Connecting Math and Science

Contextualizing to Topics that Count

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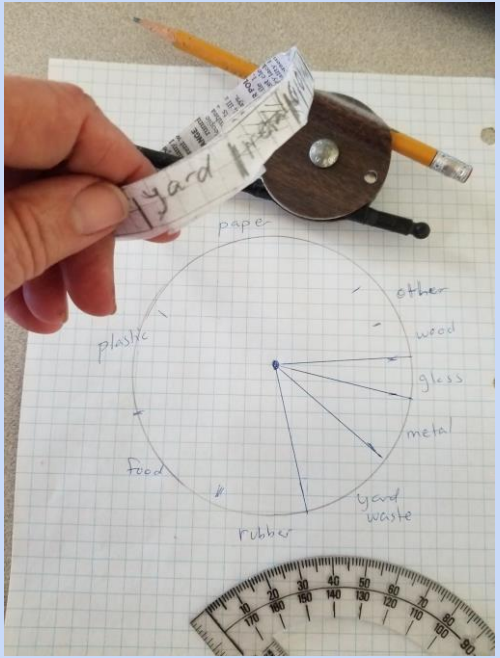
Agenda:

- Why we are here
- Teacher tips for planning
  - 3-D Teaching is like a walnut
- 3 Lesson examples
  - What’s in our Trash, Energy Offsets, Paper or Plastic?
- Change and Growth



You can have a class without a teacher

You can not have a class without students

Engage Connect

Why Math?

It’s what we teach.

Why Recycling?

In the News

ASIA ECONOMY

Malaysia, following in China's footsteps, bans imports of plastic waste

PUBLISHED FRI, JAN 25 2019 • 1:02 AM EST | UPDATED FRI, JAN 25 2019 • 2:38 AM EST

RESTAURANTS

Starbucks announces trials for recyclable and compostable cups

PUBLISHED WED, MAR 20 2019 • 9:00 AM EDT | UPDATED WED, MAR 20 2019 • 10:30 AM EDT

Amelia Lucas

Under China's New Rules, U.S. Recycling Suffers

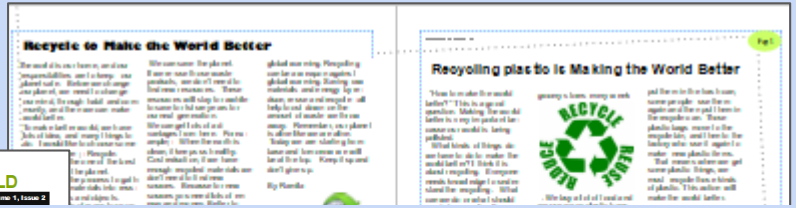
Some cities are closing recycling plants. Others are ending curbside pickup. For recycling to be sustainable, consumers must learn to sort their trash better.

BY ALAN GREENBLATT | DECEMBER 2018

FEATURED

Whale that ingested 88 pounds of plastic washed ashore during campaign to stop plastic pollution

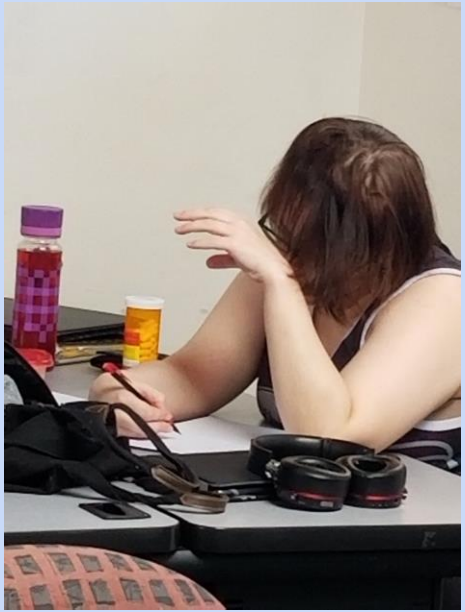
By Gina Joseph gjoseph@medianewsgroup.com; @ginaljoseph on Twitter Mar 20, 2019 Comments



You can not disconnect math and science

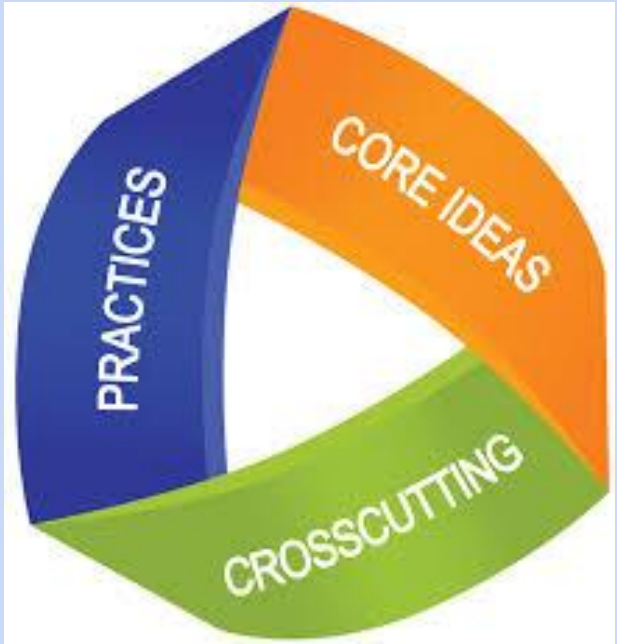
It’s all about the student

Their learning and their progress toward goals

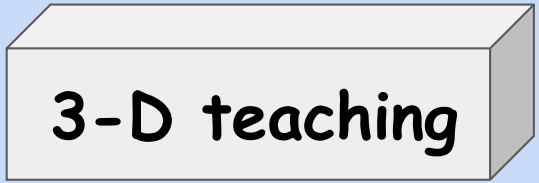


TEACHERS

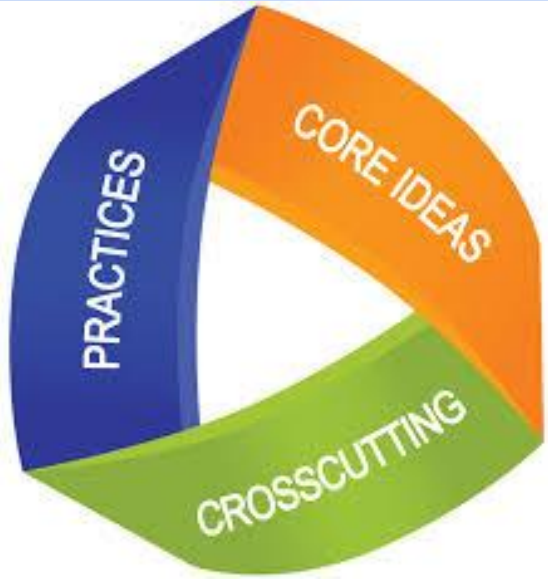
How to get more in our lessons?



Connect
Math and Science



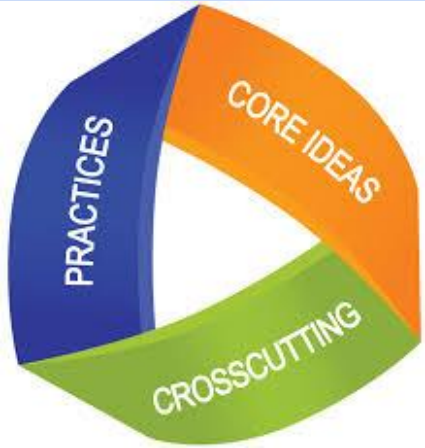
What is 3-D teaching



Three dimensions:

- Core Ideas- from Standards
- Practice - Methods of action
- Concepts - Apply across topics

Remember to give time for Feedback and Reflection

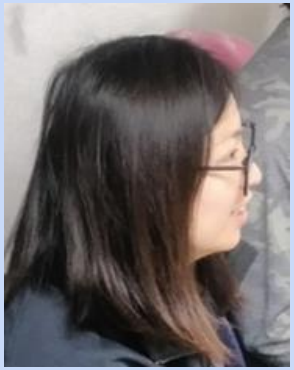


D 1 - CORE IDEAS:

Content:

- For math
- For science

Remember its application



Use Student Questions to help guide you.

