**(AP) ENVIRONMENTAL SCIENCE 2021-22 December 2, 2021**

**Today’s Agenda (Day 66)**

1. Housekeeping Items

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1. Homework Check:

🡪 Biodome: Data Observations & Photos - Week 3

🡪 Chapter 8 & 9 Vocabulary

🡪 Lab Reports: Natural Gas, Strip Mining, Cookie Mining

1. Class Activity:

🡪TEST: Chapter 8

 \*Go to [www.socrative.com](http://www.socrative.com) 🡪 enter room “MSBENVIRO” 🡪 enter ID #

🡪FRIDAY: Chapter 9 PPT Review

1. Section 9.1 - Major Energy Sources
2. Section 9.2 - Resources and Reserves
3. Section 9.3 - Fossil-Fuel Formation
4. Section 9.4 - Issues Related to the Use of Fossil Fuels
5. Section 9.5 - Nuclear Power

HOMEWORK:

* READ: Chapter 9 – Nonrenewable Energy Sources
* COMPLETE: Lab Reports: Biodome Project
* STUDY: Chapter 9 Tests

Chapter 8 & 9 Vocabulary

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Absorbed dose | Acid mine drainage | Alpha radiation | Anthracite | Beta radiation | Bituminous |
| Black lung disease | Coal | Crude oil | Dose equivalent | Fissionable | Fossil fuels |
| Gamma radiation | Hydraulic fracturing (fracking) | Industrial Revolution | Ionizing radiation | Lignite | Liquified natural gas |
| Mountaintop removal | Natural gas | Nonrenewable energy sources | Nuclear chain reaction | Nuclear fission | Nuclear reactor |
| Oil shale | Open pit mining  | Ore | Overburden | Peat  | Petrochemicals |
| Petroleum (crude oil) | Plutonium-239 | Radiation | Radioactive | Radioactive half-life | Renewable energy sources  |
| Reserves  | Resource | Smelting | Spoils | Strip mining | Surface mining |
| Tar sands | Underground mining | Uranium-235 |  |  |  |

REMINDERS:

* **QUIZ: Chapter 8\_9 Vocabulary 🡪 Dec. 8**
* TEST: Chapter 9 **🡪 Dec. 9**
* **MIDTERM: Chapters 1 - 10**

|  |  |
| --- | --- |
| ~~Biodome Design Project Workbook~~ | ~~Nov. 2~~ |
| ~~Biodome (pre-growth)~~ | ~~Nov. 5~~ |
| ~~Biodome (biotic set-up)~~ | ~~Nov. 8~~ |
| ~~Data Observations & Photos - Week 1~~ | ~~Nov. 12~~ |
| ~~Data Observations & Photos - Week 2~~ | ~~Nov. 19~~ |
| ~~Data Observations & Photos - Week 3~~ | ~~Nov. 26~~ |
| Lab Report - Final | Dec. 4  |
| Power Point Presentation | Dec. 4  |
| Project Presentations | Dec. 13-14 |

**(AP) ENVIRONMENTAL SCIENCE 2021 -22 Lab Activity**

**APES- Cookie Mining Activity**

**Background Information:**

Fossil fuels *(natural gas, oil and coal)* are created by the decomposition of dead plants and animals over millions of years and with a little help from high temperatures and high pressures.

The fuels contain stored potential energy that originally came from the Sun. Fossil fuel extraction *(harvesting of coal, oil and natural gas)* can be very damaging to ecosystems. Coal mining can strip the surface of the Earth, leaving desolate areas permanently damaged. Petroleum extraction or transportation can spill and kill wildlife or soak through the aquifer to contaminate our water supply. Our government creates laws to protect the environment and levies fines to companies that damage the environment due to accidents or damaging extraction methods. **Ninety percent** of the energy we use in the United States comes from fossil fuels. The U.S. uses more than ***17 million barrels of oil everyday account for over 40% of our country’s energy.***  Stored chemical energy in coal is converted into the thermal energy of steam when the coal is burned. This thermal energy, in turn, is converted to mechanical energy that spins turbines to create electricity. Coal is used to produce almost ***60% of our nation’s electrical power and accounts for 22% of our overall energy consumption.***  The third form of fossil fuel, ***natural gas, accounts for almost 23% of our usage.***  Each American uses an average of 7 gallons of gasoline every day. **The United States only has 5% of the world’s population but consumes 26% of the world’s energy.**

