**Unit Essential Question:** *How have natural processes and human activities created the ecosystems we see today?*

**Introduction**

In the 1990’s a group of scientists designed and built an artificial living environment called Biosphere 2 in Arizona. The purpose of the project was to construct a self-sustaining environment that would allow 8 people to live and survive for two years without ever leaving the building. Scientists planned to use what they learned from this “experiment” to design and build artificial living environments on Mars. For Biosphere 2, scientists constructed a series of dome-shaped areas representing different ecosystems, including an ocean with a coral reef, mangrove wetlands, tropical rainforests, savanna grasslands, desert, and a human living space. Biosphere 2 was constructed with the goal of providing people with the basic ingredients in order to live for two years. By looking at the phenomenon of a biosphere, students can begin to generate questions about what an ecosystem is and how it functions. The questions they generate will guide them throughout the unit as they continue to make sense of this phenomenon and begin to imagine what their culminating project of an imitation ecosystem will look like.

**Alignment Table**

Because the Lift-Off tasks focus on student-generated questions, we do not identify specific Disciplinary Core Ideas or Science and Engineering Practices in this table.

|  |
| --- |
| **Crosscutting Concepts (\*depending upon student-generated questions)**   * Patterns   + Patterns in rates of change and other numerical relationships can provide information about natural systems.   + Patterns can be used to identify cause-and-effect relationships. * Cause and Effect   + Cause and effect relationships may be used to predict phenomena in natural or designed systems. * Systems and System Models   + Systems may interact with other systems; they may have sub-systems and be a part of a larger complex system.   + Models can be used to represent systems and their interactions—such as inputs, processes, and outputs—and energy and matter flow within systems. * Energy and Matter   + The transfer of energy can be tracked as energy flows through a natural system. |
| **Equity and Groupwork**   * Share and listen to broad and diverse student contributions. * Make connections between each other’s ideas. * Work together to co-construct a concept map. |
| **Language**   * Use connector words to link ideas. * Generate and write questions about the phenomenon. * Organize key questions in a concept map. |

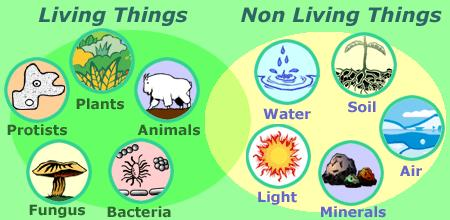
**Learning Goals**

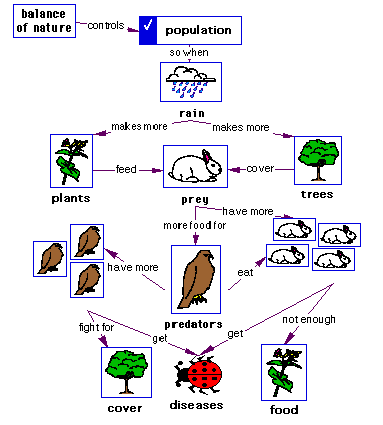
This learning task introduces students to the phenomenon of biospheres and begins generating questions that will guide them through the unit. More specifically, the purpose is to:

* Individually generate a list of questions about biospheres, using observations from the video and an outdoor exploration.
* Make connections between related questions.
* Generate possible answers to questions, using prior knowledge.
* Apply prior knowledge of ecosystems to make a list of the components that might be included in the final project arena.

**Content Background for Teachers**

An ecosystem is a biological community of interacting organisms and their physical environment. This Lift-Off Task serves to introduce students to what this definition really means and what they should expect to find in any given ecosystem. All the living parts of an ecosystem are known as biotic factors, although this term is not necessary to teach at this level. Living, or biotic factors, include animals, plants, fungi, etc. The rest of the environment, in which these organisms reside, are known as abiotic factors, or non-living factors. These include physical factors such as temperature, light, water, nutrients, soil, rocks, oxygen, carbon dioxide, etc. An ecosystem is thus the total of all living and non-living factors in a region.



 These living and non-living parts are inseparably intertwined because they constantly exchange materials. Energy and materials flow constantly within an ecosystem. For example, animals, which are living factors, use up oxygen, which is a non-living factor, when they need to create energy from the food they eat. They also expel carbon dioxide, another non-living factor, in the process. There are multiple examples of these connections within an ecosystem, which students will examine throughout the unit.

In this task, students create a concept map, which is a graphical tool that helps to organize and represent knowledge and questions, and is a successful academic language instruction tool. In this task, students will likely add only basic terms relating to an ecosystem, mostly living and non-living factors. As students learn more about the geoscience processes that have led to different ecosystems, the flow of energy and matter within ecosystems, and the organism interactions within ecosystems, they will add more complex questions and ideas to this concept map. If your students have not had previous experience making concept maps, please see the instructions in Part B below for strategies on teaching this skill.