**?How much of my trash can I recycle?

HOW ARE NEW USES FOR DISCARDED MATERIALS DEVELOPED?

WHICH SHOULD I CHOOSE, PAPER OR PLASTIC OR REUSABLE BAG?

If it's more expensive, will people buy it?

How much energy can we save if we recycle?

Which is more cost effective, landfill or recycling?

WHAT IS THE MANUFACTURING PROCESS? HOW MUCH ENERGY IS USED?

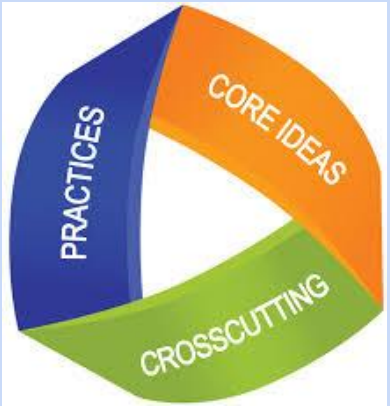
D - 2 Practice:

Math practice Science Practice

What is similar?
How can you combine the two?

Look at your “YELLOW” handout

3-D teaching



Math Practices:

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively
- Construct viable arguments and critique the reasoning of others.
- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make sense of structure.
- Look for and express regularity in repeated reasoning.

Science and Engineering Practices

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Math Practice: Questions for teachers to ask students in order to promote best math practice

Stem Questions to Promote the 8 Mathematical Practices
https://www.nd.gov/dpi/uploads/1382/QuestionStemsPromote8MathematicalPractices.pdf

Common Core State Standards, Standards for Mathematical Practice, Questions for Teachers to Ask
http://www.ride.ri.gov/Portals/0/Uploads/Documents/Instruction-and-Assessment-World-Class-Standards/Transition/EIA-CCSS/ScarpelliD-MP_TeacherQuestionStarters.pdf

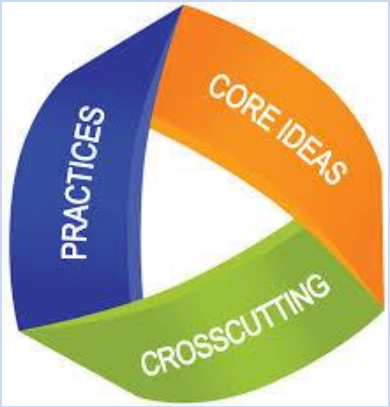
You might have chosen differently

Math Practice

- Use appropriate tools strategically.
- Attend to precision.

Science Practice

- Planning and Carrying Out Investigations
- Analyzing and Interpreting Data



Your focus helps choose the questions you ask,
the feedback you offer and the reflection you design.

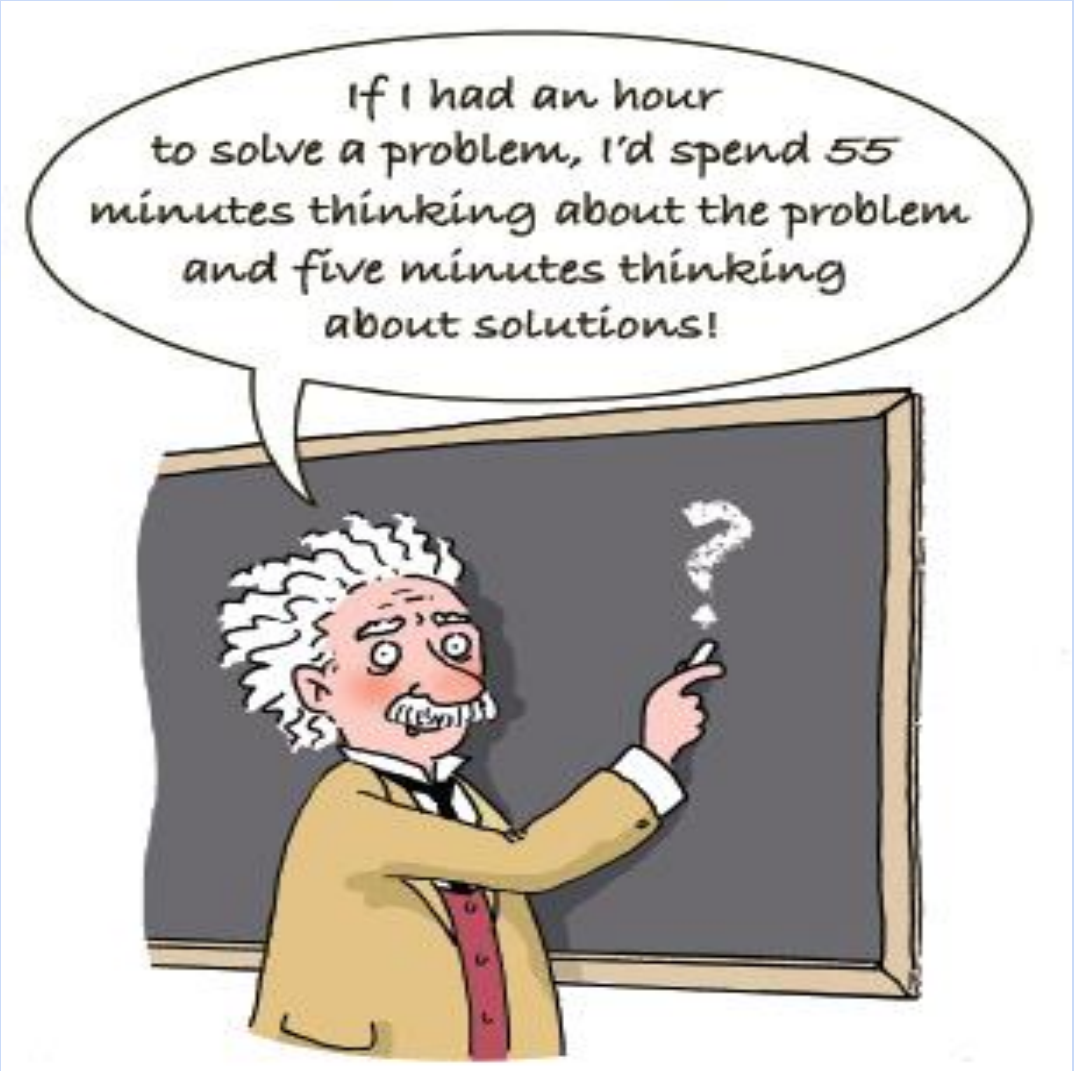
Your focus helps choose the questions you ask.

- *What steps did you take to solve this?*
- How does this tool help you find and explain your answer?
- *Does that answer make sense?*
- What conclusions have you drawn from your work?

… and the feedback you offer:

- You showed your thinking clearly in the organization and steps you took along the way.

Practice matters



D - 3 CC Concepts:

What are appropriate Cross-cutting CONCEPTS?

Check the back side of the same yellow handout Pair, share, what do you see?

Crosscutting Concepts

Adapted from: A Framework for K-12 Education, and NGSS

The seven crosscutting concepts that allow us to connect different arenas of science, also cut across other academic content areas: Math, social studies, reading and writing.

1. ***Patterns****.* Observed patterns of forms and events guide organization and classification.

