**Summer Academy 2018**

**Biodomes**

**Description:**

Students explore the biosphere and its associated environments and ecosystems in the context of creating a model ecosystem, learning along the way about the animals and resources. Students investigate different types of ecosystems, learn new vocabulary, and 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 communities. Students will use their growing understanding of various environments and the engineering design process, to design and create their own model biodome ecosystems.

**Objectives:**

* Have a working knowledge of the various types of environments and ecosystems.
* Describe how population and population density affect an organism.
* Identify how engineers apply knowledge of population density to the development of space, such as land and building capacity.
* Compare and contrast producers and consumers in a food chain or food web.
* Diagram the flow of energy through simple food chains and food webs.
* Define a biodome as a human-built environment used to study interactions of organisms.
* Explain how engineers are involved with the design and construction of biodomes.
* Construct an argument with evidence that certain habitats are more suitable for certain organisms.

**Standards:**

**MS-LS2-1** Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

**MS-LS2-3** Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.

**HS-LS2-6** Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions but changing conditions may result in a new ecosystem.

**HS-ETS1-2** Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

**Session Organization:**

10:00 – 10:30 Cultural Connection

10:30 – 11:00 Background Information (Biodomes)

11:00 – 11:15 Activity 1 – Environments and Ecosystems Research

11:15 – 11:30 Background Information (Population Density)

11:30 – 12:00 Activity 2 – Population Density

12:00 – 12:30 Lunch

12:30 – 12:45 Background information (Food Chains and Webs)

12:45 – 1:00 Activity 3 – Creating a Food Web

1:00 – 3:00 Activity 4 – Create Biodomes

3:00 – 3:30 Present Biodomes/Wrap-up

# Activity 1

# Environments and Ecosystems Worksheet

1. Research the following ecosystems and write in the table the types of plants, animals and soil you might expect to find in those environments.



1. In which ecosystem would you prefer to live? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Describe how an engineer might design a house in your preferred environment, taking into consideration the types of weather that exist in that ecosystem. Use the back side if needed.

Activity 2

Population Density

Materials List

**Each group needs:**

* Pencil
* Meter stick (share among teams if supply is limited)
* Population Density Worksheet (one per pair of students)

**With the Students**

1. Divide the class into teams of two students each. Assign one student to be the measurer (with the meter stick) and the other to be the recorder (using the worksheet). Tell the students that they are acting as engineers who need to know the population density of the classroom in order to help design safety evacuation procedures.
2. Have the students make the following measurements and record them on their worksheets:
* Use a meter stick to measure the length and width of the classroom.
* Multiply the length and width to get the area of the classroom in square meters.
* Count the number of individual people in your classroom (remember to count the teacher[s]).
* Calculate how much space each person has by dividing the number of square meters in the classroom by the number of people.

space = area (length x width) divided by (# of people)

* Predict the amount of space each person would have if your class size doubled. (For example: If the student population is 20 and the classroom size is 200 square meters, then each student would have 10 square meters of space. Repeat the above calculation. If the population density of the example classroom doubled, each person would have only 5 square meters of space.)
* Calculate the population density of the class by dividing the number of people in the classroom by the area to get individuals per unit area. (In our example, the population density is: 20 students/200 square meters = 2 students per 20 square meters = 1/10 = 0.1 students/square meter.)

population density = (# of people) divided by area (length x width)

1. Have students practice more population density problems by completing the worksheet table.
2. Conclude with a class discussion to review the worksheet and discuss population density trends. How does the population density of the classroom affect the amount of resources (tape, paper, chairs, space, etc.) for each student? (Answer: The amount of resources decreases with an increase in population density.) How might an engineer use the population density of the classroom to design a good safety evacuation procedure for the class in case of a fire drill? (Answer: Engineers would use the information to find the safest number of students to have in the classroom and the best way to get them from the classroom to outside the building quickly.) How many exit doors are there in your classroom? How many exit doors are in your school's auditorium, cafeteria or gymnasium? Why are they different? Tell the students that they will use the knowledge of population density to figure out how organisms and environments interact inside our biodomes.

