Q405 Saturday Science Teaching – Fall 2017

Lesson Plan Week #1

SAVE OUR PLANET

GREENHOUSE GASES

GRADE 4-5

A) LEARNING OBJECTIVES and CRITERIA FOR DETERMINING IF OBJECTIVES ARE MET (minimum of 2/ lesson)

- Students will be able to recognize the effects that greenhouse gases have on the planet.
- Students will be able to connect how greenhouse gases connect to themselves and what the students can do to improve the planet.
- Criteria:
    - In order to identify if the students have met the objectives above, they will be building their own greenhouse with different materials and explain what makes it a greenhouse.
    - In order to identify if the students have met the objectives above, the students will be calculating their carbon footprints in order to discover the ways that they can do in their lives to improve the state planet.

B) STANDARDS (see http://www.doe.in.gov/standards/science)

- **Science and Engineering Process Standards:**
    1. SEPS.2 Developing and using models and tools.
    2. SEPS.6 Constructing explanations (for science) and designing solutions(for engineering).
- **Content Standards:**
    1. 4.ESS.4: Develop solutions that could be implemented to reduce the impact of humans on the natural environment and the natural environment on humans.
    2. 3-5.E.2: Construct and compare multiple plausible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
    3. 5.ESS.4: Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
    4. 4-ESS3-2: Generate and compare multiple solutions to reduce the impacts of natural Earth processes on humans.
    5. 5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

C) MATERIALS (**asterisk (*)** = any materials that may be a **safety concern**)

- 4 Two liter bottles
- 5 boxes of straws (approx. 200 straws)
- 6 rolls of plastic wrap,
- 1 pack of clear plastic cups
- 24 IPADS (MILL)
- 6 thermometers
- 6 heat lamps
- 6 rolls of masking tape
- 6 pairs of scissors
- Soil (get it wet before putting it in the greenhouse)
- Unifix Cubes (Pink, Purple, Blue, Yellow, Orange, and Green)

D) TEACHER CONTENT KNOWLEDGE

- A carbon footprint is the amount of carbon dioxide and other carbon compounds emitted due to the assumption of fossil fuels by a particular person, group, etc. which contribute to greenhouse gases that are emitted into the atmosphere.
- A greenhouse gas is a gas that contributes to the greenhouse effect by absorbing infrared radiation, e.g., carbon dioxide and chlorofluorocarbons.
- A greenhouse is a building made mostly of glass or another transparent material, that hold plants that require specific climate conditions in order to grow that can simulate what is happening on Earth with the greenhouse effect.

E) REFERENCES (list **ALL** references that you borrowed ideas from to develop this lesson – including any handouts you may distribute)

-https://ethicalnutrition.wordpress.com/2013/07/12/five-ways-to-reduce-your-carbon-foodprint/
-http://www.wikihow.com/Make-a-Mini-Greenhouse
-https://www.education.com/science-fair/article/greenhouse-project/
-http://meetthegreens.pbskids.org/features/carbon-calculator.html
-https://www.thehandmadehome.net/2015/05/a-super-simple-greenhouse-for-kids/

F) TENTATIVE TIMELINE

- 9:00-9:30 - Check-in ~
- 9:30-10:00 - students are all here ready to go. We will start with an ice breaker
    - Unifix Cube game ~
        - Pink: What school do you go to?
        - Purple: What is your favorite after school activity?
        - Blue: Where is your favorite place to go on vacation?
        - Yellow: How do you see science in your everyday life?

        - Orange:What is your favorite thing about science?
        - Green: What are ways that you save the planet?
- 10:00-10:15 - Transition/Explanation of what is coming next
- 10:15-10:45 - Creating greenhouses
    - Each table is creating a greenhouse (1 per table) but they are building it together
    - Three Major Features of a Greenhouse:
        1. Enclosed
        2. Traps Sunlight (heat)
- 10:45-11:00 - Snack ~
- 11:00-11:15 - Calculating Carbon Footprints ~
    - On the iPads
    - If we run out of time for the iPads, put it up on the board and go through the small assessment as a whole class
    - https://docs.google.com/a/umail.iu.edu/presentation/d/1U20dKKYo7qVNVjEyCeM7d-X57rYO5U33AAHzqvxEN38/edit?usp=sharing
- 11:15-11:55 - Assessing the Greenhouses ~
    - Take the temperature of the inside of the greenhouse gases
    - Talk about what a greenhouse gas is
        - https://www.youtube.com/watch?v=BPJJM_hCFj0
    - Connect it to the inside of the greenhouse which should be thought of as Earth
        - Why might the temperature be higher inside?
        - If we think about the Earth, how is the greenhouse similar?
    - Have a discussion about what the students can do in order to make the world healthier.
- 11:55-12:00- Clean-up time

G) DESCRIPTION OF YOUR LESSON

ENGAGE : We will start our lesson by talking about greenhouses and having students explain what they think they do and how it is comparable to Earth.