2. ***Cause and effect****: Mechanism and explanation*. Events have causes, sometimes simple, sometimes multifaceted that can then be tested and used to predict and explain events in new contexts.

3. ***Scale, proportion, and quantity****.* Recognize what is relevant at different measures of size, time, and energy and how changes affect a system's structure or performance.

4. ***Systems and system models.*** Defining the system under study provides tools for understanding and testing ideas.

5. ***Energy and matter****: Flows, cycles, and conservation.* Tracking fluxes of energy and matter into, out of, and within systems helps one understand the systems' possibilities and limitations.

6. ***Structure and function.*** The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.

7. ***Stability and change****.* conditions of stability and determinants of rates of change are critical elements.

Concept: Scale Proportion and Quantity

Be Intentional.

Plan for success

Give time for reflection

Math/Science 3D Lesson Planning Organizer

Date:
Class:

A unit or lesson includes a component from each of the three dimensions:	Comments / ra
Practices: Math Practice Science Practice	
Cross Cutting Concept:	
Content: Core Ideas Math Science	
Cross-walking Theme:	

My brainstorm for connections and lesson ideas:

Let's check out some lessons.

But first,

a question about you.

Think about your recycling habits and awareness.

Pull out your phone or device and sign in to Mentimeter. Code:

Let's take a quick quiz.

Mentimeter - menti.com

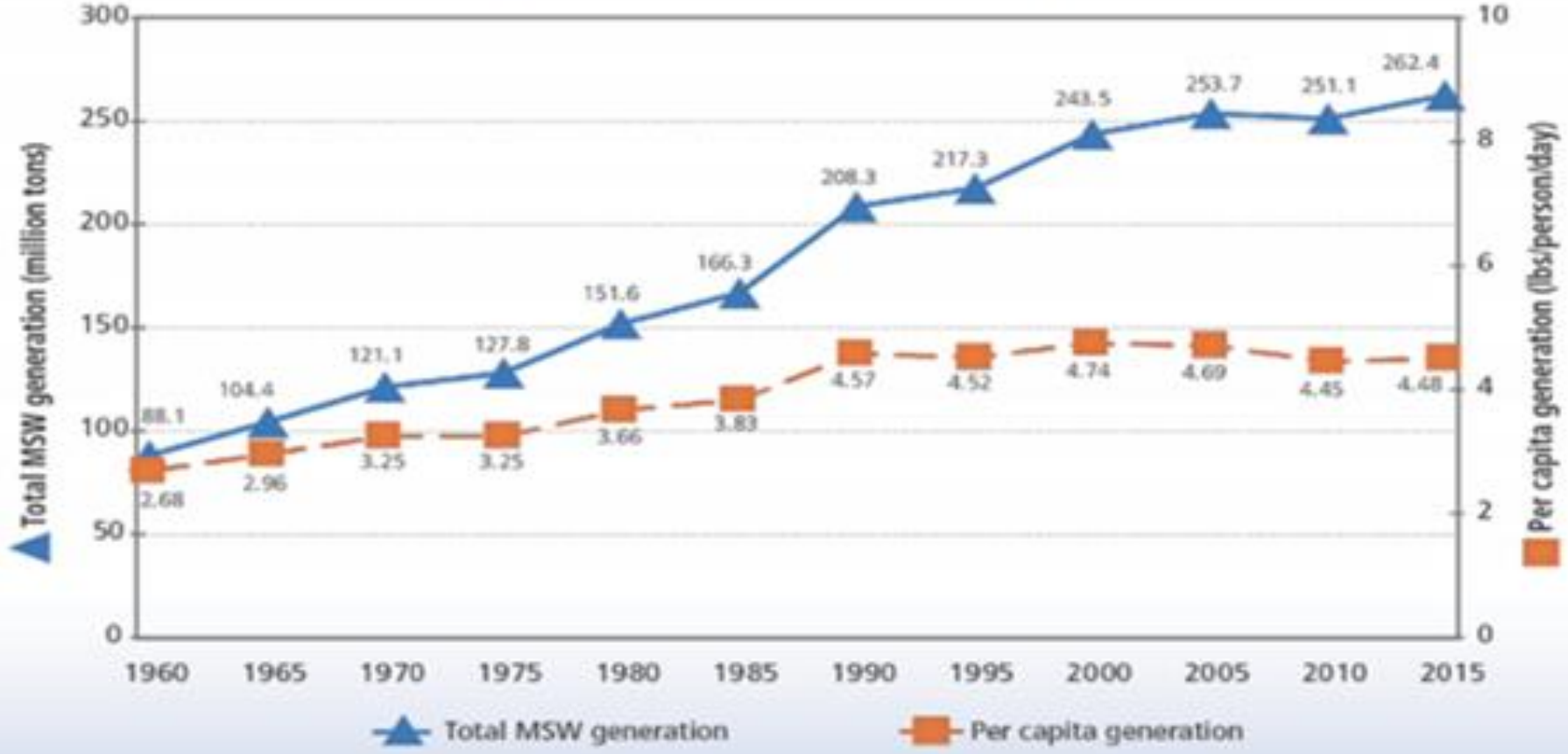
code:

Would you spend more to buy a product made from recycled materials?

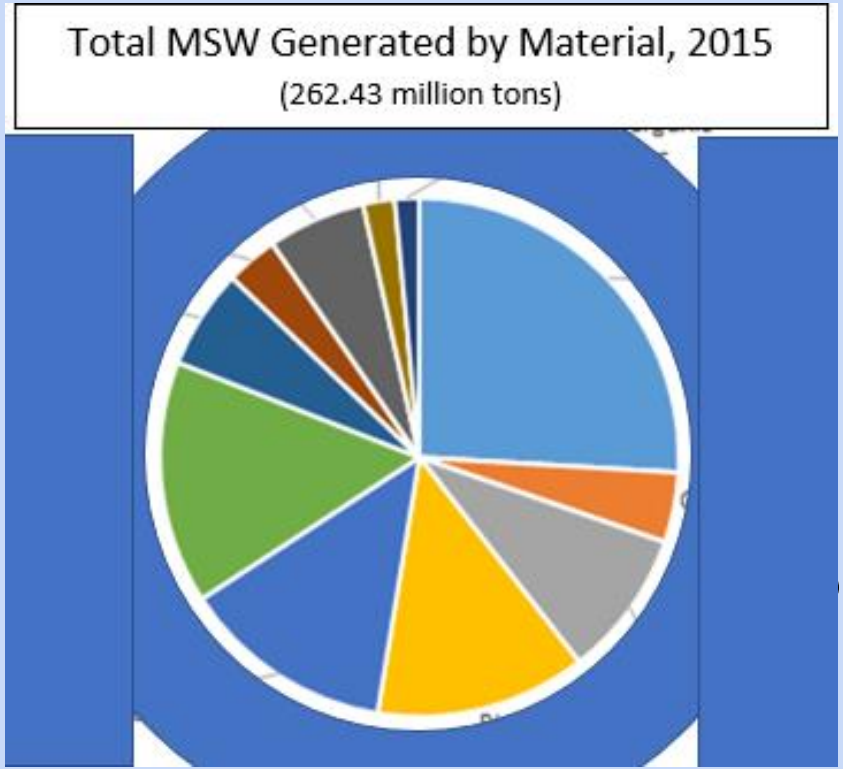
a) If it is better quality?
b) If it is the same quality?
c) If it is slightly lower quality?

YOU MAY VOTE FOR MORE THAN ONE OPTION.