**Academic Vocabulary**

* Ecosystem
* Biosphere
* Environment

\*Additional academic vocabulary will vary by class

**Time Needed (Based on 45-Minute Periods)**

2 Days

* Introduction, Part A and Part B: 1 period
* Class Concept Map, Project Overview, and Project Organizer: 1 period

**Materials**

* Unit 1, Lift-Off Task Student Version
* Projector and Speaker (for video)

Part B

* Poster paper and markers
* Post-Its (Optional)

Part C

* Class Poster Paper and markers
* \*See Instructions below for other optional materials to use for the class concept map

Connecting to the Culminating Project

* Culminating Project Handout
* Project Organizer Handout

**Instructions**

1. Introduce students to the unit by reading or projecting the Unit Essential Question aloud.
2. Tell students that by the end of this unit, they will be designing their own artificial environment.
   * Read or summarize the paragraph on page 1 of the student guide aloud, which gives an overview of the artificial living environment known as Biosphere 2.
   * Then watch the video clip (see link in slide deck) about Jane Poynter, who spent time in the Biosphere in Arizona. (Note: Near the end of the video the audio is intentionally deleted so that students can see the various components of the Biosphere without the detailed explanations.)
   * Ask students to take a moment and reflect about what they saw in the Biosphere.
   * Conduct this as a think-pair-share and then share out a few responses class-wide, using equity sticks for a more equitable discussion (See “How to Use This Curriculum” for more details).
     + There are no right answers. This just gives an opportunity to begin thinking about biospheres and generating ideas and questions.
3. Take the students outside for 5-10 minutes. Let them quietly observe the ecosystem around them, encouraging them to think about the following questions:

* What things do you see?
* And what things do you not see in the schoolyard but you might see in another ecosystem?

**Part A**

1. In this Lift-Off task, students will be generating questions to help them make sense of the phenomenon. In this section of the task, students will work to generate questions about how Biospheres (and ecosystems in general) function.
2. Have students complete this section individually in their student guide.

* For students who need more support, encourage them to think of the Biosphere images they observed, visualize a picture of other ecosystems such as the schoolyard, and consider any questions they have.
* Here is a list of some potential questions students might generate: “What other things are in the biospheres that we can’t see? What did scientists learn from the Biosphere 2 project? How does energy or matter go through biospheres (or other ecosystems)? What do we need to maintain a healthy biosphere (or other ecosystem)? Why is it called a biosphere? How is a biosphere different from an ecosystem? Did the plants and animals in Biosphere 2 survive? Why or why not?”

**Part B:**

1. In this part of the task, students create a concept map as a group.

* Remind students to refer to the directions on their student guide to help them make their concept map. First, students should compare each member’s list of questions and record/connect key questions on a piece of poster paper. They will then draft possible answers to the questions, using prior knowledge.
* Remind students that there are no right or wrong questions or predictions, so students feel encouraged to contribute any and all questions and ideas they think of.
* Because this is a collaborative task, it is recommended that you remind students of group work norms and assign group roles, such as Resource Manager, Facilitator, Recorder, and Harmonizer (See “How to Use this Curriculum” for more details).

1. Students will post their posters on a wall and then walk around and look at each group’s ideas. One suggestion for gallery walks is for students to interact with the posters in some way. For example, students are required to initial or leave post-its on three questions that they are also excited about on other posters.

|  |
| --- |
| Macintosh HD:Users:laurenstoll:Downloads:Sample Concept Map (1).jpg**How to Concept Map**  For students who have not had a lot of experience making concept maps, we have detailed a strategy below for introducing concept mapping using more familiar content. An example is also provided, but this will vary depending on what your students come up with as you make your own model.   1. Write the phenomenon in the middle of the poster, in this case “Humans breathe harder when they exercise.” 2. Ask students to share questions they might ask to make sense of this phenomenon and make a list of these questions on the board. 3. Model the process of reviewing the list and finding similarities amongst the questions.    * Place these key questions on the concept map poster, modeling how to put similar questions near each other on the poster. Circle these to signify that these are questions, not content knowledge. 4. Ask students to look at the key questions and see if any of the questions are connected: Would answering one question lead to one of the other questions? Model making these connections by drawing arrows between the circles. 5. In this Lift-Off task, students will only be drafting possible answers to the questions, not actually gathering and recording learned concepts. However, throughout the unit, they will be adding content they have learned. Model this by recording a student’s prior knowledge to one of the questions, using boxes to signify that these are pieces of content knowledge rather than questions.    * Use connector words to identify the relationships between the content boxes (See image above for an example). 6. Optional: To emphasize crosscutting concepts using a concept map, make a key of different colors for the crosscutting concepts emphasized in this unit. Identify questions that clearly show evidence of the different crosscutting concepts and circle them with the corresponding colors. Explain to students how you made that choice by pointing out the language that hints at that crosscutting concept. \*Note: not all boxes and circles will necessarily have a crosscutting concept. |

**Part C**

1. Construct a whole-class concept map that begins to help students make sense of the phenomenon of a Well-Functioning Biosphere.