- M&M ice breaker with questions about Earth.
- Bring in different topics that we will be talking about with the students: What a greenhouse is and how it relates to Earth? Why can it be bad?
- Show short video on what a greenhouse is.

~30 minutes

EXPLORE: Students will have a chance to build their own greenhouse with a group. This lets them explore the different aspects of a greenhouse.

- Some good questions for this time might be:
    - Do you think it's important that it's clear?
    - Does temperature matter?
    - What materials are best for creating this?
- During this part of the activity, the students will be able to create their own greenhouses using different materials that their group is given. After they complete their greenhouses, they will measure the temperature of each greenhouse and record it on the chart (chart on the board).
- The greenhouses will then be set under a heat lamp in order to model how the planet heats up from greenhouse gases. In this activity the lamp will represent the sun and the greenhouses will represent Earth's atmosphere.
- After the students eat their snack, they will continue their exploration with calculating their carbon footprints. This will either happen as a class or individually with iPads. iPads will be set up with the website that the students will be visiting to ensure the transition is smooth.

~45 minutes

EXPLAIN: Students will find their own carbon footprint in order to explain why greenhouses and greenhouse gases are important.

- Important topics to discuss will be:
    - Can you make changes to help the Earth?
    - What types of things give off greenhouse gases?
- During this part of the activity, the students will be able to take the temperature of the inside of the greenhouse in order to see what happens to the Earth the hotter that it gets. The students will then be able to record their findings of the different types of greenhouses on the board as a class for a discussion later on.
    - 2 liter bottles
    - Straws and plastic wrap
    - Clear plastic cups taped together

~15-20 minutes

ELABORATION: We will hold a discussion about how different aspects of the greenhouses are like Earth and what people might do inside Earth

that affects the atmosphere in terms of greenhouse gases. We will also discuss the results from the greenhouse building activity. We will talk about how how the greenhouses they built in class relate to the greenhouse effect that is happening on Earth. Questions might include:

- What do people and greenhouse gasses have in common?
- How do people affect the Earth?
- Can we make less of an impact?
- How does the Earth and its atmosphere relate to the greenhouses built in class

~45 minutes

H) EMBEDDED FORMATIVE ASSESSMENT (the 5th "E")

- We will know the students understood the lesson if they are able to explain why the air inside their greenhouses is warmer than the air in the room. This will happen during a discussion at the end of the lesson. (Elaboration)
- We will know the students understood the lesson if they are able to understand ways to reduce their carbon footprint through the iPad activity. This will happen during a discussion after the students complete the iPad activity. (Explain)
- What school do you go to? (Engage)
- What is your favorite after school activity? (Engage)
- Where is your favorite place to go on vacation? (Engage)
- How do you see science in your everyday life? (Engage)
- What is your favorite thing about science? (Engage)
- What are ways that you save the planet? (Engage)

I) GEARING UP/GEARING DOWN

1. Gearing up:

- Discuss the different greenhouse gases in more detail such as water vapor, carbon dioxide, methane, ozone, and nitrous oxide.

2. Gearing down:

- Have examples of greenhouses already built for students to reference.
- Walk the students through the iPad activity on the projector.

Q405 Saturday Science Teaching – Fall 2017
Lesson Plan Week 2
SAVE THE PLANET
WATER POLLUTION

4-5

A) LEARNING OBJECTIVES and CRITERIA FOR DETERMINING IF OBJECTIVES ARE MET (minimum of 2/ lesson)

- Students will be able to identify what water pollution does to the planet.
- Students will be able to learn different ways to clean the water that has been polluted.
- Students will be able to create a device to remove pollution/objects from water.

B) STANDARDS (see http://www.doe.in.gov/standards/science)

- **Science and Engineering Process Standards:**
    1. SEPS.1 Posing questions (for science) and defining problems (for engineering).
    2. SEPS.2 Developing and using models and tools.
- **Content Standards:**
    1. 5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
    2. 4.ESS.4 Develop solutions that could be implemented to reduce the impact of -humans on the natural environment and the natural environment on humans.