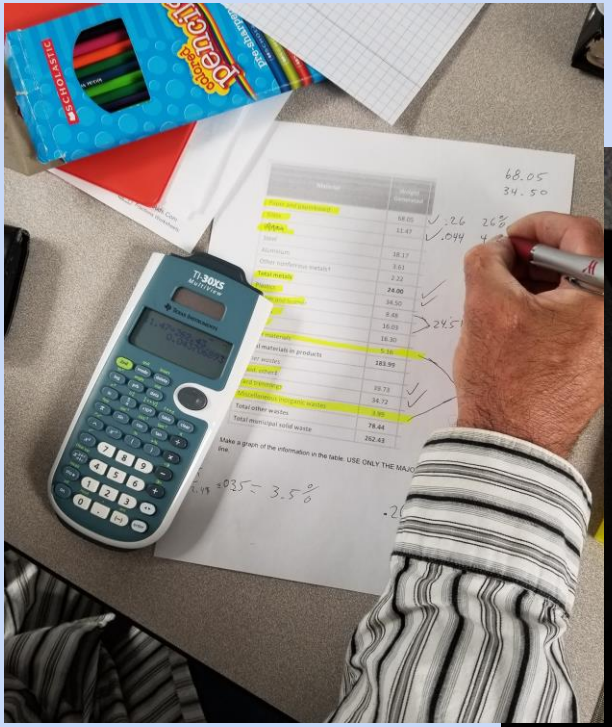
Figure 1. MSW Generation Rates, 1960 to 2015

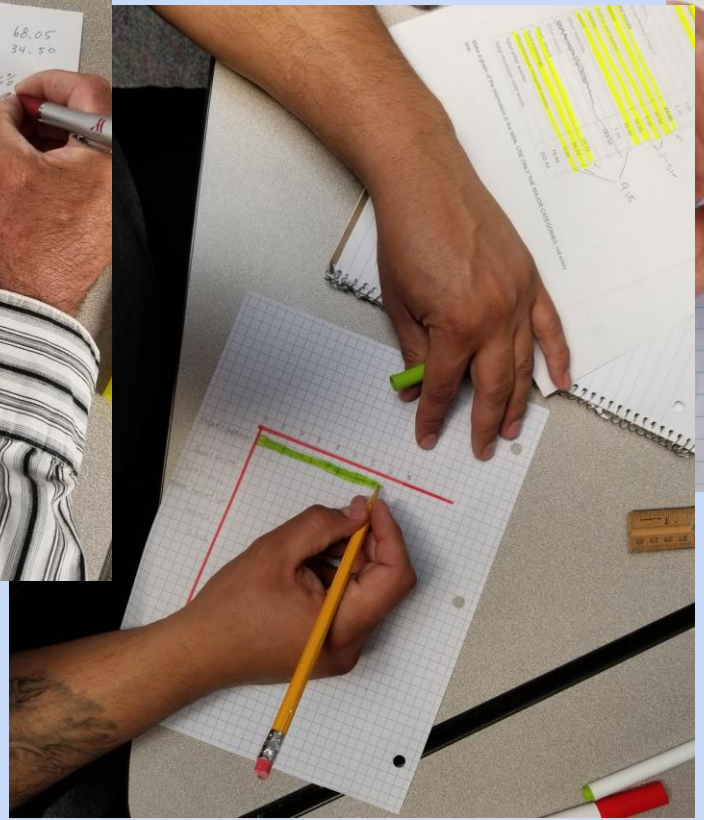


Material	Weight Generated
Paper and paperboard	68.05
Glass	11.47
Metals	
Steel	18.17
Aluminum	3.61
Other nonferrous metals†	2.22
Total metals	**24.00**
Plastics	34.50
Rubber and leather	8.48
Textiles	16.03
Wood	16.30
Other materials	5.16
Total materials in products	**183.99**
Other wastes	
Food, other‡	39.73
Yard trimmings	34.72
Miscellaneous inorganic wastes	3.99
Total other wastes	**78.44**
Total municipal solid waste	**262.43**



Transform chart data to pie chart.

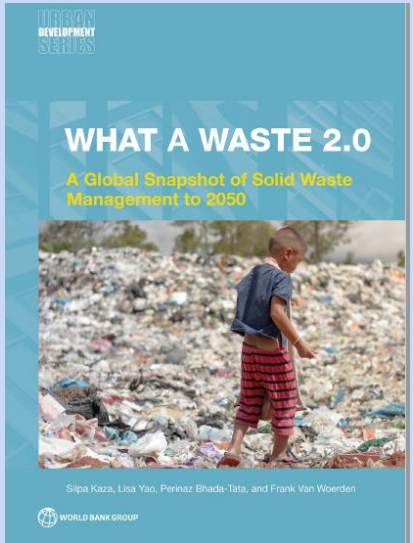




Credit to
Empower series: Many Points Make a Point

Film clip
Why does this matter?

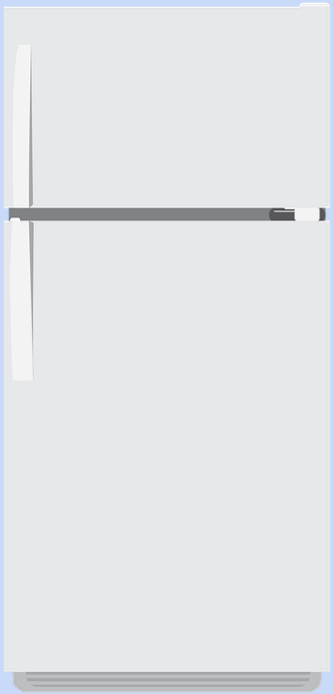
World Bank - Waste 2.0
4 ½ minute film to introduce to students (clip 1:25 segment)

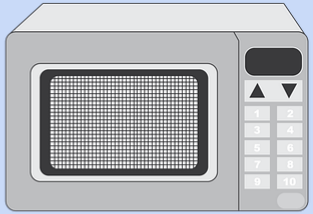


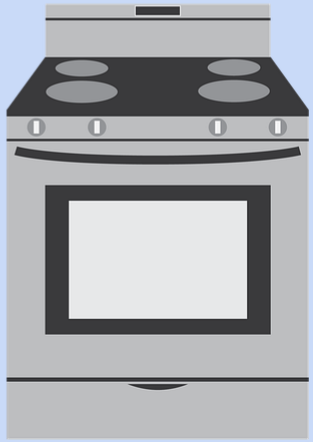
Student quote:

I went home and told my children, “We need to start recycling.” I never knew it was so important. In my country we don’t recycle. I never heard anything about it, so I thought it wasn’t important. But it is! We can do something to help the environment.