**Purpose:** *The purpose of this activity is to simulate a mining operation. In order to simulate a real mining operation:*

* *A land area will be purchased from the bank*
* *The land area will be surveyed and quantified*
* *Mining equipment will be purchased from the bank*
* *A mining operation will be undertaken, with the cost for each minute of the mining operation included in the total operating costs*
* *At the conclusion of mining operations, the reclamation of the land area is required, with a fine assessed for any part of the land that is not successfully reclaimed*
* *The ore that was mined will be sold back to the bank to offset the start-up costs of the mining operation*

**Procedure:**

1: Each miner must obtain a sheet of graph paper and purchase a land area (cookie), on credit, for the bank.

* **Mother’s Cookie- $3.00**
* **Chips Ahoy- $5.00**
* **Chips Deluxe- $7.00**

2: Each miner may purchase any combination of the following mining equipment, on credit, from the bank *(at least two items MUST be purchased)*

* **Flat Toothpick- $50,000**
* **Round Toothpick- $75,000**
* **Plastic Fork/Pick- $100,000**
* **Paper Clip- $100,000**

3: Following the purchase of the land and mining equipment, place the land on the graph paper, trace the outline of the cookie, determine the area of the cookie by counting the number of squares that fall inside the line *(count partial squares as full squares)*, and record the area of the cookie *(size of deposit).*

4: Once mining begins, the cookie is **ONLY TO BE TOUCHED BY MINING TOOLS.** The cookie **MAY NOT** be touched with fingers or hands. You MAY NOT blow crumbs off the paper at any time. Any part of the cookie that falls off the graph paper is considered “lost” and should not be retrieved until the simulation is complete.

5: Attempt to dig out as many chocolate chips as possible. The chocolate chips represent ORE and will be sold to the bank to offset the start-up costs of the mining operation.

Whole, clean, intact chocolate chips ONLY will be purchased for full price. 1/2 chips will only receive 1/2 price. The rest will be considered to be “overburden” and need to be disposed of appropriately.

6: The cost of the mining operation is **$10,000 per minute** and the **processing fee per chocolate chip is $1,500.**

7: After the cookie has been mined, reclamation must be attempted. Try to place all that remains of the cookie back into the circled area on the graph paper using the mining tools (remember, NO FINGERS or HANDS allowed!) Draw additional circles around each crumb that is not placed back in the circle and count the number of squares that fall inside all circles. The fine for **unsuccessful reclamation is $1,200 per square.**

8: When all mining and reclamation is complete and you are ready to sell your chocolate chips to the bank, arrange them in such a way that they may be easily counted, record the end time of the simulation, and raise your hand.

9: Answer the questions and summary while you are waiting for the bank to count up your ORE.

**Data Table (Resources)**

|  |  |  |
| --- | --- | --- |
|  | **Cookie #1** | **Cookie #2** |
| Cookie Area (#squares) |  |  |
| Mass-Unmined (g) |  |  |
| Mass of Ore (g) |  |  |
| Mass Difference (g) |  |  |

**Data Table (Mining Costs)**

|  |  |  |
| --- | --- | --- |
|  | **Fees $ (Cookie #1)** | **Fees (Cookie #2)** |
| Cookie Brand/Cost $ |  |  |
| Tool Rental Fees $ *(pick at least 2)* |  |  |
| Mining Costs *($10,000 per minute)* |  |  |
| Processing Fee *($1500 per chip)* |  |  |
| Labor Costs/Insurance | $2500 | $2500 |
| Reclamation Costs *($1200 per square)* |  |  |
| Overburden $1000 | $1000 | $1000 |
| **Total Mining Fees** |  |  |

**Data Table: Selling the Ore**

|  |  |  |
| --- | --- | --- |
|  | **Cookie #1** | **Cookie #2** |
| Whole Chips $10,000 each |  |  |
| 1/2 Chips $2500 each |  |  |
| Total $ Made |  |  |
|  | **Cookie #1** | **Cookie #2** |
| Total Mining Fees |  |  |
| Total $ Made |  |  |
| Difference ($) (-/+) |  |  |

***Questions/Analysis:***

1: Were the minerals evenly distributed throughout the cookie mines? *Explain how this relates to real mining.*

2: Were you able to “reclaim” the land after mining? **Discuss issues.**

3: Do you think the animals and plants in the area are affected by strip mining? How?