C) MATERIALS (**asterisk (*)** = any materials that may be a **safety concern**)

- 12 LARGE aluminum pans (2 for each table)
- 4 two liter bottles of oil
- Two black stackable sifters
- 6 sponges
- 2 bottles of dish soap
- 24 feathers
- Paper towels (in the classroom)
- 6 Pipettes
- 6 tongs/assortment of gardening tools
- 24 pairs of disposable/rubber gloves
- 6 cups of soil
- Pieces of trash (brought in by us)
- 5 pool noodles
- Netting (either six separate nets or enough to cut into six that are around 10X10 or bigger)
- String or rope (20 ft.?)
- 2 hot glue guns

- Food coloring
- Plastic bucket/tote (only if Jordan River water levels are too low)
    - A plastic bottle or funnel.
    - A vase.
    - Gravel.
    - Activated Charcoal.
    - Clean sand.
    - Cotton.
    - Dirt.
    - Water.

D) TEACHER CONTENT KNOWLEDGE

- Water pollution is when particles, chemicals, or substances that make water contaminated are discharged directly or indirectly into bodies of water without proper treatment to get rid of harmful compounds
- 40% of America's rivers and 46% of America's lakes are too polluted for fishing, swimming, or aquatic life.
- Effects of water pollution
    - Death of aquatic animals
    - Disruption of food chains
    - Diseases
    - Destruction of ecosystems

E) REFERENCES (list **ALL** references that you borrowed ideas from to develop this lesson – including any handouts you may distribute)

- -http://onetimethrough.com/water-pollution-for-kids-fun-science-activities/
- -http://onetimethrough.com/inspiring-kids-to-protect-our-oceans-oil-spill-activity/
- -http://gironlife.blogspot.com/2010/04/experiment-can-you-undo-water-pollution.html
- https://www.youtube.com/watch?v=6IjaZ2g-21E

F) TENTATIVE TIMELINE

- 9:30-10:00 - Ice Breaker/Game
    - Beach Ball Questions
- 10:00-10:45 - Water Clean-Up with Buckets
- 10:45-11:00 - Snack/Create Filters
- 11:00-11:50 - Create Filters/Take them Outside to the Jordan River
- 11:50-12:00 - Walk back and leave

G) DESCRIPTION OF YOUR LESSON

ENGAGE:

- To begin the lesson, we will have the students explore how to remove pollution from water on a small scale.
    - There will be pans of water with food coloring in them on each table with different pollutants in it, such as oil, trash, and feathers. We will give the students different tools to try to clean the water.
    - We will ask the students questions such as:
        - What tool worked the best to remove the pollutants?
        - Did any of the tools not work at all?
        - What pollutant was the hardest to remove from the water?
- We will introduce the focus question: How can we take what we learned about removing pollution from water in this activity to bigger bodies of water?
    - This question will help us move into the next activity of creating filters to take to the Jordan River.

EXPLORE

- Students will be shown three different types of filters and be allowed to choose which one they actually want to create. The students will be given the option to work in a group or individually. During this time, the students will have the option to record their designs if they choose to, but the main goal is getting them to think about why their filters will work.
    - We will ask them questions such as:
        - Why is the filter you made going to work to remove pollutants from the water?
        - What are features of your filters that you find important?
        - What kind of pollutants are you trying to remove with your filter?
    - https://www.youtube.com/watch?v=nBVL3lp9fGo (smaller ocean filter)
    - https://www.youtube.com/watch?v=6IjaZ2g-21E (big ocean filter)
    - https://www.youtube.com/watch?v=tPP_Yn2w2Sk (water purification filter for drinkable water)

- http://news.nationalgeographic.com/2017/02/mr-trash-wheels-professor-trash-wheels-baltimore-harbor-ocean-trash-pickup/ (Picture of googly eye conveyor belt trash collector)
- After the students work to create their own filter, we will take them out to the Jordan River in order to test how well it will clean up the water. If the water level is too low, we will recreate this is the classroom using a plastic bucket with water in it for the students to use their filters.
  - We will ask them questions such as:
    - How are your filters working?
    - Do you think any of the filters we used inside would work to clean the water out here?

EXPLAIN

- Students and teachers will discuss what is effective in trash removal from water.
  - What trash was hard to remove?
  - What makes it difficult to remove trash from water?
- Students and teachers will have a discussion about why some of the devices are or are not working.
  - What device worked the best?
    - Why do you think it was the most effective?
  - What device did not work?
    - Why do you think it was the least effective?
- Students and teachers will discuss how the small scale of the aluminum pan pollution (Engage phase) relates to the large scale of the Jordan river pollution (Explore phase).
  - Was removing trash easier or harder in a real life situation?
  - How did your group make a device so that animals/wildlife were not harmed?

ELABORATION

- We will have a conversation about what were some of the good and bad things about each of the devices removed trash the best. We want to lead the conversation towards why this is important but also what the downfalls could be.
  - Questions
    - What were the best devices?
    - Why were they effective?
    - How could these be bad?