Energy offsets lesson

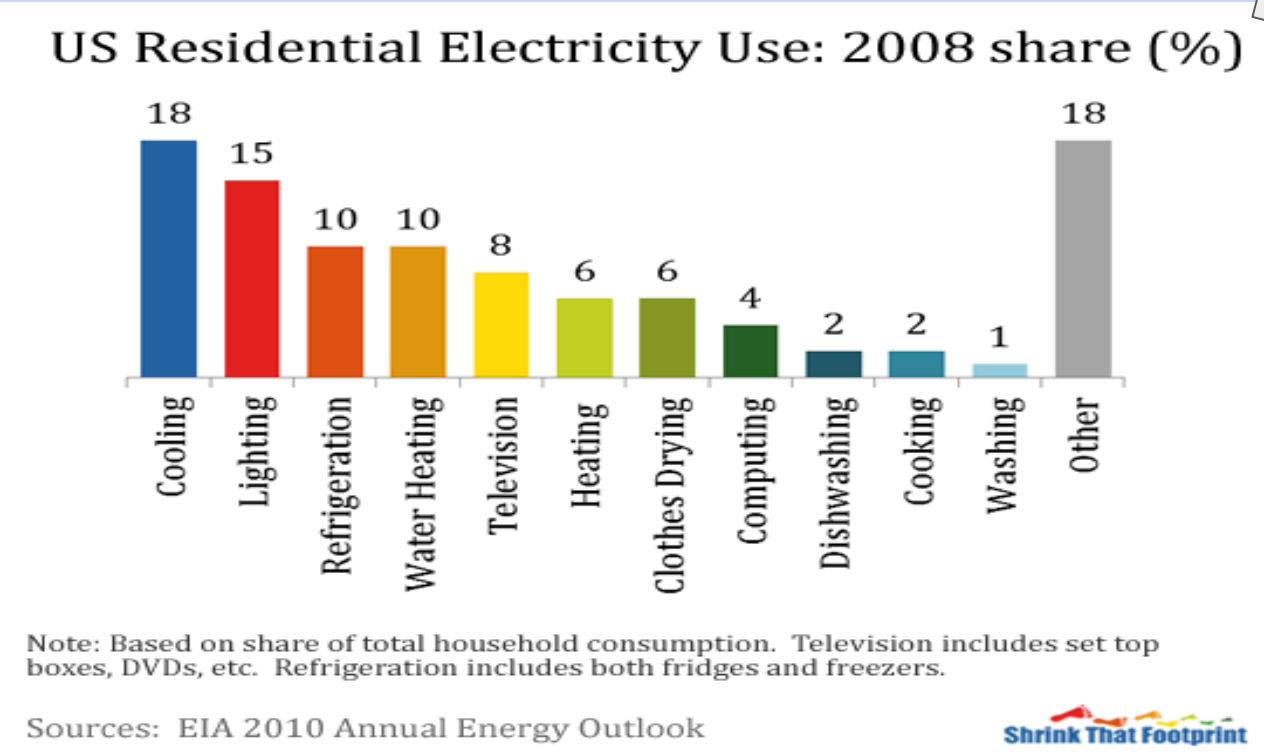






Energy
kWh

Where do we use energy in our homes?



What do we need to know, if we want to find out how much to recycle to offset our energy use?

We need to know:

- How much energy do our devices use?
- How much energy do we get from recycling?

First:

EnergyUse CALCULATOR

Click calculate to find the energy consumption of a refrigerator using **180 Watts** **hours a day @ $0.10 per kWh.**

Cost Per Hour: **0.0180**
Cost Per Day: **0.4320**
Cost Per Month: **13.14**
Cost Per Year: **157.70**
kWh Per Day: **4.32**

Hours Used Per Day: 24
Power Use (Watts): 180
Price (kWh): 0.10
Calculate

My Energy Use

(Collect your information from Energyusecalculator.com)	**Kw per day**	**Kw per month**	**Kw per year**
Laptop Computer *(example)*	.36	10.8	131.4
Total Use			
Compare to US per capita figure from EPA chart			

Second:

Paper:

- One ton of recycled office paper saves 4,100 kWh of energy
- One ton of recycled newsprint saves 601 kWh of energy
- One ton of cardboard saves 390 kWh of energy

Aluminum Cans:

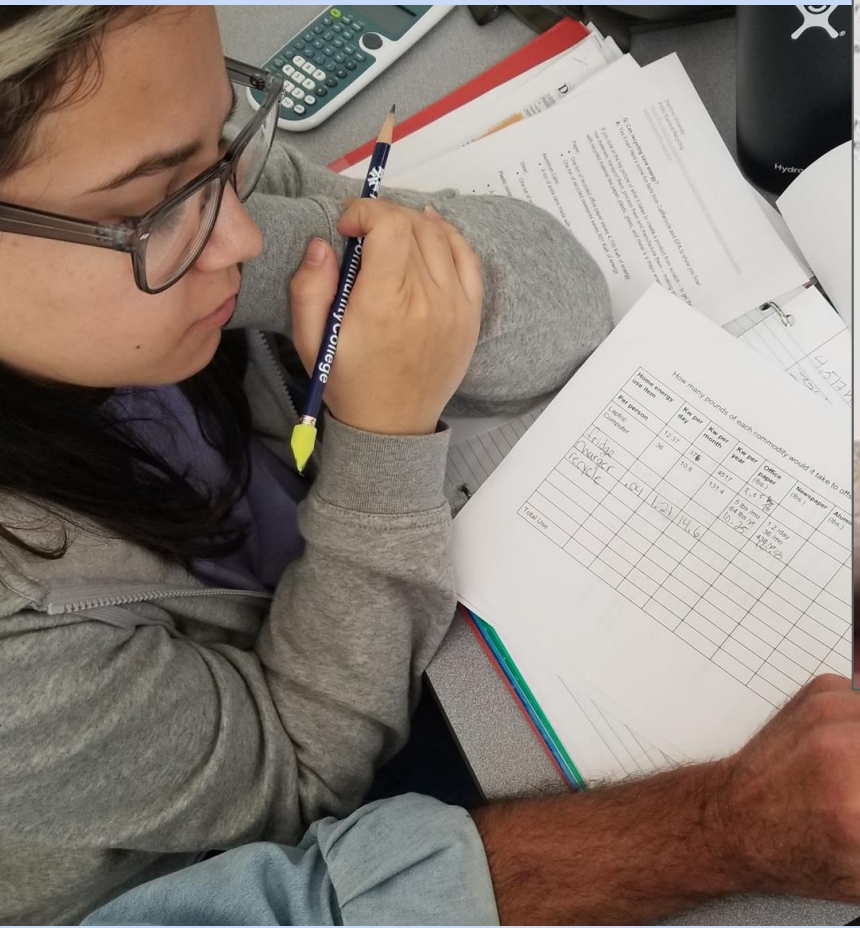
- A ton of soda cans made with recycled aluminum saves 21,000 kilowatt hours

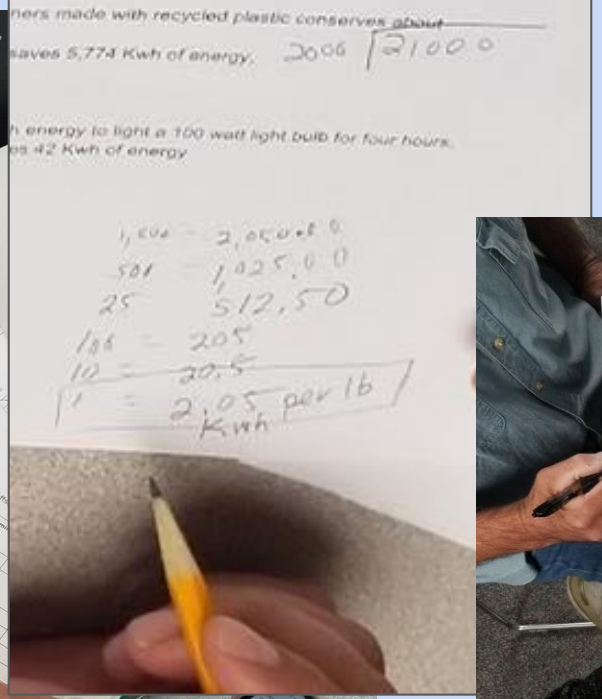
Steel:

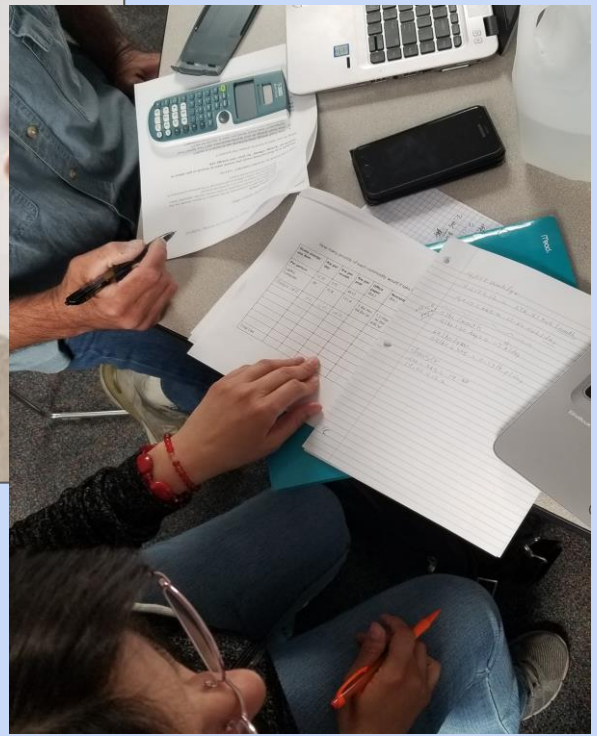
Recycling Conversions

(Convert information from Energy Saving Factoids handout)

