

- Teach kids how to do an observation

What questions can kids ask?

Translated

Describe a typical food chain for the herbivores, carnivores, and omnivores in the deciduous forest biome.	→	Can we design a menu for the storybook animals that live in the forest?
Describe the important portions of the Constitution and summarize why it is a living document.	→	How can we create a public service announcement for TV showing why the Constitution is still important today?
What is an environmental brown field and describe why they are difficult to use?	→	How can we convince the park department that the old oil field near the beach could be valuable?
Name the various reasons that the American Colonists declared war with England	→	Can we create a play that would convince the colonist in our hometown to declare war on England?

http://learnpbl.weebly.com/uploads/1/1/6/6/11669033/driving_question_mjgorman.pdf

From the Standards

- iPad app for NGSS

Students who demonstrate understanding can:

4-PS3-1. **Use evidence to construct an explanation relating the speed of an object to the energy of that object.** [*Assessment Boundary: Assessment does not include quantitative measures of changes in the speed of an object or on any precise or quantitative definition of energy.*]

4-PS3-2. **Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.** [*Assessment Boundary: Assessment does not include quantitative measurements of energy.*]

4-PS3-3. **Ask questions and predict outcomes about the changes in energy that occur when objects collide.** [Clarification Statement: Emphasis is on the change in the energy due to the change in speed, not on the forces, as objects interact.] [*Assessment Boundary: Assessment does not include quantitative measurements of energy.*]

4-PS3-4. **Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.*** [Clarification Statement: Examples of devices could include electric circuits that convert electrical energy into motion energy of a vehicle, light, or sound; and, a passive solar heater that converts light into heat. Examples of constraints could include the materials, cost, or time to design the device.] [*Assessment Boundary: Devices should be limited to those that convert motion energy to electric energy or use stored energy to cause motion or produce light or sound.*]

4-ESS3-1. **Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.** [Clarification Statement: Examples of renewable energy resources could include wind energy, water behind dams, and sunlight; non-renewable energy resources are fossil fuels and fissile materials. Examples of environmental effects could include loss of habitat due to dams, loss of habitat due to surface mining, and air pollution from burning of fossil fuels.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Asking Questions and Defining Problems
Asking questions and defining problems in grades 3–5 builds on grades K–2 experiences and progresses to specifying qualitative relationships.
- Ask questions that can be investigated and predict reasonable outcomes based on patterns such as cause and effect relationships. (4-PS3-3)

Planning and Carrying Out Investigations
Planning and carrying out investigations to answer questions or test solutions to problems in 3–5 builds on K–2 experiences and progresses to include investigations that control variables and provide evidence to support explanations or design solutions.
- Make observations to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution. (4-PS3-2)

Constructing Explanations and Designing Solutions
Constructing explanations and designing solutions in 3–5 builds on K–2 experiences and progresses to the use of evidence in constructing explanations that specify variables that describe and predict phenomena and in designing multiple solutions to

Disciplinary Core Ideas

PS3.A: Definitions of Energy
- The faster a given object is moving, the more energy it possesses. (4-PS3-1)
- Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2),(4-PS3-3)

PS3.B: Conservation of Energy and EnergyTransfer
- Energy is present whenever there are moving objects, sound, light, or heat. When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced. (4-PS3-2), (4-PS3-3)
- Light also transfers energy from place to place. (4-PS3-2)
- Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-2),(4-PS3-4)

Crosscutting Concepts

Energy and Matter
- Energy can be transferred in various ways and between objects. (4-PS3-1),(4-PS3-2),(4-PS3-3),(4-PS3-4)

Cause and Effect
- Cause and effect relationships are routinely identified and used to explain change. (4-ESS3-1)

Connections to Engineering, Technology, and Applications of Science

Interdependence of Science, Engineering, and Technology
- Knowledge of relevant scientific concepts and research findings is important in engineering. (4-ESS3-1)

Influence of Engineering, Technology, and Science on Society and the Natural World
- Over time, people's needs and wants change, as do their demands for new and improved technologies. (4-ESS3-1)

Disciplinary Core Ideas

- That's the science!!!! If you are not as knowledgeable as you would like to be—use the DCIs, ask your upper grade colleagues, connect to an expert, challenge your students to help you research.

Project-Based Learning—It's not just for science!