- What would you do differently in the future?

H) EMBEDDED FORMATIVE ASSESSMENT (the 5th "E")

- We will know that the students understand the detrimental effects of pollution if they are able to answer the questions:
  - What tool worked the best to remove the pollutants? (Engage)
  - Did any of the tools not work at all? (Engage)
  - What pollutant was the hardest to remove from the water? (Engage)
  - How are your filters working? (Explore)
  - Do you think any of the filters we used inside would work to clean the water out here? (Explore)
  - Was removing trash easier or harder in a real life situation? (Explain)
  - How did your group make a device so that animals/wildlife was not harmed? (Explain)
  - What were the best devices? (Elaborate)
    - Why were they effective? (Elaborate)
    - How could these be bad? (Elaborate)
    - What would you do differently in the future if you had to improve your device? (Elaborate)
- We will be assessing the student's ability to create some sort of device to remove trash/pollution from the ocean

I) GEARING UP/GEARING DOWN

1. Gearing up:

- Discuss how real water filters work and how they make water safe to drink
- Discuss oil spills that have happened in the ocean and how they have affected marine life in those areas

2. Gearing down:

- Demonstrate ways students can try to separate the oil from the water
- Have an example of the different types of water filters

A) LEARNING OBJECTIVES and CRITERIA FOR DETERMINING IF OBJECTIVES ARE MET (minimum of 2/ lesson)

- Students will be able to create their own source of wind energy.
- Students will be able to explain how wind energy can help our planet.
- Students will be able to measure the different materials that they will be using to make their windmills.

B) STANDARDS (see http://www.doe.in.gov/standards/science)

- **Science and Engineering Process Standards:**
    1. SEPS.2 - Developing and using models and tools
    2. SEPS.4 - Analyzing and interpreting data
- **Content Standards:**
    1. 4.PS.4 - Describe and investigate the different ways in which energy can be generated and/or converted from one form of energy to another form of energy.
    2. 4.PS.5 - Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.
    3. 4.ESS.4 - Develop solutions that could be implemented to reduce the impact of humans on the natural environment and the natural environment on humans.

C) MATERIALS (**asterisk (*)** = any materials that may be a **safety concern**)

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- Craft sticks/popsicle sticks
- Bamboo skewers
- Paper
- Card board
- Tape
- Hot glue guns
- Pencils
- 6 rulers
- Scissors
- Plastic cups i
- 2 liter bottles (as many as we can have)
- Tissue paper
- 1 roll of saran wrap
- 3 Vernier photogate sensors
- 3 labquests

D) TEACHER CONTENT KNOWLEDGE

- Windmills collect the energy from the wind and store it.
- Energy can be transferred from wind to electrical energy
- When windmills turn, the energy is transferred to a generator that takes the wind energy and transforms it into electrical energy

E) REFERENCES (list **ALL** references that you borrowed ideas from to develop this lesson – including any handouts you may distribute)

- http://sciencing.com/make-windmill-school-project-6600557.html
- http://www.alliantenergykids.com/wcm/groups/wcm_internet/@int/@aekids/documents/document/mdaw/mdiy/~edisp/022818.pdf
- https://www.youtube.com/watch?v=niZ_cvu9Fts&t=57s
- https://www.youtube.com/watch?v=EoLv4rhFsMk
- 1 sheet per table (6) with their family's scenario on it
- 1 sheet per table (6) with positives of getting a windmill
- 1 sheet per table (6) with negatives of not getting a windmill

F) TENTATIVE TIMELINE

- 9:30-9:45 - Seating chart & address rules (1,2,3)
  - Allow students to help create expectations
  - The students will be creating our own "classroom norms/rules" as a group
- 9:45-10:15 - Farm scenario
  - Students will each be given a scenario with each table group and working through how to conserve their money in order to put windmills on their property
- 10:15-10:30 - Discussion about farm scenarios
- 10:30-10:45 - Snack/Video
  - https://www.youtube.com/watch?v=niZ_cvu9Fts&t=57s
- 10:45-11:30 - Create Windmills
- 11:30-11:45 - Testing the Windmills/Showing how they work
  - https://www.youtube.com/watch?v=EoLv4rhFsMk (2:30-End)
  - Students will be allowed to test and recreate their windmills three times in order to create the best windmill that they possibly can
- 11:45-12:00 - Discussion about windmills

G) DESCRIPTION OF YOUR LESSON

ENGAGE

- To begin the lesson, each table group will get a scenario where they own farms of varying sizes. They will be given an amount of money that their farm brings in every month, along with a list of

living expenses that they can choose from. There will be a packet on each table that provides the students with their families scenarios, the positives of adding a windmill to their farm, and the negatives of adding a windmill to their farm. The students will have to decide whether or not it would be a good idea for their family to add windmills to their farms based on their income, expenses, and the positives and negatives of the windmill additions.