Commodity	Energy savings per ton	Energy savings per pound
Office Paper		
Newspaper		
Aluminum Cans		
Steel		
PET containers		
Other plastic		
Glass		




ners made with recycled plastic conserves about
saves 5,774 Kwh of energy. 2006 21000
energy to light a 100 watt light bulb for four hours.
es 42 Kwh of energy
1,000 - 2,050.00
501 - 1,025.00
25 - 512,50
100 - 205
10 - 20.5
1 = 2,05 per lb
Kwh



Third

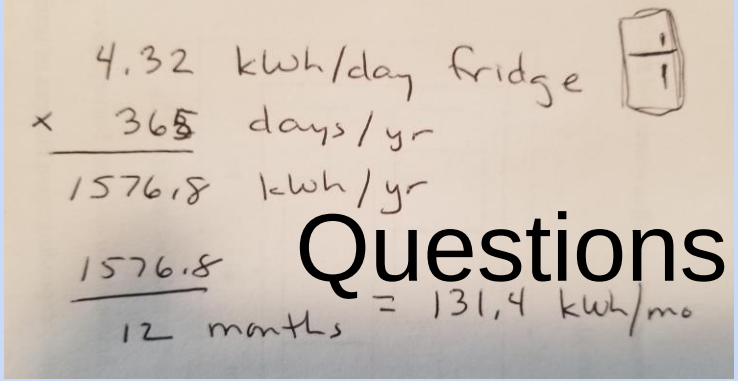
My Energy Offsets Possibility

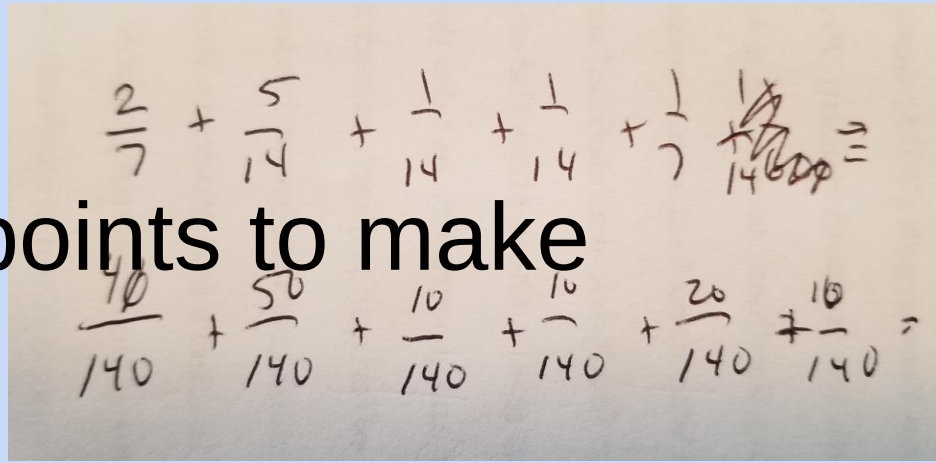
Home item	Item uses Kw per month From My Energy Use Use	Office paper (lbs. needed)	Newspaper (lbs. needed)
Laptop Computer	10.8	5 lbs.	36
TOTALNEEDED of each commodity if it alone were to cover the energy			

Calculate the pounds of each commodity needed to offset your de

My Energy Offsets ~~Portfolio~~ Possibility

Single commodity options explored Home item	Item uses Kw per month From My Energy Use Use	Office paper (lbs. needed)	Newspaper (lbs. needed)	Aluminum (lbs. needed)
Laptop Computer	10.8	2.05	~~2.05~~ 3	10.5
plane + wright clock	6.38	5 lbs	36	
light bulbs	45.63	2.94		1.63
fridge	131.40	22.26	21.3	.6
stove + microwave	26.45	64.1	152.1	4.35
clothes washer	3.04	12.9	438	12.51
fans - (my cooler?)	27.40	1.48	88.2	2.52
TOTALNEEDED of each commodity if it alone were to cover the energy use	240.3	122.04 ~~119.2~~ lbs	747.2 lbs	23.91 lbs