- Remember CCRSS ELA—students should ask
- Compelling questions from HGSS—example from 5th Grade

Sample Compelling Questions

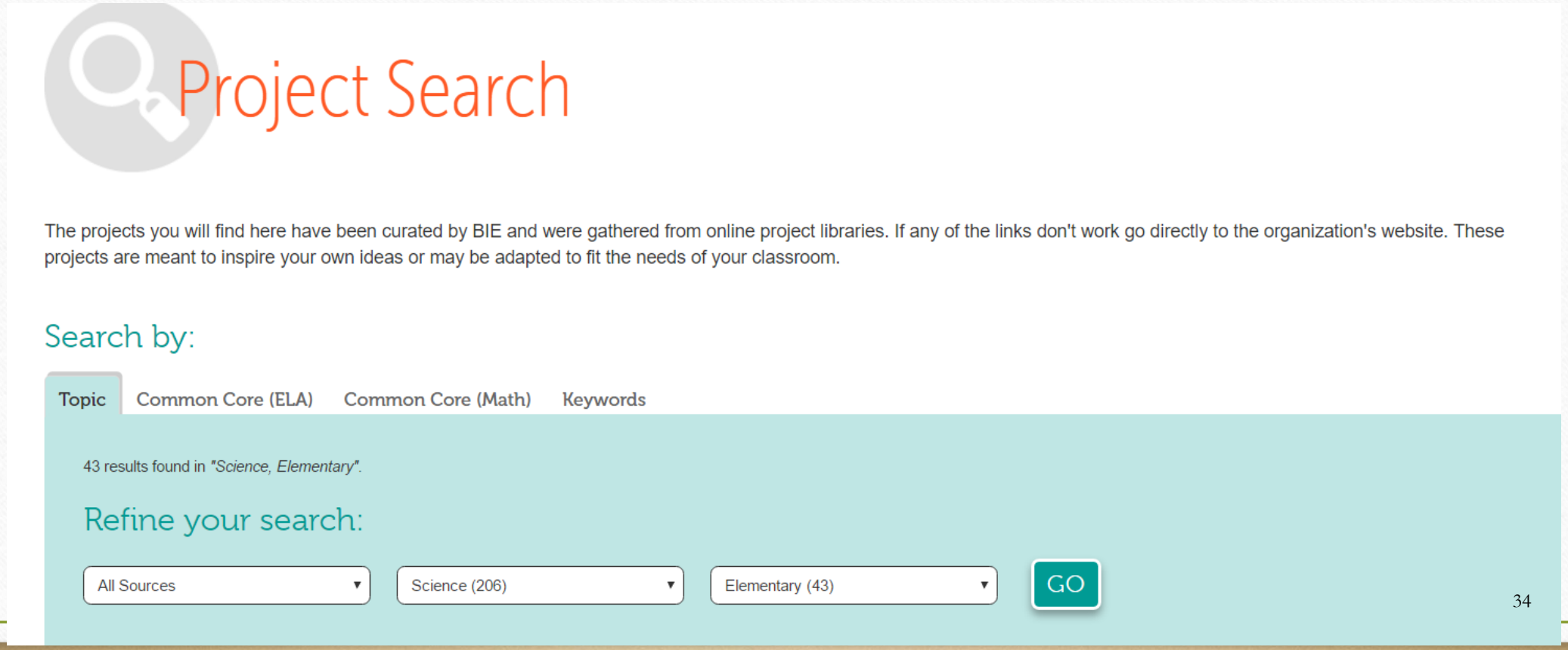
- How do people decide where to live? (Standard 1)
- What were the rights and responsibilities of men and women in an American Indian cultural group? (Standard 2)
- How were American Indian cultural groups shaped by beliefs and ideas? (Standard 3)
- What causes people to change the way they live? (Standard 4)
- Why were natural resources a common cause of conflict among American Indian cultural groups? (Standard 5)

Relevance

- https://www.teachingchannel.org/videos/teaching-science-with-current-events

More ideas!

http://www.bie.org/project_search/results/search&channel=project_search&category=330&&331&ps_first=330&ps_second=331