- Focus questions for discussion:
  - What did you choose to do to make extra money for your farm? Why?
  - What are the pros and cons of windmills?

EXPLORE

- During this section of the lesson, students will be instructed to design and create their own windmills. After the students are given a bit of background information on what aspects of a windmill will work the best and model their own windmills after what they think they will need to include in their windmills. The students will get to do three trials and have the chance to make modifications to their windmills based on what they are learning about the design of their particular windmill in each trial. While the students are creating their windmills, we will be floating around the room and asking students some of the following questions:
  - How did you decide to design your windmill?
  - What do you think will make your windmill work the best? What about this design will make it spin the fastest?
  - Why did you choose to build your windmill with the materials that you chose? How will those materials contribute to speed

EXPLAIN

- We will play a video that shows a homemade windmill that does transfer energy to a light so that students can see how their windmills would work if we were able to spin them fast enough
- Explain different types of energy transformation to students
- We will then have a class discussion about why our windmills did not work
  - How did the windmill in the video transfer energy to the light?

- Discuss why some of their windmill creations spun faster than others
    - What designs worked well? What designs did not?
    - What designs would be more suitable for a backyard in town?
    - Would any of your designs possibly be harmful to birds or other animals?

ELABORATION

- We will have a discussion about the impact that windmills can have on the environment. We will discuss the positives and negatives that are associated with them. We will also talk about which designs they think work best. We want to have the students think critically about whether they think the benefits outweigh the costs.
    - Questions
        - What are pros of windmills?
        - What are cons of windmills?
        - How do windmills impact the environment?
        - If you had the resources, would you be for or against putting up a windmill by your house or in your town?

H) EMBEDDED FORMATIVE ASSESSMENT (the 5th "E")

- The formative assessment in this lesson will be done throughout the time that they are creating and designing their own windmills in order to see if they are understanding what it takes to make a windmill. There will also be another formative assessment while we are discussing how we created our windmills in order to see if the students understand why our windmills are not creating energy.
    - What did you choose to do to make extra money for your farm? Why? (Engage)
    - What are the pros and cons of windmills? (Engage)
    - Why does the government give money to farms that have windmills? (Engage)
    - What are pros of windmills? (Elaboration)
    - What are cons of windmills? (Elaboration)
    - How do windmills impact the environment? (Elaboration)
    - If you had the resources, would you be for or against putting up a windmill by your house or in your town? (Elaboration)
    - How did the windmill in the video transfer energy to the light? (Explain)
    - What designs worked well? What designs did not? (Explain)

- What designs would be more suitable for a backyard in town? (Explain)
- Would any of your designs possibly be harmful to birds or other animals?(Explain)

I) GEARING UP/GEARING DOWN

1. Gearing up:

- Discuss the inner workings of a windmill with students.

2. Gearing down:

- Have examples of windmills already built for students to reference.
- Have a teacher at each table to help with decisions and math during farm scenarios.

Q405 Saturday Science Teaching – Fall 2017
Lesson Plan Week 4
SAVE THE PLANET
SOLAR POWER - ENERGY CONSERVATION
4-5

A) LEARNING OBJECTIVES and CRITERIA FOR DETERMINING IF OBJECTIVES ARE MET (minimum of 2/ lesson)

- Students will be able to identify another way to conserve energy.
- Students will be able learn what that means for the planet.
- Students will be able to create their own example of how to use solar energy.

B) STANDARDS (see http://www.doe.in.gov/standards/science)

- **Science and Engineering Process Standards:**
  - SEPS.2 - Developing and using models and tools.
  - SEPS.6 - Constructing explanations (for science) and designing solutions (for engineering).
- **Content Standards:**
  - 3-5.E.1 - Identify a simple problem with the design of an object that reflects a need or a want. Include criteria for success and constraints on materials, time, or cost.
  - 4.ESS.4 - Develop solutions that could be implemented to reduce the impact of humans on the natural environment and the natural environment on humans.
  - 4.PS.5 - Make observations to provide evidence that energy can be transferred from place to place by sound, light, heat, and electric currents.

