El Paso Water & SCIENCE

WATER IS LIFE: Build Your Own Hueco Tanks Model

Grade 6th

Vocabulary

abiotic
algae
bacteria
biotic
community
cryptobiosis
detritus
dormant
ecosystem
hueco
organism
pluton
population
protozoa
rotifer

Activity Overview

In this activity, students will understand that abiotic factors such as water are necessary to create a living environment. Animals use a variety of strategies to deal with harsh environmental conditions, including cryptobiosis.

TEKS Alignment

6.12 (E) The student is expected to describe biotic and abiotic parts of an ecosystem in which organisms interact.

6.12 (F) The student will diagram the levels of organization within an ecosystem including organism, population, community and ecosystem.

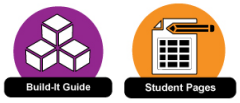
Materials

Per Group:

- 3 wide brim clear containers
- Dry dirt from an area where water naturally pools after a rainstorm such as a dry arroyo bed or riverbed
- Water (dechlorinated) if you are using tap water, let it sit out for a day before using it.
- Magnifying glass
- Camera (Smartphone cameras are fine for this)
- White paper
- Masking tape (used to label the jars by group)

Per Student:

- El Paso Water Chronicles: Issue 1
- Build Your Own Hueco Tanks Lab (Build-It Guide) and Researching Life in the Hueco (Student Pages)



THE SCIENCE BEHIND IT: Cryptobiosis

6.12 (E) Abiotic and Biotic Factors within Ecosystems: An **ecosystem** is only successful when the living things within the ecosystem have everything that they need to survive, which includes both living things **(biotic)** and nonliving things **(abiotic)** within the environment. In earlier grades these were described as “basic needs”. Water is a key abiotic factor with all living things on Earth and in this particular unit, the animals and plant life have evolved adaptations to help them wait until this life saving factor is plentiful enough to flourish. In this activity

the smallest life (bacteria) feeds on the most basic abiotic factor (carbon).

Cryptobiosis: Survival in harsh environments is a never-ending battle for animals and plants that make their home in the Chihuahuan desert. One such adaptation is cryptobiosis. **Cryptobiosis** is a dormant state that some microscopic animals such as tardigrades, brine, fairy and tadpole shrimp and rotifers go into when it encounters an unfavorable environmental condition such as drought. During cryptobiosis the animal dehydrates itself to protect itself from the harsh conditions and will revive itself when exposed to water. This state can occur either during their egg stage or sometimes during their adult life, but always with the possibility that they will be revived with the coming of a desert rain. Cryptobiosis doesn't just happen with microscopic animals, the majority of plant seeds also are in a form of cryptobiosis and the desert plant named the "Resurrection Plant" can also dehydrate itself and bring itself back to life during harsh arid conditions.

Collecting the soil for this investigation should be done at the base of arroyos, dried riverbeds and other areas where ponding occurs. You will almost certainly collect specimens of microbial cryptobiosis in these areas. The animals that spring to life after a desert rain become food for the tadpoles of desert amphibians such as desert toads and tiger salamanders.

6.12 F Levels of Organization: Vocabulary such as **organism** (a single living thing), **population** (multiple living things of the same species) and **community** (living things within the ecosystem that interact together to survive) should be used throughout the lesson to ensure that at risk and second language learners are aware of the academic vocabulary.

ENGAGE: El Paso Water Chronicles Issue 1: Hueco Tanks State Park (East El Paso)

Students will read the El Paso Water Chronicle and discuss life in the huecos at the Hueco Tanks State Park.

Answers to the Life in Huecos Word Puzzle:

Across
3. biotic
7. ecosystem
8. population

Down
1. rotifer
2. dormant
4. pluton
5. community
6. hueco
9. organism
10. abiotic

EXPLORE: Build Your Own Hueco Tanks Model

Students will need the "Build Your Own Hueco Tanks" (Build-It Guide).

Whole class: Students will read and discuss the procedure that describes the setting for huecos to come to life after a desert rainstorm. Then proceed to follow the steps to build their own hueco models:

Purpose:
Understand that water is required to create a living environment.
Models can be used to simulate natural environments. Animals use a variety of strategies to deal with harsh environmental conditions, including Cryptobiosis.