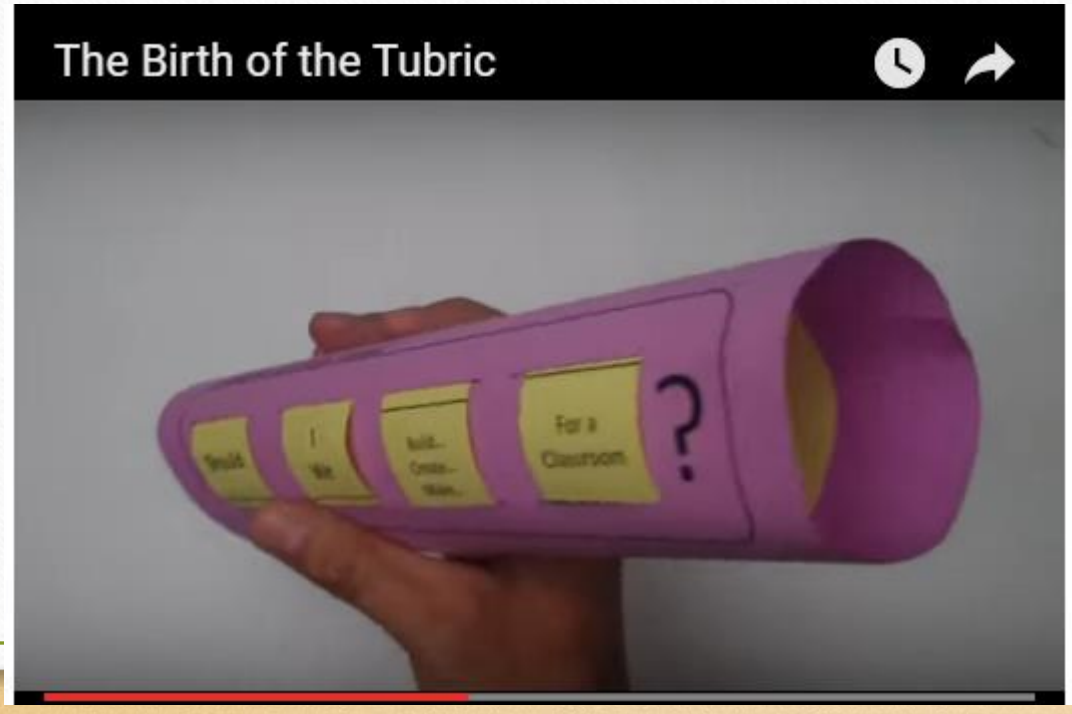


How to Write Driving Questions

- See article---Handout

How do I refine the questions?

- http://www.bie.org/object/video/the_birth_of_the_tubric



Now you try!!

Form: **Report**
Language: **Formal**
Audience: **Teenage**
Language: **Scientific**

1. Title

(what is your investigation about?)

_____

iMat

? Your title must be a question

2. Aim

(what are you trying to find out?)

What are your independent and dependent variables?

My aim is to find out

_____

I am going to investigate

_____

6. Method

Firstly I will collect the equipment in my equipment list and set it up as shown in the diagram.

2. Then I will_____

3. Next I will_____

And so on_____

4. Prediction

(what do you think will happen?)

I predict that_____
I think this will happen because

_____

3. Equipment

(What are you going to use?)

I will need to use the following equipment:

_____

_____

_____

_____

Why are you using that equipment – **justify** your choice.

Keywords

Change	Variable
Time	Method
Measure	Read
Record	See
Observe	Safety
Reaction	Goggles
Units	Table

5.Risk Assessment

(what will I do to be safe?)

Form: **Report**
Language: **Form**
Audience: **Teenage**
Language: **Scientific**

Do your results support your prediction?

2. Conclusion

(What have you found out?)

I have found out _____

LINK

Connectives Bank

However
But
Although
Therefore
So
Because
Nevertheless
Although
On the other hand
Despite
Whereas
In addition
Evidence for this is

Point: What is your point?

Evidence: Select evidence to back up your point

Analysis: Explain how the evidence proves your point

1. Analysis

(What do your results show?)

My results show that _____

The graph shows that _____

iMat

Is there a pattern in your results?

3. Evaluation

(How can you improve your investigation?)
What equipment might have worked better?
How would you do it better if you were to do it again?