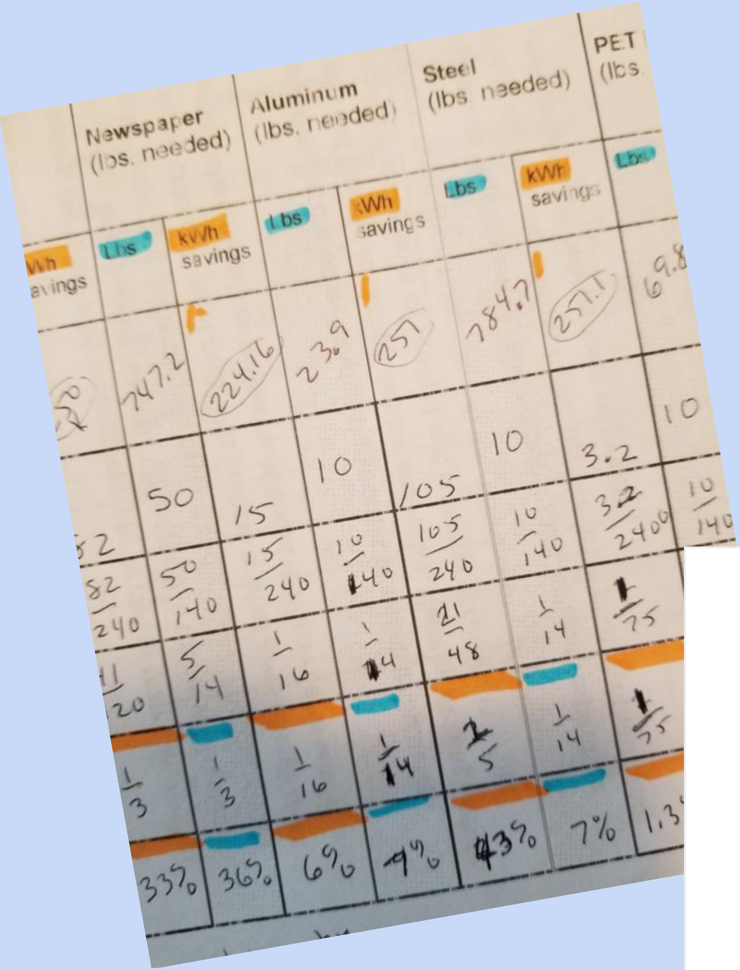


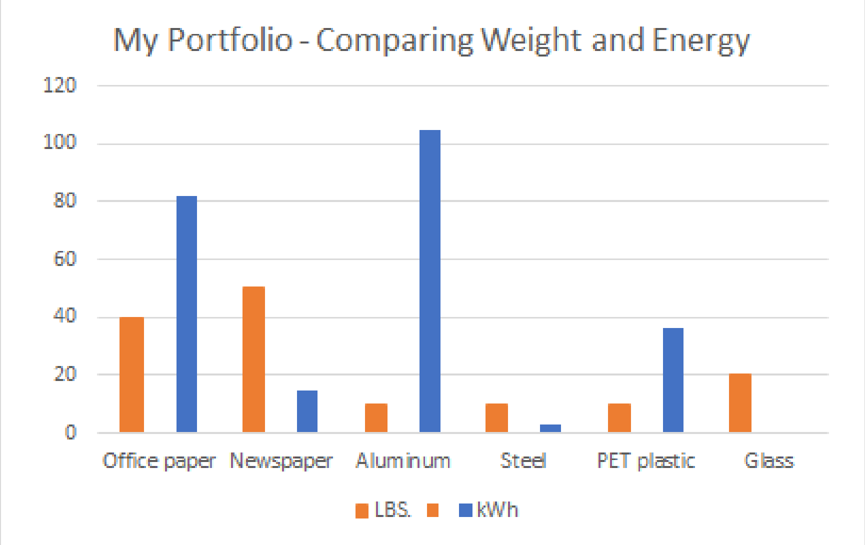
Questions and points to make

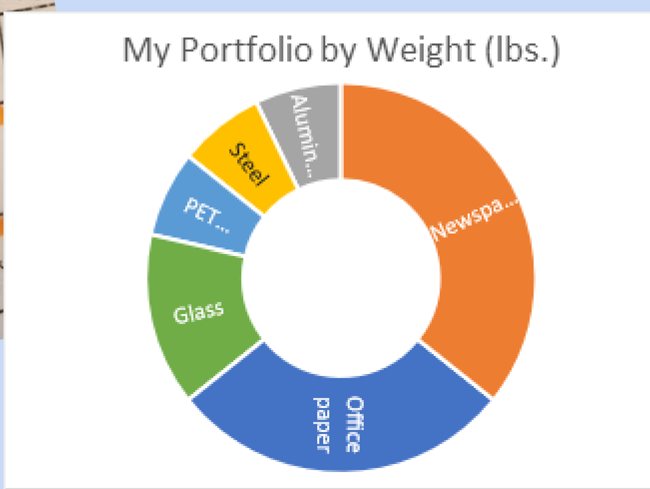
- What is your process?
- Why is it important to keep track of units as you work?
- How can you double check your work? Which areas should be the same values?
- Relate to conversion factors and proportions

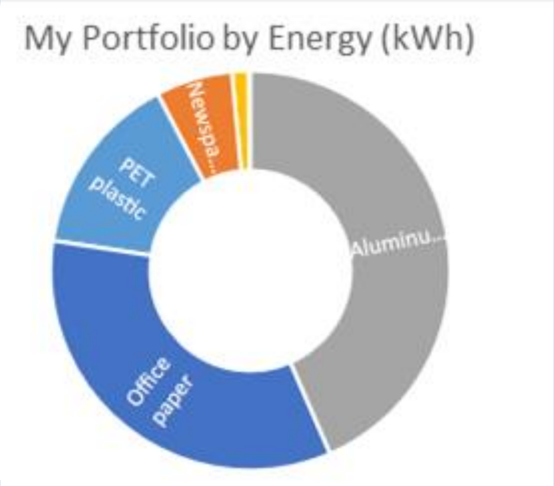
The goal

		My Energy Offsets Portfolio												
MY PLAN Mix and match	**Item uses Kw per month**	**Office paper**		**Newspaper** (lbs. needed)		**Aluminum** (lbs. needed)		**Steel** (lbs. needed)		**PET Plastic** (lbs. needed)		**Glass** (lbs. needed)		**totals** lbs. / kWh
	kWh From My Energy Use	Lbs	kWh savings	Lbs	kWh savings	Lbs	kWh savings	Lbs	kWh savings	Lbs	kWh savings	Lbs	kWh savings	
My personal mix	240.3	~~40~~		82		50		15		10		105		10		3.2		10		36		20		.4		lbs 140 / 241.6
fractions	240/240	40/140		82/240		50/140		15/240		10/140		105/240		10/140		3.2/240		10/140		36/240		20/140		.4/240		140/140 / 2416/241
Fraction reduced	1	2/7		41/120		5/14		1/16		1/14		21/48		1/14		1/75		1/14		3/10		1/7		1/600		
Fraction rounded/ benchmark	1	2/7		1/3		1/3		1/16		1/14		2/5		1/14		1/75		1/14		3/24		1/7		1/600		21
rounded/ benchmark																										
Percent	100%																									


Newspaper (lbs. needed)
Aluminum (lbs. needed)
Steel (lbs. needed)
PET (lbs.
Lbs
kWh savings


My Portfolio - Comparing Weight and Energy
120
100
80
60
40
20
0
Office paper
Newspaper
Aluminum
Steel
PET plastic
Glass
LBS.
kWh


My Portfolio by Weight (lbs.)
Newspa...
Office paper
Glass
PET...
Steel
Alumin...


My Portfolio by Energy (kWh)
Aluminu...
Office paper
PET plastic
Newspa...

Student quote

It looks so different when you see it in pounds and when you see it in kWh - energy. I didn’t know it would look so different.

Student quote:

Everyday we take a bottle of water to school. When we finish, we throw it away. In class, we learned that energy comes in many forms. It is in that water bottle.
Energy is not created or destroyed, but it can be lost if we throw it away, or useful if we recycle.

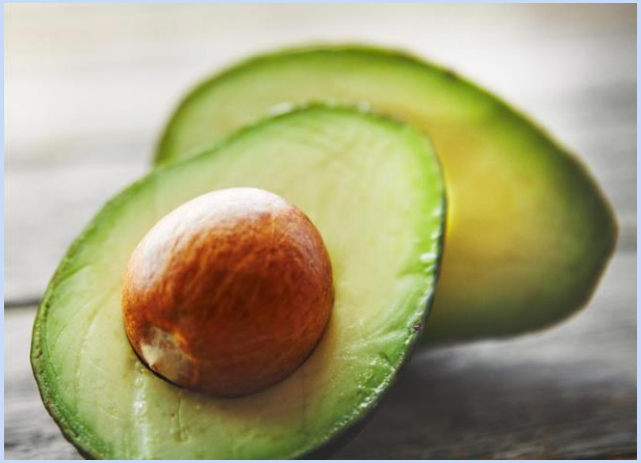
THE STORY OF STUFF PROJECT

The Story of Stuff clip

Paper vs plastic

Gather student questions.
Make a plan and do the research.

- What do you need to know to answer this question?
- What factors are involved in the decision?
- Where do you think you can find this information?



Avocado Pits for Sustainable Single-Use Cutlery and Straws

Alternatives

Use of Recycled Post Consumer material

Biodegradable vs Bioplastic

Let’s take a quick quiz.

Mentimeter - menti.com
code:

Would you spend more to buy a product made from recycled materials?

a) If it is better quality?
b) If it is the same quality?
c) If it is slightly lower quality?

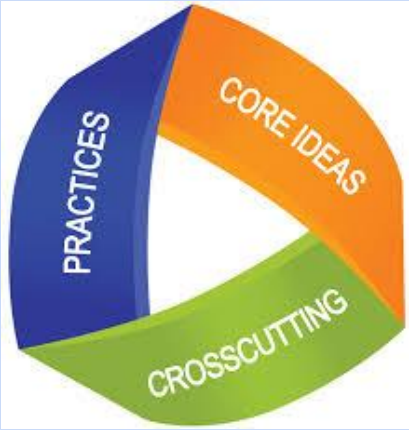
YOU MAY VOTE FOR MORE THAN ONE OPTION.

Class Surveys

A great way to engage, gather data, and work with data

HAVE STUDENTS COME UP WITH THE QUESTIONS.