C) MATERIALS (**asterisk (*)** = any materials that may be a **safety concern**)

- Stuff for Smores
  - Chocolate
  - Graham Crackers
  - **MINI** Marshmallows
- Aluminum Foil (3)
- Saranwrap (3)
- Shoe boxes (6)
- Black construction paper (10 pieces)
- Scissors
- Masking tape
- Bamboo skewers (no pointy ones if possible)
- Heat lamps (6/as many as possible)
- Potting soil
- Sand
- Aluminum pie pans (3)
- Thermometers (12)
- Ping Pong Balls (lots of them/100)
- 8 small baskets

D) TEACHER CONTENT KNOWLEDGE

- Solar energy in the form of heat and light sustains life on Earth.
- Solar energy can also be collected, stored and put to work by converting it to pollution-free thermal (heat) energy and electricity.
- When conditions are right, the basic method of putting the sun's rays to work is in passive heating. Here, no mechanical devices are used and heat energy

moves by convection in heating homes or pools of water. Building constructions such as large windows facing the sun contribute to passive solar power heating.

- Solar energy is unlimited and harnessing it for heat and electricity produces no air or water pollution. The development of solar energy technologies can only help our environment by decreasing CO_2 emissions and reducing drain-off pollution from fossil fuel power plants.

E) REFERENCES (list **ALL** references that you borrowed ideas from to develop this lesson – including any handouts you may distribute)

- https://www.kiwico.com/diy/Science-Projects-for-Kids/3/project/Solar-Oven/2624?utm_source=Pinterest&utm_medium=SOCIAL&utm_content=Kiwi&utm_campaign=DIY&utm_term=Solar%20Oven
- https://www.youtube.com/watch?v=qofh1vy2XzI
- https://www.youtube.com/watch?v=av24fEMhDoU
- Solar oven observation sheets

F) TENTATIVE TIMELINE

- 9:30-9:40 - Explain that we are working with solar power and show a video of a solar oven
  - https://www.youtube.com/watch?v=qofh1vy2XzI
- 9:40-10:15 - Have the students create their solar ovens
- 10:15-10:30 - Snack and check s'mores
  - https://www.youtube.com/watch?v=av24fEMhDoU
- 10:30-11:30 - Ping Pong Ball Activity
- 11:30-12:00 - Discussion of Solar Ovens and **EAT S'MORES**

G) DESCRIPTION OF YOUR LESSON

ENGAGE

- To begin the lesson, we will gauge what the students already know about solar energy by having a discussion about it. We will talk about the benefits of solar energy and why it is important. We will also show a video about constructing solar ovens.
  - Questions:
    - What do you already know about solar energy?
    - What are ways you see solar energy in your everyday life?
    - Why do we need solar energy/why is it important?

EXPLORE

- During this portion of the lesson, the students will be instructed to design and create their own solar ovens. Each table group will be provided with a set of materials for one solar oven to be made. While the students are creating their solar ovens, we will be floating around asking groups some questions about their design.
    - Questions:
        - What materials will capture the heat the best?
        - Why do you think those materials will capture the heat the best?
        - How is this simulation similar to a real life situation?

ELABORATION

- During this portion of the lesson, we will take the students to the atrium in the School of Ed. to explore how different types of energy sources work. Each of the groups will be given a different types of renewable (wind & solar) and nonrenewable energy (natural gas & coal). The groups will then be given the same task (to get ping pong balls into the basket). The students will then get into their groups and begin their tasks with the stipulations below popping up and different points. After this activity, we will then have a discussion about which types of energy were more efficient and talk about which types of energy are harder and easier to get to/use.
    - Wind Energy will move their balls by pushing them with their breath.
        - Part of the way through the activity they will lose "wind power" and must wait for more.
    - Solar energy will move their balls by running.
        - They must stop during the "night" or when the clouds are out as there is no solar energy reaching them.
    - Natural Gas will move their balls by walking.
        - Part of the way through the activity, they will run out of natural gas and must move to a farther location to obtain more.
    - Coal will move their balls by crawling.
        - Part of the way through the activity, they will run out of coal and must move to a specific location (ex: touch a bench before going to the coal) before going to the original location to obtain more coal.

EXPLAIN

- For this part of the lesson, the students will take their solar ovens out of the vent hood and see how much their marshmallows melted. We will have a discussion with the students about why the materials they used melted the marshmallows and which materials worked the best. We will also go over the worksheet they filled out when they checked their ovens while they were heating up in the oven.
    - Questions:
        - Why did the marshmallows melt?
        - What do the lamps represent?
        - What kinds of observations did you make while your ovens were heating up (written on worksheet)?
        - How does the energy from the lamps (light energy) transfer to melting the marshmallow (heat energy)?
        - Do you think using the sun for energy is a good idea?