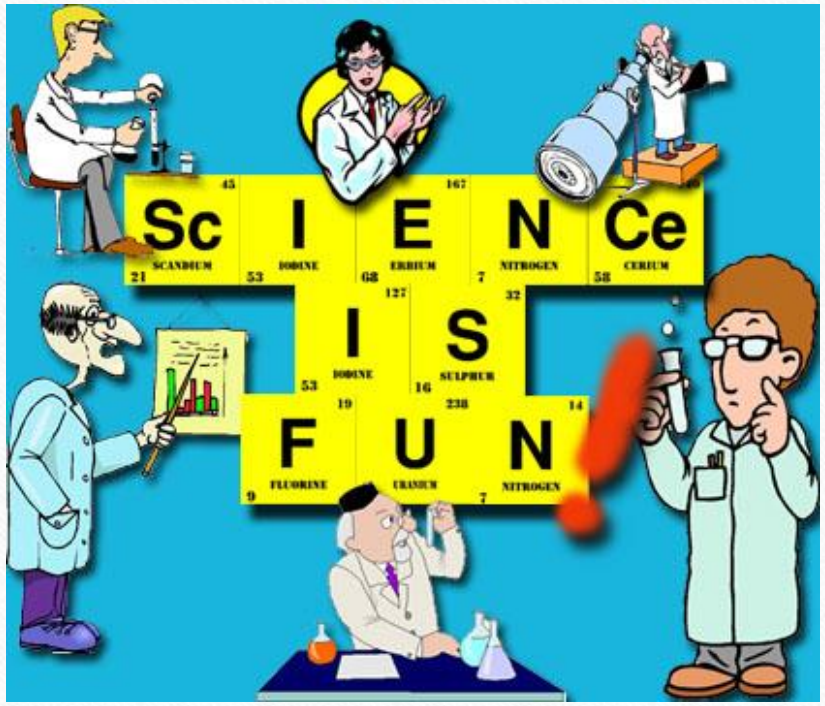
Stretch

What does your graph show?
Are there any results that don't fit? (*anomalous results*)
Why did you take repeats?
What is the scientific reason for your results?

Word Bank

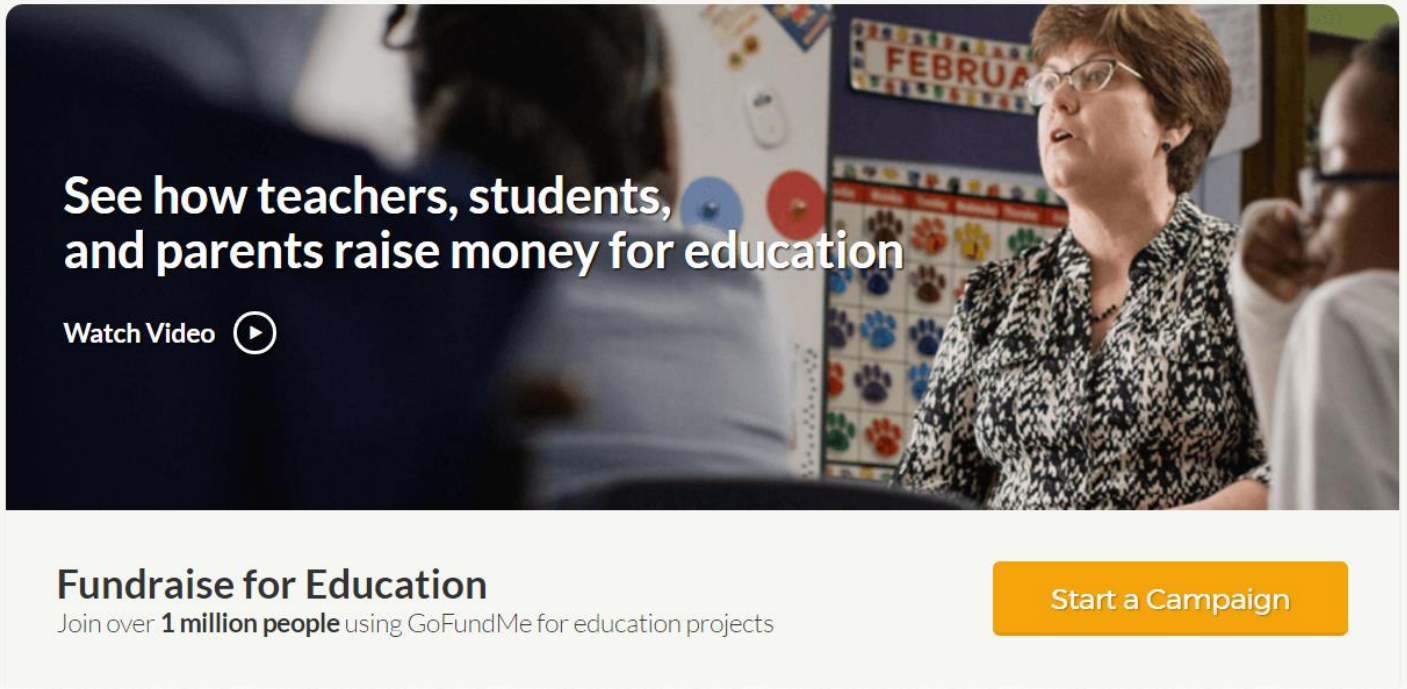
Anomalous – a result that doesn't fit the pattern
Independent variable – the thing you choose to change, e.g amount of water
Justify – giving reason for you statement or choice
Dependent variable – the thing that you measure e.g time taken to heat up

What is holding schools back from teaching science?