3-D teaching



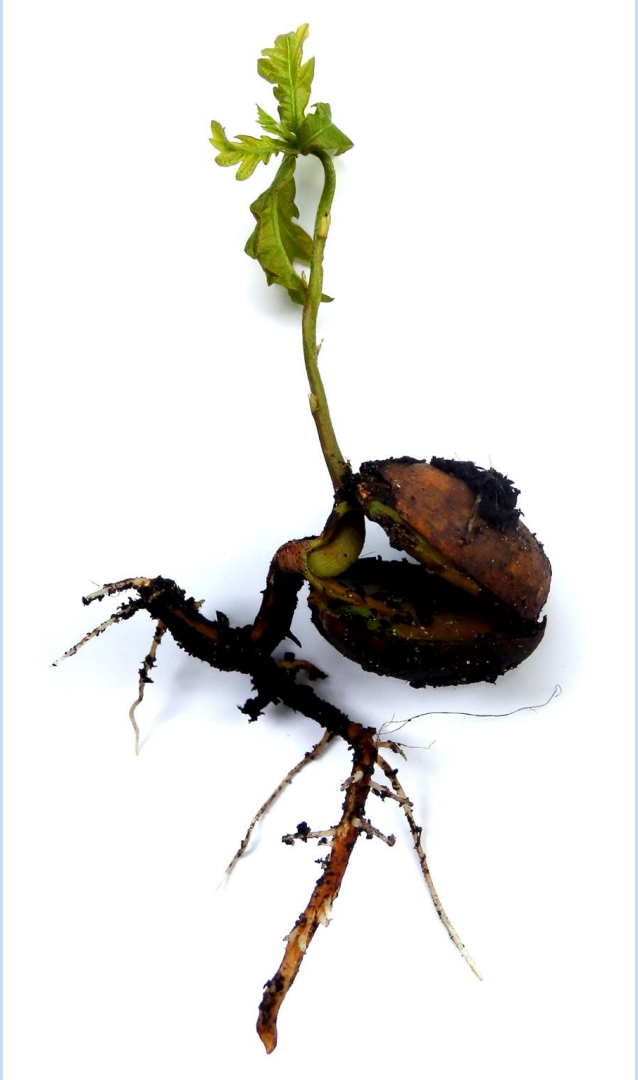
Growth

Be Intentional

Engage

Content, Practice, Conceptual understanding

Motivation and Civic engagement



How students learn

UA Science

We learn from experience. Not from rules alone, or being told “how to”. We compare what we have experienced to what is in front of us. Our breadth of experience gives us the ability to apply what we know to a wide range of situations.

Metacognition and the process of science help us to recognize when our experience does not fit or explain a situation. It helps us to recognize our misconceptions.

Anna Dornhaus, Professor of Ecology and Evolutionary Biology, Univ. of Arizona

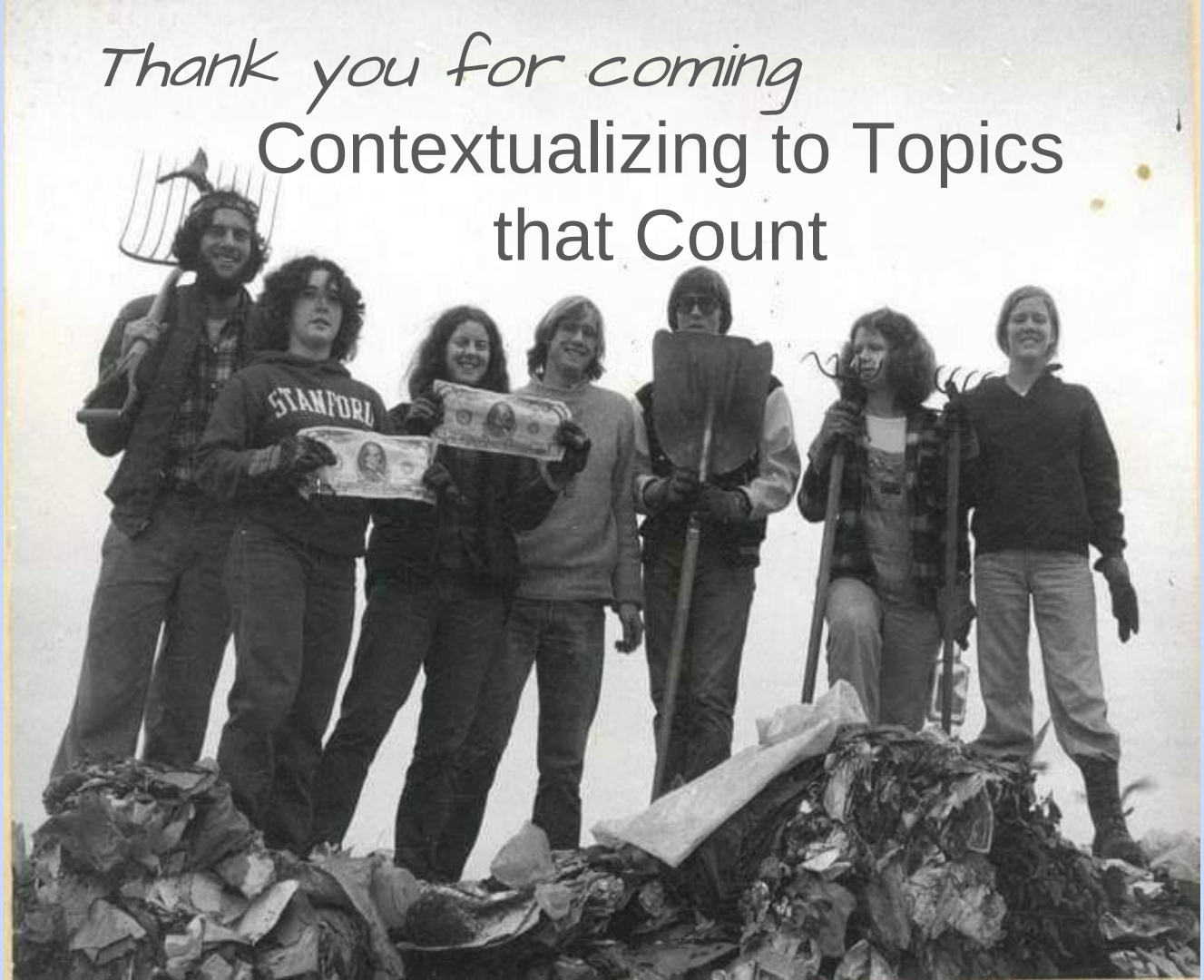
Questions? and Reflection

Where do you see using this?
What ideas do you have?

Write your ideas on the postcard. Address the front. We will mail this to you when we get home so that you won’t forget your ideas.

Thank you for coming

Contextualizing to Topics that Count



Resources:

Recycling and Waste management facts, figures, graphs, charts and other cool things:

U.S. Environmental Protection Agency (EPA), (2015) *Facts and Figures about Materials, Waste and Recycling*,
https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling

World Bank - Understanding Poverty, Urban Development
What a Waste 2.0 film and other resources
http://www.worldbank.org/en/topic/urbandevelopment
Link to pdf downloadable What a Waste 2.0 material
http://datatopics.worldbank.org/what-a-waste/

Waste Management - Recycling Facts
http://www.wm.com/location/california/san-joaquin/stockton/facts/index.jsp

Energy Use Calculator - Find out how much energy is used by different appliances and gadgets
http://energyusecalculator.com/

Science Practice and Cross Cutting Concepts

Next Generation Science Standards - Link to the Appendices with explanations on Science Practice and Cross-Cutting Concepts
https://www.nextgenscience.org/resources/ngss-appendices

Bozeman Science - Films with explanations for Science Practices and Cross-cutting concepts
http://www.bozemanscience.com/next-generation-science-standards/
http://www.bozemanscience.com/

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