Materials:
- **Three clear containers** that can hold water and dirt. Any size will work. Just make sure that the sides are smooth. (If you are using glasses from your home, make sure you have your parent's permission!)
- **Dry dirt from an area where water naturally pools after a rainstorm such as a dry arroyo bed or riverbed.** You can use the same type of dirt for all three containers, or you can try a different type of dirt in each one. You don't need a lot, just enough to cover the bottom of your container to a depth of about 5-10 cm of the collected dirt. Not everyone can get dirt from an arroyo, so use whatever dirt you can find, such as dirt from a garden. (Try to remove any large objects such as pebbles or sticks that might be in the dirt.) If you cannot get to dirt form an outside source, students could even try dirt from a garden. Note: Do not use dirt that is just on the surface. Dig down a little bit, maybe 20-30 cm below the surface. Organisms that are in a suspended state must burrow down a bit.
- **Water:** Rainwater is best for this experiment, but in El Paso we don't get a lot of it. You can use tap water, but you should let the water sit uncovered for a day or more before using it. Water is treated with chlorine so it is safe for human consumption but may kill microorganisms. Letting the water sit allows the chlorine to evaporate. You will need enough water to cover the dirt to a depth of about 2 cm. You can also treat tap water with a de-chlorinator.

- Magnifying glass
- Camera if you have one (Smartphone cameras are fine for this!)
- White paper

Procedure:

1. Remove the top of the wide brim clear container.
2. In each container place 5-10 cm of dirt. If you are using the bowls, place enough to cover the bottom of each bowl.
3. Pour the water over the dirt until it covers the dirt at least 2cm deep from the surface.
4. Let the mixture settle.
5. Put aside out of direct sunlight, but in a warm environment.
6. If too much evaporation occurs before the animals have a chance to hatch, add more dechlorinated water to the model.

Observations:

Students will use the “Record Your Observations Worksheet” and “Investigation Questions” found in the Build-It Guide.

1. After a day, use your magnifying glass to see if you can spot any signs of life. (You may wish to place the white paper behind the clear bottle if using a bottle or jar container so that you can better see the contents)

2. Observe your artificial “Hueco Tanks Model” for a week or until the water evaporates. Is there change over time? Signs of life might include:
   - bubbles arising from the dirt
   - movement in the dirt
   - movement across the top of the dirt or in the water

3. Check daily for a week to see what happens inside your model.
   - What do you see?
   - Are there signs of life? What are they?
   - Can you see living organisms in the water?
   - How are they swimming? In straight lines? Zig-zag motion?

EXPLAIN: Researching Life in the Hueco

Students will research life forms that are found within the Hueco using the "Researching Life in the Hueco" student pages. In this worksheet students will research the basic needs of the life in the Hueco. With this information they will be able to create a food web.

Possible answers to this worksheet include:

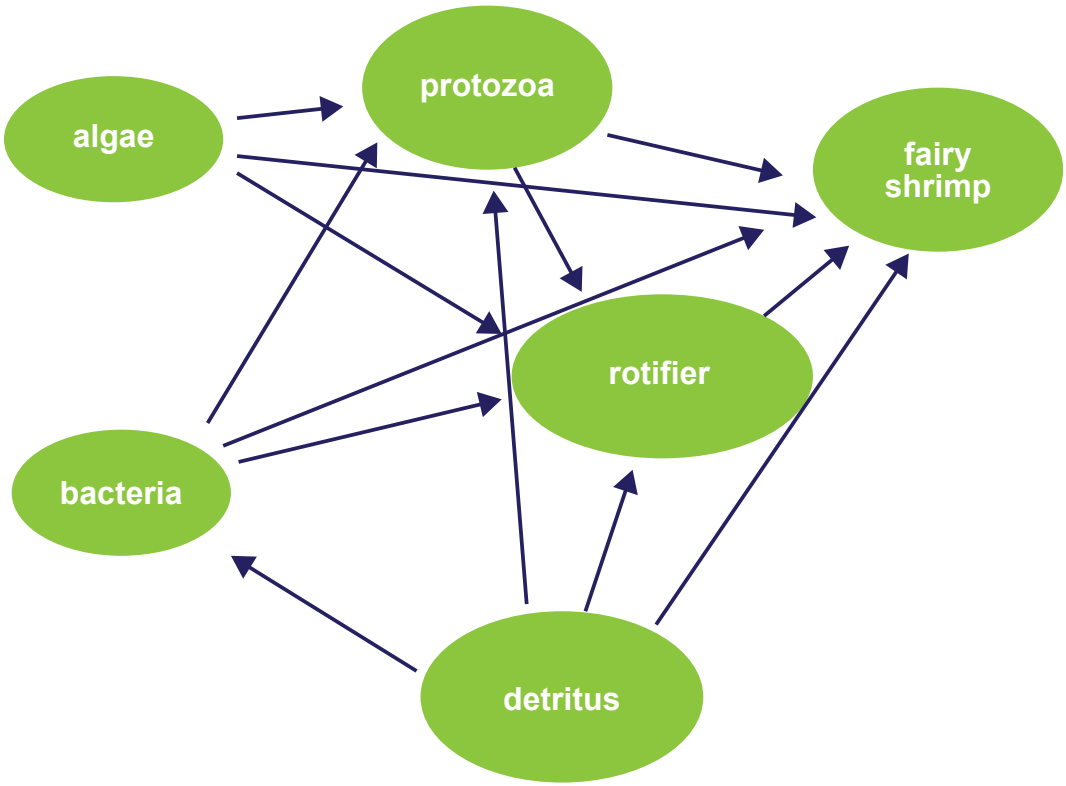
Animal Description (sketch)	Biotic Factors	Abiotic Factors
Bacteria 	• Detritus: (decomposed animal and plant life)	• Oxygen • Nutrients such as: carbon, nitrogen, phosphorus or sulfer • Water • Temperature
Algae	Carbon dioxide released from animals within the environment Nitrogen released from decomposers	Water Sunlight Carbon dioxide Nitrogen
Rotifer	Rotifers are omnivorous and eat anything that fits in their mouth: algae, detritus protozoa, bacteria	Water Oxygen
Protozoa	Protozoa eat bacteria and detritus	Water Oxygen (sometimes soil)
Fairy Shrimp	Fairy Shrimp eat protozoa, rotifers, algae, bacteria and detritus	Water Oxygen

ELABORATE: Design a Hueco Food Web

Using the "Researching Life in the Hueco" data, students will create a Hueco Food Web. Lizards and birds will feast on tadpole and fairy shrimp in huecos. Using your hueco environment research, design a food web that includes the community of the environment. Include the sketches that you made into the food web design.

Possible Food Web Answer:

Design a Hueco Food Web



VOCABULARY

abiotic	Non-living chemical and physical factors in the environment which affect ecosystems.
algae	A simple, nonflowering, and typically aquatic plant of a large group that includes the seaweeds and many single-celled forms.
bacteria	A member of a large group of unicellular microorganismims which have cell walls but lack organelles and an organized nucleus, including some that can cause disease.
biotic	A living component of an ecosystem; for example organisms, such as plants and animals.
community	Living things within the ecosystem that interact together to survive.
cryptobiosis	A dormant state that some microscopic animals such as tardigrades, brine, fairy and tadpole shrimp and rotifers go into when it encounters an unfavorable environmental condition such as drought.
detritus	Organic matter produced by the decomposition of an organism.
dormant	A state in which life suspended until revived.
ecosystem	A biological community of interacting organisms and their physical environment.
hueco	Small depression in the rocks that collect water.
organism	An individual animal, plant, or single-celled life form.
pluton	Happens when igneous rock pushes up from under the surface of the ground.
population	a community of animals, plants, or humans among whose members interbreeding occurs.
protozoa	A phylum or group of phyla that comprises the single-celled microscopic animal.
rotifer	An organism only found in the Hueco. A microscopic creature that is considered more animal than bacteria.