Go Fund Me

https://www.gofundme.com/education



Donorschoose.com

Thank you packet must be submitted when the grant is fully funded

SCIENCE AS INQUIRY

https://www.youtube.com/watch?v=mAYh4nWUkU0

5:25

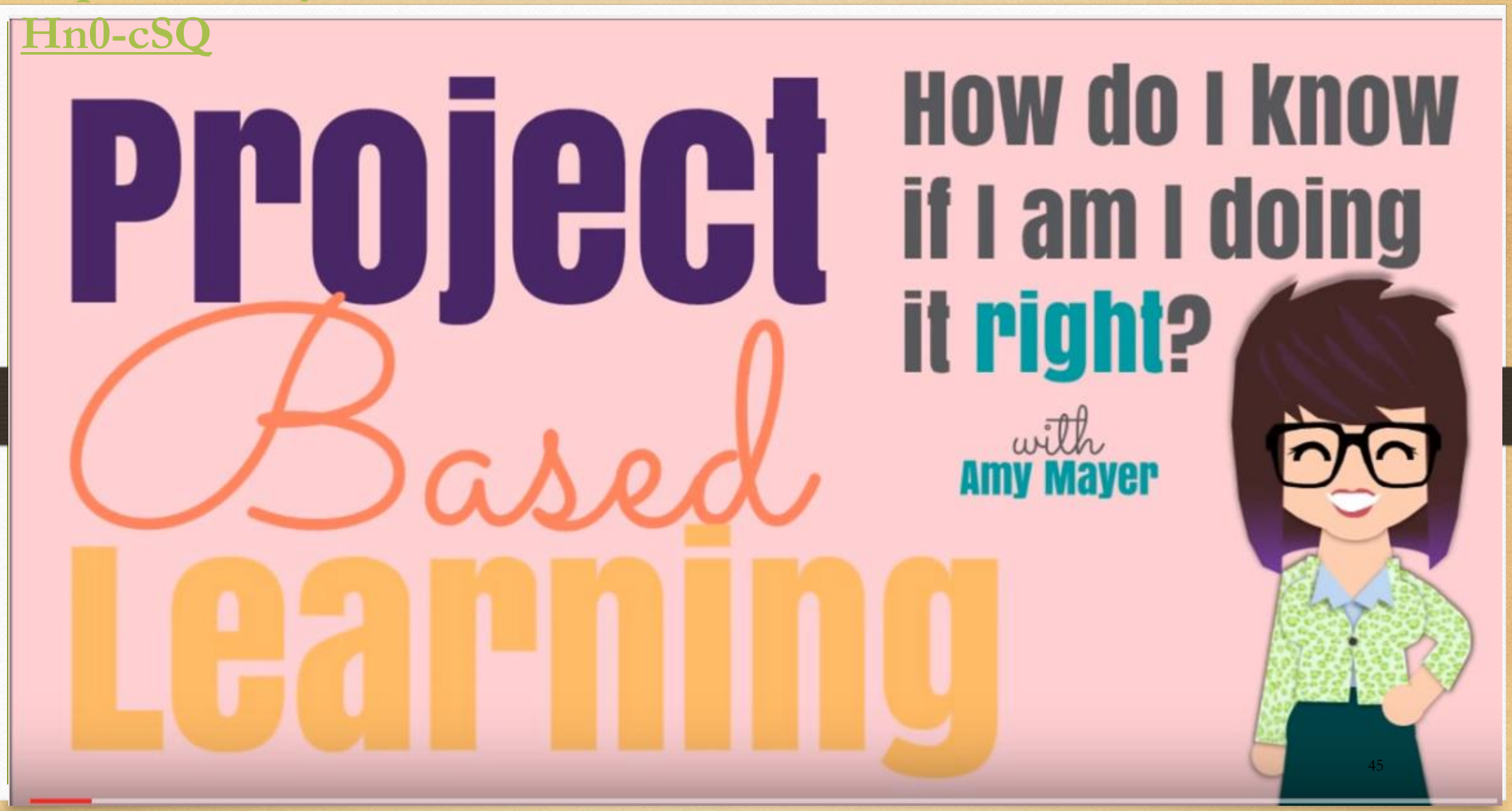
Consider

- What is empirical evidence?
- https://www.youtube.com/watch?v=H7LHsL0iB_w
  STEAM school 6:00 minutes right at the end th… is a bullet of high achievement in reading/mat…

You will need to teach the soft skills

- Start with cooperative learning structures or ideas from ***Total Participation Techniques***
- Plus ELA Standards

https://www.youtube.com/watch?v=tE6WHn0-cSQ



Brainstorm Ideas/Plan a Project

Thanks for your time!

- Please go to www.swprsc.org
  ---then Professional
  Learning ---then Workshop
  Evaluation