4: Can you think of anything humans can do to minimize the destruction of the environment when extracting fossil fuels? Explain.

5: Explain how the time required for mining is affected by the advanced knowledge that the land must be restored.

6: Explain why legislation that requires land to be restored after mining makes mining more expensive.

7: *Look up and outline* the **Surface Mining Control and Reclamation Act**:

8: Identify when and *discuss why* the Surface Mining Control and Reclamation Act was written.

9: Speculate about the citizens and organizations most likely to **support and oppose** the Surface Mining Control and Reclamation Act.

10: What was the purpose of this activity? What was learned?

**(AP) ENVIRONMENTAL SCIENCE 2021-22 PROJECT**

**BIODOME ENGINEERING DESIGN PROJECT**

Summary

In this multi-day activity, students explore environments, ecosystems, energy flow and organism interactions by creating a scale model biodome through applying the [engineering design process](https://www.teachengineering.org/k12engineering/designprocess). Students will develop their model biodome. Subjects include energy flow and food chains, basic needs of plants and animals, and the importance of decomposers. Students consider why a solid understanding of one's environment and the interdependence of an ecosystem can inform the choices we make and the way we engineer our own communities.

Engineering Connection

Every day, engineers adapt existing designs for housing, structures and cities so they work optimally in specific environments and ecosystems. To do this, engineers apply their understanding of the specific environment and biosphere, along with the concept of ecosystems to inform their designs and shape the human-built environment. Engineers employ the cyclical steps of the engineering design process to creatively brainstorm, design, prototype and create our human-made world.

### Learning Objectives

After this activity, students should be able to:

* Define a biodome and name its important features.
* Use the [engineering design process](https://www.teachengineering.org/k12engineering/designprocess) to create a model biodome of a particular environment.
* Describe how engineers use their understanding of the biosphere, ecosystems and community interactions to design our human-built environment.
* Plan, develop, and maintain a functioning enclosed mini-ecosystem.
* Describe the biogeochemical cycles and their relevance for survival of their mini-ecosystem.
* Demonstrate understanding of the role of abiotic and biotic factors in the energy flow within their mini-ecosystem.
* Demonstrate understanding of the interdependence of factors within their mini-ecosystem.

Materials List

**Each group needs: (Most items are available at hardware or garden center stores.)**

* 2 plastic containers (1- and 2-liter bottles with lids work well, or other inexpensive clear plastic trays, bowls, covers and lids) Well in advance, ask students to bring biodome construction materials from home, or rinse out plastic containers from a recycling bin.
* seeds (provide several types for different climates)
* soil (3-4 cups or .7-.9 l)
* sand (3-4 cups or .7-.9 l)
* supply of miscellaneous materials, such as pebbles, rocks, wire, small paper cups, plastic wrap, string, foil, popsicle sticks, chopsticks, etc.
* If insects are not available outside (due to the weather or other limitations), consider purchasing a small supply of “small creatures” from a pet store.

**Other items to consider:**

* masking tape
* duct tape
* glue (preferred: hot glue sticks with glue guns)
* scissors
* exacto knives (if teacher cuts the plastic bottles)
* butterfly nets and/or jars and paper cups (to catch and hold insects and worms)
* drill (to make a hole in plastic bottle lids)
* water

### Introduction/Motivation

Let's see what you know about different environments. Can anyone name an example of an environment? (Possible answers: Tropical rain forest, desert, other forest types [such as deciduous or coniferous], grassland prairie and arctic tundra.) All of these environments and ecosystems are part of our biosphere. The biosphere is the part of the Earth's atmosphere that supports life and includes both living (biotic) and nonliving (abiotic) things. It includes all the plants, animals, weather and climate. So, what happens when we have too many organisms in one environment? It may get too crowded! We call the number of organisms in a particular environment its population. Populations are made up of all the members of a species living in the same place at the same time. We learn about population numbers, or population density, to help us understand how much of resources (such as food, water and air) are available for each individual organism in an environment. Engineers need to know about the population density and how it is distributed so they can design areas for cities, parks, roadways, and even water systems so enough is available for a community to drink and use.

If you were able to design an environment, what would it look like? Would it have plants and animals in it? Which ones? How would you decide how many plants and animals you would put in your environment? Would you also live in your environment? How would you get the right amounts of air, water, and food for each of your plants and animals? Well, engineers actually design artificial environments that consider all of these things. These environments are called biodomes. A biodome is a model that is designed to represent a particular environment and the community of organisms that live there. Biodomes are used to study ecosystems and attempt to model how living and nonliving things interact in those natural environments. The goal of a biodome is to create an environment that has enough resources for every plant and animal, creating a balance or equilibrium. Engineers come up with all sorts of cool designs using the engineering design process and eventually they settle on one to create.