El Paso Water Chronicles
Hueco Tanks State Park

Print instructions: Print double sided, flip on short side and scale fit to printable area.

WORD PUZZLE: MICROBE FARMS, JUST ADD WATER!

by Ernie

LIFE IN HUECOS WORD PUZZLE

by carmen

Across
3. the living things in an environment
7. things that interact in a system
8. the number of one species in an environment

Down
1. Species that are only found at Hueco Tanks State Park
2. a state in which life is suspended until revived
4. a formation of rocks sticking out of the earth that are formed by magma
5. different types of animals living in one environment
6. a small depression in the rocks that collect water
10. non-living things in an environment

WORD BANK

biotic	hueco
rotifer	dormant
pluton	organism
ecosystem	abiotic
population	community

EL PASO WATER CHRONICLES

The Latest News in Water and Science from El Paso

PHOTO COURTESY OF HUECO TANKS STATE PARK

IN THIS ISSUE

Hueco Tanks State Park (East El Paso) (pg. 1)

The "tanks" in Hueco Tanks (pg.2)

Shrimp in the desert? Don't set up the grill just yet (pg. 2)

WORD PUZZLE (pg.4)

COMIC (pg.4)

Hueco Tanks State Park (East El Paso)

By TecH$_2$0

In El Paso County there is a wonderful place to visit called Hueco Tanks State Park. The park is located in far East El Paso off of Montana Avenue. Inside the park you will find everything from ancient pictographs that are hundreds of years old to pottery shards from the times when the area was inhabited by small tribes of hunter gatherers.

Formed about 34 million years ago, Hueco Tanks was created when surrounding ground eroded away forming the **pluton** that we see today. In geology, a pluton happens when igneous rock pushes up from under the surface of the ground.

This large igneous pluton makes up the main part of the park and on the surface of these rocks, contain small depressions or "**huecos**". Hueco Tanks is famous for its huecos because it allows rock climbers to climb the rocks easily.

Rock climbers from all over the world visit the park to climb its interesting surface, but the surface of the rock is also famous with scientists because of the hueco's ability to collect water during passing desert rains.

While walking within the park you find sparse vegetation to an oasis of trees, bushes, and flowers. How can these plants survive the harsh desert?

The "tanks" in Hueco Tanks

The "tanks" in Hueco Tanks were once large enclosed formations that could contain up to a year's supply of water, collected from rainwater and from several natural springs that exist in the area. Humans, both pre-historic and modern man have been using this area to store water for thousands of years. Both the huecos and the water stored within them are **abiotic factors**. Abiotic factors are the things within the environment that are not living but are necessary for the system to work.

PHOTO COURTESY OF TEXAS PARKS AND WILDLIFE

The huecos are necessary factors because they help collect water. The water found at Hueco Tanks helps to sustain life, from microscopic (that which cannot be seen by the human eye) to the macroscopic, (which can be seen by the human eye). You are most familiar with the big macroscopic living **organisms**, like trees, and coyotes however even the small huecos hold secret environments when they collect the rain. Can you think of some abiotic factors that are needed for life to exist?

Shrimp in the desert? Don't set up the grill just yet.

Each hueco forms a temporary aquatic environment as they fill with water, because inside the hueco is also a small amount of dirt and the **dormant** eggs of small animals which provide the ingredients for a microenvironment. While the hueco, water and dirt may be considered abiotic factors of this environment, the eggs and dormant animals are considered biotic factors. **Biotic** factors are all of the living things inside an environment.

The huecos can also host a variety of life called a **community** which are living things that rely on each other inside an environment. A single hueco can grow bacteria, fungi, algae, rotifers and tiny shrimp called "fairy shrimp." They are called "fairy shrimp" because they are translucent. If you have ever raised a colony of Sea Monkeys, you might have raised Fairy Shrimp. Fairy Shrimp are not the only type of shrimp found in the huecos. Tadpole shrimp (Genus: Notostracans) are also found within these microenvironments. Much like animals and humans feed on larger ocean

PHOTO COURTESY OF TEXAS PARKS AND WILDLIFE

shrimp, the freshwater shrimp of the hueco **ecosystem** become food for passing lizards climbing on the rock and those lizards become food for larger animals like birds. For a short period of time within it becomes an important supply of food for creatures living in the park.

