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

**Today’s Agenda (Day 48)**

1. Housekeeping Items

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1. Homework Check:

🡪 Section 6.4 Notes

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1. Class Activity:

🡪CONT’D: Chapter 6 PPT Review

1. **Section 6.2 – Biomes are determined by climate**
2. Section 6.3 – Major biomes of the world
3. Section 6.4 – Major aquatic ecosystems

HOMEWORK:

* READ: Chapter 6 – Kinds of Ecosystems & Communities
* STUDY: Chapter 6 Test

CHAPTER 6 – Kinds of Ecosystems & Communities

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Abyssal ecosystem | Alpine tundra | Benthic ecosystem | Biochemical oxygen demand | Biomes | Boreal forest |
| Chaparral | Climax community | Coral reef ecosystem | Deserts | Emergent plants | Estuary |
| Euphotic zone | Eutrophic lake | Freshwater ecosystems | Limnetic zone | Littoral zone | Mangrove swamp ecosystem |
| Marine ecosystem | Marsh | Mediterranean shrublands | Oligotrophic lake | Pelagic ecosystem | Periphyton |
| Permafrost | Phytoplankton | Pioneer community | Plankton | Primary succession | Savanna |
| Secondary succession | Seral stage | Sere | Steppes | Submerged plants | Succession |
| Successional stage | Swamps | Taiga | Temperate deciduous forest | Temperate grasslands | Temperate rainforests |
| Tropical dry forest | Tropical rainforests | Tundra | Zooplankton |  |  |

REMINDERS:

* TEST: Chapter 6 **🡪 Nov. 4**

|  |  |
| --- | --- |
| 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 | Nov. 30 |
| Power Point Presentation | Dec. 1 |
| Project Presentations | Dec. 1 - 3 |

**(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 |
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| Biodome (biotic set-up) | Nov. 5 |
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<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>

# Biodomes Engineering Design Project

# W O R K B O O K

**Part 1: Designing Your Biodome**

The type of environment we have chosen to design is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

BRAINSTORMING: Use this space to brainstorm some ideas for your biodome.

BIODOME DESIGN: Sketch your biodome in the box below for construction approval.

MATERIALS LIST: List the materials your engineering team needs to build your biodome.

**Part 2: Building Your Biodome Structure**

BUILDING: What *challenges* did you have when building your biodome?

What could you do to *improve* the structure for next time?

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

Describe the type of environment that is found in your biodome.

List some *organisms* (plants or animals) that could be found in this environment?

What do those organisms need to survive?

In the space below, draw one or more food chains or food webs that you might find in your biodome.

**Part 4: Plants in Your Biodome**

What seeds are you planting in your biodome?

Draw a sketch of your biodome that shows where the seeds are planted.

Will these plants support your food chain in Part 3? What changes will you need to make to your food chain if not?

**Part 5: Animals in Your Biodome**

What *observations* did you have when you looked at your biodome today? Has anything changed? How are the seeds or plants?

What are some types of animals that you *could* put in your biodome?

List the animals you are actually adding to your biodome.

What kinds of problems did you have in picking which animals to put inside the biodome? Did you need to make any design changes to your biodome because of the animals you put in it?

**Part 6: Decomposers in Your Biodome**

What *observations* did you have when you looked at your biodome today? Has anything changed? How are the seeds or plants? How are the animals?

List the decomposers you are adding to your biodome.

How do the decomposers fit into your food chain or web from Part 3? What is their role in the flow of nutrients?

**Part 7: Review & Evaluation**

What *observations* did you have when you looked at your biodome today? Has anything changed? How are the seeds or plants? Animals? Decomposers?

Was your biodome *successful*? Why or why not?

What *improvements* would you make to your biodome if you built it again?