**Population Density Worksheet Answers**

1. **Record** the classroom dimensions and population below. Then, **calculate** the area and amount of classroom space per person.

**6**

**11**

Length = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ meters Width = \_\_\_\_\_\_\_\_\_\_\_\_ meters

**Answers for #1, 2 and 3 are example calculations: Students’ answers will vary depending on the classroom size and number of people.**

**66**

Area (length x width) = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ square meters

**30**

Population = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ people in the classroom

**2.2**

How much space does each person have? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ square meters

*Hint: space = area (length x width) divided by (# of people)*

1. **Prediction**: How much space would each person have if the number of people in the class doubled?

**1.1 square meters**

1. Calculate the population density.

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Population density = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ per square meter

*Hint: population density = (# of people) divided by area (length x width)*

1. Perform and record the population density calculations for the prairie dog population below.

|  |  |  |  |
| --- | --- | --- | --- |
| **Year** | **# Prairie Dogs** | **Area(square meters)** | **Population Density** |
| **1985** | **10** | **10** | **1 prairie dog per square meter** |
| **1990** | **30** | **10** | **3 prairie dogs per square meter** |
| **1995** | **130** | **10** | **13 prairie dogs per square meter** |
| **2000** | **80** | **10** | **8 prairie dogs per square meter** |
| **2005** | **2** | **10** | **2 prairie dogs per square meter** |

1. Why would an engineer want to know about how populations change over time?
* **Example answers: for city planning, for planning use of natural and human-made resources, etc.**

Activity 3

Food Web

Materials List

**Each group needs:**

* 1 piece of paper per group (2 per group)
* Pencil

**For the entire class to share:**

* Several balls of string or yarn (can be re-used for future projects)

Procedure

**Before the Activity**

* Gather materials.
* Hold a class discussion. Explain the idea that food chains are sometimes too simple to show what is actually going on in an environment. For example, humans eat more than chicken; they also eat fish, vegetables, fruit, grains, cheese and other types of meat. Bears and mountain lions eat birds and fish, and bears also eat berries. Skunks eat insects, bird eggs, baby birds, as well as fruit and berries. If possible, have the class research food webs in a variety of ecosystems online or in natural history books.

**With the Students: Part 1 — Human Food Web**

* Divide the class into teams of eight students each. (Groups may be larger or smaller, if desired, but they must be at least five students each.)
* Have all the students stand in a circle.
* Distribute a ball of string or yarn to one member of each group. This person represents the sun and starts each food web.
* Have the first student hold tightly to the end of the string and toss the ball of string to another person in the group, across the circle.
* Have the second person name one thing in the ecosystem that uses energy from the sun. Next, have this person clasp the string with one hand and toss the ball of string on to another student in the circle with his/her other hand.
* Have the third student name something that eats or is eaten by the previous item named.
* Continue until all students in the circle are connected with the ball of string at least once.
* Have the student groups stop and look at the web they have created. Are some webs more complex than others? Why? (Answer: Some species may have been named twice because they are consumers of multiple things; some ecosystems have more variety of food sources, etc.) Point out to students how they have modeled a food chain or food web.

**With the Students: Part 2 — Drawing Food Chains and Webs**

1. Divide the class into teams of two students each.
2. Ask each pair to think of a terrestrial food chain and an aquatic food chain, and create each of these with words on one side of a piece of paper, using arrows to show the energy flow.

Answers will vary, check for reasonableness.

Activity 4

Create Your Own Biodome

Materials List

Most of this can be purchased at the dollar store. You can pick and choose what you want for them to use. Students could create some of these items on paper and cut them out if you don’t want to purchase the figurines. Let the students be creative!

**Each group needs: (Teams of 2- 4)**

* Activity 4 design and planning sheets (These can be used for brainstorming before they begin building.)
* 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.
* fake plants and trees
* fake people (army guys or whatever)
* fake animals
* soil
* sand
* supply of miscellaneous materials, such as pebbles, rocks, wire, small paper cups, plastic wrap, string, foil, popsicle sticks, chopsticks, etc.

**For the entire class to share:**

* masking tape
* duct tape
* glue (preferred: hot glue sticks with glue guns)
* scissors
* water