Surprisingly enough, there are some organisms that live ONLY in the Hueco Mountain State Park and nowhere else on earth. UTEP's Professor of Biological Sciences. Dr. Liz Walsh been studying populations of **rotifers** for over 20 years. A **population** is a group of animals of the same species.

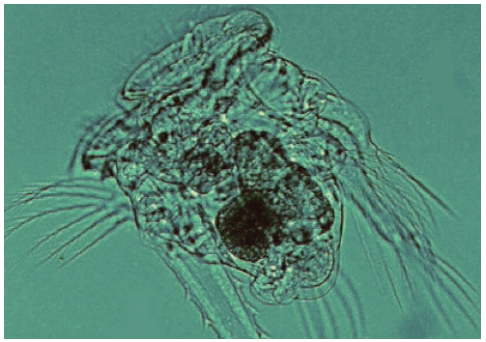


PHOTO COURTESY OF HUECO TANKS STATE PARK & HISTORIC SITE

She has discovered that there are certain species of **rotifers** that only live at Hueco Tanks Park and can only be found within the hueco depressions after a rain. A rotifer is a a microscopic creature that is considered more animal than bacteria.

Since the water in the small depressions only lasts a short period of time before it evaporates, the life span of the rotifers, shrimp and all the other organisms in the bowls is very short. By the time the water dries up, the organisms must hatch from eggs, grow to adulthood, and lay eggs for the next generation. This might happen in the span of just a few days. Life in the desert can be very quick for some organisms.

Researching Life in the Hueco

Fairy shrimp are a common life form found in a hueco environment. Researching the living and non-living things necessary to keep this life form alive will help you to understand all of the elements present in the hueco environment. Using the information given about fairy shrimp, continue to research the biotic and abiotic elements necessary to sustain it. In the case of types of animals (such as bacteria) research what types of bacteria that rotifers eat.

Animal Description (sketch)	Biotic Factors	Abiotic Factors
Bacteria 	• Detritus: (decomposed animal and plant life)	• Oxygen • Nutrients such as: carbon, nitrogen, phosphorus or sulfer • Water • Temperature
Algae		
Rotifer		
Protozoa		
Fairy Shrimp		

Design a Hueco Food Web

Lizards and birds will feast on tadpole and fairy shrimp in huecos. Using your hueco environment research, design a food web that includes the community of the environment. Include the sketches that you made into the food web design.

El Paso Water & SCIENCE

Build-It Guide

Build your own Hueco Tanks Model

Think about how fast the hueco environment cycle has to happen in the desert:

- A passing rainstorm leaves some water in a small hueco.
- Bacteria and other microscopic organisms have to come out of their dormant state. This state is known to biologists as "Cryptobiosis" when an organism can go into a state of suspended animation when it encounters an unfavorable environmental condition, like drought.
- The dormant fairy and tadpole shrimp have to come out of their dormant state and start their life cycle, which includes looking for food and to reproduce. They eat the bacteria and algae that are also growing.
- The shrimp grow large enough to be seen by passing animals looking for lunch such as birds and lizards.
- If they can survive not being eaten, they reproduce and when the hueco dries up, the offspring go into their own state of cryptobiosis until the next rainstorm.

Park rangers and scientists strongly discourage anyone from touching inside these little depressions during dry times (or anytime for that matter), for fear of disturbing the dormant eggs laying inside. But you can make your own "Hueco Tanks" at home using some simple materials that you probably have around the house, and a few things that you gather from outside.

Build your own Hueco Tanks

Purpose:
Understand that water is required to create a living environment, Models can be used to simulate natural environments. Animals use a variety of strategies to deal with harsh environmental conditions, including Cryptobiosis.