* Start with the phenomenon in the middle.
* Then ask students to share out the questions that were most common across all the posters in the classroom. As you record questions on the poster, organize them based on connections you see. Draw circles around each question (as you add to the concept map throughout the unit, you’ll also be adding concepts learned, which can be written in boxes to distinguish them from the questions).
* Ask students to identify any connections they see between the questions and record these as lines between the questions.
  + Recommended: Give pairs of students think time to come up with 1-2 connections to add to the class concept map and call on pairs using equity sticks. This encourages more equitable participation in this class-wide activity.
* The purpose of this concept map is to facilitate generation of student questions, promote language development, and support understanding of the science content throughout the unit. Allowing students to ask their own questions and use their own words to make meaning of the concepts will not only help them make deep connections about science content but will also help their oral and written language development.
* This whole class concept map will be revisited at the end of each task, asking students questions like: Are there any new questions you have about the phenomenon? Are there any connections you want to add or change? What is your reason for that addition/revision? Are there more connections we can make between the questions/ideas already on the map? Do you want to add any new ideas/concepts to the map?

1. Because this concept map will be added to and revised throughout the unit, here are some practical options for implementation.

* If you have access to white board paper, we encourage you to use these for class posters since it will allow you and your students to make revisions throughout the unit.
* Another option is to use smaller pieces of paper for each class and project using a document camera; this will save space as opposed to doing large class posters.
* We highly recommend students keep their own version of this concept map in their notebooks, adding questions and concepts as they go through the unit.

1. Once the draft concept map is complete, introduce students to the crosscutting concepts for this unit. We recommend posting posters of each crosscutting concept in your classroom (See beginning of teacher guide for templates).

* The crosscutting concepts for this unit are: Patterns; Cause and Effect; Systems and System Models; and Energy and Matter. Assign a color for each crosscutting concept that can be used throughout the unit.
* Have students analyze the class concept map for as many examples of the crosscutting concepts as they can find. Depending on the questions they have, they may be able to find an example of each of the crosscutting concepts or perhaps just some.
* We recommend modeling this process by picking a question, identifying the crosscutting concept, and tracing the circle in the corresponding color. Explain the key words that helped you identify the crosscutting concept in this question. Some identifying words that students might look for are:
  + **Patterns**: These could be phrases such as, “is the same as”, “has in common with”, “is similar to”, “shares” etc.
  + **Cause and Effect:** These could be phrases such as, “that results in,” “that causes,” “that explains why,” “is due to,” etc.
  + **Systems and Systems Models**: These could be phrases such as, “is a part of” “connects to,” “interacts with,” “is made up of,” “works together with,” etc.
  + **Energy and Matter**: These could be phrases such as, “energy is transferred/flows,” “is conserved,” “is important for,” “is needed,” etc.

**Connecting to the Culminating Project**

1. Hand out the Culminating Project Task Card and read the Challenge and Group Project Criteria for Success aloud as a class.
   * Take questions for clarification.
   * Optional: You may want to take a student volunteer to give a more detailed description of *The Hunger Games* for students who are interested but have not read the book or seen the movie; this is however, not necessary for success on the Culminating Project.
   * Optional: Show a clip from the first *Hunger Games* movie that shows the arena and a clip that shows the digitized map of the arena.
2. Pass out their Project Organizer and explain that they will complete a section of this after each task in class. Students should independently complete the Lift-Off Task section of the Project Organizer in class. Revisions can be done for homework, depending upon student’s needs and/or class scheduling.
   * Students have been tasked with creating a Hunger Games arena that mimics an environment they might see on earth. The student prompt is as follows: Your arena will be very similar to a Biosphere in that you are designing your own ecosystem. Using your prior knowledge,
     + What parts of an ecosystem should you be thinking about including in your arena? Make a list or draw a diagram of an ecosystem with parts labeled.

**Reflection**

1. At the end of the task, ask students to reflect on what they have learned over the course of this task by answering the following three questions in their student guide:
   * At the beginning of this task, you made a list of all the questions you have about biospheres. Look back at your list: after learning from your peers, how can you add to your list? What kinds of things did you initially leave out? Use the class concept map to help you.
   * In this unit, we will be focusing on four crosscutting concepts: **Patterns**: Patterns can be used to identify cause and effect relationships and provide information about natural systems; **Cause and Effect**: Cause and effect relationships may be used to predict phenomena; **Systems and System Models**:Models can be used to represent systems and their interactions within and between systems; and **Energy and Matter**: The flow of matter and energy can be tracked through a natural system. Looking at your class concept map, give one example of how a crosscutting concept came up in today’s task.
   * Now that you understand what project you’ll be working on over the course of this unit, what else do you need to know? What additional questions do you have?
2. There are no right answers but encourage students to look back at their initial lists and their class concept map. They should not change their initial responses, but rather use this reflection space to add to their questions and ideas based on what they have learned through this task. By generating more of their own questions, students continue to engage in sense-making of the phenomenon and the gathering of knowledge and skills for their final project.