H) EMBEDDED FORMATIVE ASSESSMENT (the 5th "E")

- What do you already know about solar energy? (Engage)
- What are ways you see solar energy in your everyday life? (Engage)
- Why do we need solar energy/why is it important? (Engage)
- What materials will capture the heat the best? (Explore)
- Why do you think those materials will capture the heat the best? (Explore)
- How is this simulation similar to a real life situation? (Explore)
- Why did the marshmallows melt? (Explain)
- What do the lamps represent?(Explain)
- What kinds of observations did you make while your ovens were heating up? (Explain)
- How does the energy from the lamps (light energy) transfer to melting the marshmallow (heat energy)? (Explain)
- Do you think using the sun for energy is a good idea? (Explain)

I) GEARING UP/GEARING DOWN

1. Gearing up:

- Have students construct a non-traditional style solar oven.

2. Gearing down:

- Show extra videos explaining how to construct a solar oven.
- Teacher gives direct help to student while constructing their oven.

Q405 Saturday Science Teaching – Fall 2017
Lesson Plan Week 5
SAVE THE PLANET
HYDROELECTRICITY
4-5

A) LEARNING OBJECTIVES and CRITERIA FOR DETERMINING IF OBJECTIVES ARE MET (minimum of 2/ lesson)

- Students will be able to explore a different source of renewable energy that can produce electricity
- Students will be able to construct their own water turbines
- Students will be able to discuss the benefits of using water energy

B) STANDARDS (see http://www.doe.in.gov/standards/science)

- **Science and Engineering Process Standards:**
  - SEPS.2 - Developing and using models and tools.

- SEPS.6 - Constructing explanations (for science) and designing solutions (for engineering).

 Content Standards:

- 4.ESS.4 Develop solutions that could be implemented to reduce the impact of humans on the natural environment and the natural environment on humans.
- 5.ESS.3 Investigate ways individual communities within the United States protect the Earth's resources and environment.
- 3-5.E.1 Identify a simple problem with the design of an object that reflects a need or a want. Include criteria for success and constraints on materials, time, or cost.

C) MATERIALS (**asterisk (*)** = any materials that may be a **safety concern**)

- 12 small wine bottle corks
- 6 two liter bottles
- 20 wooden skewers
- 3 exacto knives (only teachers will be using these to prep before the lesson)
- 50 paper clips
- 6 regular size funnels
- A bundle of yarn or other type of string
- 6 things of masking tape
- 24 pairs of scissors
- 50 plastic cups
- 6 rulers
- 30 pieces of computer paper
- 6 packs of markers or colored pencils

D) TEACHER CONTENT KNOWLEDGE

- Hydroelectricity is is electricity produced by moving water.
- There are multiple types of hydroelectricity
    - Dams
    - Pumped Storage
    - Run-of-the-River
    - Tide
- The most common type of hydroelectric power plant uses a dam on a river to store water in a reservoir. Water released from the reservoir flows through a turbine, spinning it, which in turn activates a generator to produce electricity.
- Wind energy can be harvested by wind turbines and solar energy can be harvested by solar panels and other media that trap the sun's heat.

- There are multiple different ways energy can be conserved in our homes and other places that we visit. Some examples are:
    - turning off the lights when not in the room
    - leaving lights off when it is daylight
    - turning off the water while brushing their teeth
    - making sure the dishwasher is full before running it
    - unplugging electronics when not in use
- Although renewable energy has been a coined term when discussing solar, wind, and hydro power, these sources of energy are not completely renewable and we must still try to conserve as much energy as we can to produce less waste and not harm the environment.

E) REFERENCES (list **ALL** references that you borrowed ideas from to develop this lesson – including any handouts you may distribute)

- https://www.education.com/science-fair/article/water-produce-energy/
- https://www.youtube.com/watch?v=q8HmRLCgDAI
- https://www.youtube.com/watch?v=pTKNT7Do3xM
- https://www.youtube.com/watch?v=ABv631t1OKI
- https://www.youtube.com/watch?v=x8xow_R0YRI

F) TENTATIVE TIMELINE

- 9:30-10:00 - Discussion about water energy/hydroelectricity/video (Bill/Gary)
    - https://www.youtube.com/watch?v=q8HmRLCgDAI
- 10:00-10:45 - Creating & testing water turbine
- 10:45-11:00 - Snack
    - https://www.youtube.com/watch?v=pTKNT7Do3xM
    - https://www.youtube.com/watch?v=ABv631t1OKI
- 11:00-11:20 - Discussion combining all the types of energy we have discussed throughout Saturday Science
- 11:20-12:00 - Students will create their "Eco Houses" on paper

G) DESCRIPTION OF YOUR LESSON

ENGAGE

- To begin the lesson we will have a discussion about water energy and hydroelectricity to gauge what students already know and to get the stage set for the rest of our activities. We will then watch a video that describes how hydroelectricity works and one that shows how to make a water turbine (https://www.youtube.com/watch?v=q8HmRLCgDAI) (https://www.youtube.com/watch?v=x8xow_R0YRI)

- Questions
  - What are potential sources that can produce energy?
  - What do you know about water energy?
  - What are some different ways you think water energy can be generated?