Materials:

- 3 clear containers (can be plastic water bottles, glass jars, or three shallow bowls). Three clear containers that can hold water and dirt. Any size will work. Just make sure that the sides are smooth. (If you are using glasses from your home, make sure you have your parent's permission).
- **Dry dirt from an area where water naturally pools after a rainstorm such as a dry arroyo-bed or riverbed**
  You can use the same type of dirt for all three containers, or you can try a different type of dirt in each one. You don't need a lot, just enough to cover the bottom of your container with a depth of 5-10 cm of the collected dirt. Not everyone can get dirt from an arroyo, so use whatever dirt you can find, such as dirt from a garden. (Try to remove any large objects such as pebbles or sticks that might be in the dirt). If you cannot get to dirt from an outside source, students could even try dirt from a garden. Note: Do not use dirt that is just on the surface. Dig down a little bit, maybe 20-30 cm below the surface. Organisms that are in a suspended state must burrow down a bit.
- **Water**
  Rain water is the best for the experiment, but in El Paso we don't get a lot of it. You can use tap water, but you should let the water sit uncovered for a day or more before using it. Water is treated with chlorine so it is safe for human consumption but may kill microorganisms, letting the water sit allows the chlorine to evaporate. You can also treat tap water with a de-chlorinator.
- **Magnifying glass**
- **Camera if you have one (Smartphone cameras are fine for this!)**
- **White paper**

Procedure:

1. Remove the top of the wide brim clear container
2. In each container place 5-10 cm of dirt. If you are using the bowls, place enough to cover the bottom of each bowl.
3. Pour the water over the dirt until it covers the dirt at least 2 cm deep from the surface.
4. Let the mixture settle.
5. Put aside out of direct sunlight, but in a warm environment.
6. If too much evaporation occurs before the animals have a chance to hatch, add more dechlorinated water to the model.

Observations:

1. After a day, use your magnifying glass to see if you can spot any signs of life. *(You may wish to place the white paper behind the clear container if using a bottle or jar container so that you can better see the contents).*
2. Observe your artificial "Hueco Tanks Model" for a week or until the water evaporates. Is there change over time?
   Signs of life might include:
   - bubbles arising from the dirt
   - movement in the dirt
   - movement across the top of the dirt or in the water
3. Check daily for a week to see what happens inside your Hueco Tanks Model
   Record your observations:
   - What do you see?
   - Are there signs of life? What are they?
   - Can you see living organisms in the water?
   - How are they swimming? In straight lines? Zig-zag motion

Results:

- Can you see different types of organisms? Describe them.
- Do you see shrimp, or do you see some other kind of organism?

Extensions:

There are many variables that can be manipulated in this experiment.

- What happens when you change the type of dirt, the amount of water, or the color of the container? Will it make a difference in your results?
- Does the depth from where the dirt was removed make a difference?
- Assuming that the water does not evaporate, how long will your ecosystem stay alive?

Record your observations

Use the data table below to record your observations.

Day	Observation: Appearance of water	Appearance of static factors within the environment	Abiotic factors within the environment	Inferences you can make about biotic and abiotic factors
1	Water is cloudy and is still settling	No living organisms evident	Water, dirt	Eggs may not have hatched yet
2				
3				
4				
5				
6				
7				
8				

Investigation Questions

1. What organism appeared first? Why do you think that was the case?

2. How could you identify the organisms in your water? Ask yourself a series of questions that have yes or no answers to identify the organisms. For instance, you might ask if the organism:
   - Can be seen without a magnifying glass
   - Is it translucent or opaque
   - Does it swim in a straight line or in a zig-zag motion
   - Does it bury itself in the dirt or stay in the water at all times

3. What order did organisms appear in your "Hueco Tanks Model"? What appeared first?

4. What happened as the water began to evaporate?

5. What were some signs that there were living organisms in the "hueco"?

6. Draw the life cycle inside of a hueco at Hueco Tanks State Park based on what you have learned.

Video links to accompany Abiotic and Biotic Factors

Build your own Hueco Tanks: https://youtu.be/cblfy0KeN_s?si=zTQwvI1_YnuuzZWT

What are the huecos at Hueco Tanks:
https://youtu.be/upkkj7yU97A?si=nAchU_TxlgCVw7YA