Biosphere 2 in Arizona, USA.

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Who knows something about the engineering design process? It is the set of steps that engineers take when they develop a new or improved product. Can you think of some of the steps an engineer may need to complete when designing something? Well, first they must have a problem or a need. Then, they brainstorm creative ideas and solutions to that problem or need. Next, they select the most promising idea, and draw or communicate the idea to others. Finally, they build a model of the design and evaluate whether that design is successful.

Who would like to become and engineer, learn more about environments, and create a biodome? Here is our challenge for this project:

Countries from all over the world have started a new project to create the best biodome yet! This new biodome will represent all the different climates and landscapes on the globe. The organizing committee has asked engineers from all different countries, including you, to help them in the design process. They request that you create a small-scale version – or prototype — of your design. Your design must only include one climate and landscape. When all the designs are done, one of them will be selected as the winner, to be built. So, it is time to put on your engineering hats and start thinking about how to make the best biodome. First thing to do is brainstorm your ideas and then make a drawing. Are you ready?

### Procedure

Figure 2. Students are creative in their open-ended model biodome designs.

**Part 1: Designing Your Biodome**

1. Working in groups of three, design a biodome structure of their own imagination.
2. Use the “Biodomes Engineering Design Sheet” to brainstorm/detail your ideas.
3. Decide on a name for your engineering design team.
4. Brainstorm ideas on what a biodome would contain for a given mini-environment. [YOUR CHOICE OF MINI-ECOSYSTEM.]
5. Draw a picture of their biodome design in the space provided in the Design Sheet. Detail the materials, soils, seeds, etc. needed to create and set up the mini-ecosystem housed in your biodome.

**Part 2: Building Your Biodome Structure**

1. REMEMBER: You need a tight seal on their biodome, so that it becomes a completely contained mini-environment (use tape or hot glue, preserving the ability to open/close the biodome for future steps).

**Part 3: Energy Flow in Your Biodome**

1. Make a list of the organisms that could be found if their biodome was built on a larger scale.
2. Draw one or more food chains or food webs to show the flow of energy through their biodome environment. Consider the relationships of the food sources and consumers in their individual biodomes.

**Part 4: Plants in Your Biodome**

1. Discuss basic plant needs with your team members.
2. Place soil, sand, rocks, ponds, or earth features into their biodomes, according to your designs.
3. Plant several seeds in the soil of your biodomes.
4. Water your biodome and seal it up tightly.
5. Review your food chain drawings and the plants they placed inside your biodomes. Will these plants support the food chains? If not, what changes will you need to make to the food chains?

**Part 5: Animals in Your Biodome**

1. Record observations of what happened to your biodome since you last added something.
2. Collect animals from outdoors/pet shop to place into your biodomes. (Ideas: grasshoppers, crickets, snails, ants, flies, moths, box elder bugs, June bugs, water bugs. Worms will be added in the decomposition.)
3. What kinds of problems might you have in picking which animals to put inside the biodome. You do not want the animals to be eaten by the other animals in the biodome.

**Part 6: Ongoing Maintenance and Recording Observations**

1. Maintain biodomes as necessary.
2. Record observations several times a week.
3. Prepare to present your live biodomes, discuss the concepts covered in class, as they apply to your biodome, and present your overall findings.

### SUMMARY OF DELIVERABLES

|  |  |
| --- | --- |
| Biodome Design Project Workbook | Nov. 2 |
| Biodome (pre-growth) | Nov. 4 |
| Biodome (biotic set-up) | Nov. 5 |
| Data Observations & Photos - Week 1 | Nov. 12 |
| Data Observations & Photos - Week 2 | Nov. 19 |
| Data Observations & Photos - Week 3 | Nov. 26 |
| Lab Report - Final | Nov. 30 |
| Power Point Presentation | Dec. 1 |
| Project Presentations | Dec. 1 - 3 |

<https://www.teachengineering.org/activities/view/cub_bio_lesson02_activity1>

<https://www.teachengineering.org/content/cub_/activities/cub_bio/cub_bio_lesson02_activity1_bedp_workbook.pdf>