EXPLORE

- During this part of the lesson, each table group will be instructed to design and create a water turbine to move the paper clip that is attached to. After each group is finished creating their water turbines, they will test the rotational force on the water wheel. Teachers will walk around to each table asking guiding questions to enhance students' ideas and thoughts.
  - What is the size of your turbine blades? Do you think this matters in collecting energy?
  - What do you think the paper clips represent?
  - How can we recreate this on a bigger scale? What do we need?

EXPLAIN

- For this part of the lesson, the students will participate in a discussion about all the different types of energy that we have covered thus far in Saturday Science (solar power, wind power, natural gas, coal, and hydropower). We will draw a chart on the board to track the students' responses. For each type of energy, the students will explain how it is obtained, positives for that type of energy, and negatives for that type of energy. Some guiding questions that will facilitate this discussion include:
  - Which of these types of energy are renewable and which are nonrenewable?
  - Are all these types of energy able to be used in every place or are certain types of energy better depending on geographical features?
  - What kind of energy would you like to use to power your own house?

ELABORATION

- For this portion of the lesson students will design eco houses that contain different sources of renewable energy and explain different ways they can conserve energy. We want the students to incorporate

ways to conserve energy into their houses. We will begin by telling them that even though some sources of energy are renewable, it is still important to conserve as much energy as we can in our everyday lives to ensure we produce as little waste as possible and not cause further harm the environment. We will have a short discussion about ways they would be able to conserve energy in their eco houses. Some of their responses could be:

- turning off the lights when not in the room
- leaving lights off when it is daylight
- turning off the water while brushing their teeth
- making sure the dishwasher is full before running it
- unplugging electronics when not in use

Students will then be prompted to draw a cross-section of their eco house with their table groups (we will provide an example for this). Things they should include in their drawings are:

- The outline of their house with all the rooms labeled
- A drawing of the source of renewable energy either near the house or on the house (solar power - solar panels, wind power - wind turbine, or hydropower - water turbine and source of water) that their house is going to run on (can be multiple sources)
- Color using markers or colored pencils
- A star in each room where they plan to conserve energy

In addition to their drawings, students will complete a graphic organizer that details what form of energy they will be using and a minimum of five ways they plan to conserve energy in their house. Link to graphic organizer: https://docs.google.com/document/d/19o3lEwZiWX1m71kt1yFjNHbUm5-7yelzqtVeVIhbKCQ/edit?usp=sharing

As students are working, the teachers will walk around and ask questions such as:

- Why did you chose that source of energy?
- What happens if there is no wind, sunlight, or moving water? (depending on their source of energy)
- Do you think using renewable energy is the best option or would you like to have chosen coal or natural gas that we talked about earlier as the energy source?

At the end, the students will share their drawing, what energy source they have chosen and why, and explain ways in which they will

conserve energy in their house.
**We will be flexible with the students working in groups. They will have the choice of the people at their table to work with either as a whole group, or in pairs, or they can work alone. The teachers will make sure all the students are being included because the students will be given this freedom.

H) EMBEDDED FORMATIVE ASSESSMENT (the 5th "E")

- What are potential sources that can produce energy? (Engage)
- What do you know about water energy? (Engage)
- What are some different ways you think water energy can be generated? (Engage)
- What is the size of your turbine blades? Do you think this matters in collecting energy? (Explore)
- What do you think the paper clips represent? (Explore)
- How can we recreate this on a bigger scale? What do we need? (Explore)
- Which of these types of energy are renewable and which are nonrenewable? (Explain)
- Are all these types of energy able to be used in every place or are certain types of energy better depending on geographical features? (Explain)
- What kind of energy would you like to use to power your own house? (Explain)
- Why did you chose that source of energy? (Elaboration)
- What happens if there is no wind, sunlight, or moving water? (depending on their source of energy) (Elaboration)
- Do you think using renewable energy is the best option or would you like to have used coal or natural gas that we talked about earlier? (Elaboration)

I) GEARING UP/GEARING DOWN

1. **Gearing up:** Students can try to make a different style of turbine than shown in the video
2. **Gearing down:** Teachers will help guide students during the construction of their turbines