



Lesson 1 – Estivation, Xerophytes, and Ephemerals

Investigative Questions:

- How have the animals and plants living in Arizona adapted so that they can survive here?
- How does transpiration and evaporation relate to plants' and animals' adaptations for water conservation and temperature management when living in Arizona?
- What is a watershed and which watershed do you live in within Arizona?

Slides: [Lesson 1 Slides PowerPoint](#)
[Lesson 1 Slides PDF](#)
[Lesson 1 Slides Google](#)

Materials Needed:

- [Water Cycle Diagram](#) (optional as refresher)
- [Water Cycle Teacher Answers](#)
- [Thirsty Plant Worksheet](#)
- Plastic zip lock bag per student
- [Teacher Page – Arizona Adaptations & Species Matches](#)
- APW Materials left for class to utilize: Game & Student Handbook
 - **Adaptation Game** laminated & ready: (Set of [Arizona Adaptations Cards](#) & Set of [Arizona Species Cards](#) included)
 - **Student Handbook per group which includes:**
 - Copies of [Arizona Maps](#)
 - [Background Info on Arizona Plant and Animal Adaptations](#)
 - [Arizona Biomes](#)
 - [Entire PDF of Estivation, Xerophytes and Ephemerals Lesson](#) (optional)

Materials Needed for **optional** Watershed Activity:

- [Instructional Video Link](#)
- Spray bottles
- 2 pieces of 8-1/2 by 11 white paper per student or two pieces of large poster paper/butcher paper per group (scrap paper can be used if blank on one side)
- Water soluble markers (green, blue, brown, red, purple)
- Scotch Tape



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Warm Up:

Understanding Transpiration and Evaporation:

1. Set-up Thirsty Plant Experiment: can be done at home as well

- 1) Give each student an empty plastic bag. Have students examine their bag and record any observations on their worksheet.
- 2) Take students outside to an area with several plants (a variety of types is nice, and **sunny areas work best**). Have students carefully place the bag over several leaves of their plant (try for 2 or 3). (You may want to have a few larger plastic bags on hand for some groups who choose large trees or plants with large leaves.) Each student should count and record the number of leaves in their bag, record the time, and then take a moment to estimate the total number of leaves on the plant.
- 3) Back in the classroom, have students predict what they think will happen and write down their predictions.
- 4) Wait to collect the bags for approx. 60 minutes, or whatever time frame works for your class. (This is a good time to move on with the rest of the lesson while you wait for your experiment).

2. Ask students this question: “How do you know when you wake up in the morning that you are in Arizona and not in Florida?” To initiate a discussion of climate and the environment and how it varies from place to place. How does living in Arizona’s climate (vs. someplace like Oregon) influence their behaviors and lifestyle (e.g. the clothing they wear, the types of plants growing in their yard)? What about the plants and animals that are adapted for their area of Arizona – could a Gila monster survive in Alaska? Could a walrus survive in the Sonoran Desert? Why don’t we see saguaro cacti anywhere other than the Sonoran Desert? Many desert organisms have adapted in ways that allow them to survive and thrive in hot, arid environments.

3. Ask students to brainstorm desert plants and animals with special adaptations for their environments. Remind them that plants, as well as animals, have evolved mechanisms and structures for conserving water and for staying cool (a very important element of conserving water in the desert). Make sure you cover the adaptations and species on the Adaptations and Species cards. You can have students read the [Background Info on Arizona Plant and Animal Adaptations](#) to assist in this discussion.

Investigations Activity:

1. Define the terms *transpiration* and *evaporation*. Ask students how having the following characteristics would enable plants to conserve water and stay cool: few or no leaves; waxy coating on leaves; shallow radial roots; deep tap roots; water storage capacity. Ask students to explain the advantages and disadvantages of evaporation and transpiration in plants and animals that are trying to conserve water and stay cool.



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2. Distribute copies of the [AZ maps](#) found in **Student Handbook and have students identify where they live on the Arizona Reference map. What is a *watershed* and **which watershed do they live in?** What plants and animals live in their area? What adaptations have they made to survive? Then have students identify other areas on the Arizona map and compare water availability, temperature, and rainfall in these areas, using the appropriate maps. Discuss the ways that the climate of a place influences the types of ecosystems and habitats that are found there. What kinds of plants and animals live in these different habitats and how have they adapted?**

- Feel free to use the [slides provided above](#). Ask students: **What is a watershed?** Split the word in two and ask, **what is water?** (we are just looking for a simple definition here).
- **What is a shed?** They will likely know that sheds store something. **What does a watershed store?** Water. Then, think about shed as a verb. **What does it mean to shed?** They will likely be able to relate the word to a pet. A pet sheds hair. **What do you think watersheds shed?** Water. We relate this to water running off the land. **Do you think a watershed looks like a toolshed?** No.
- ***A watershed is a land area that drains to the low points.*** What marks the **edge or boundary** of a watershed? The high points or mountains. What are the **low points?** The rivers or valleys that may become rivers when it rains. When managing a watershed, we are managing both the **land and water** ... everything within the boundaries.

3. Tell students they are going to play a matching game in which they must match a species to its adaptations, using clues about how it has learned to survive in the arid climates of Arizona.

4. Distribute [Arizona Adaptations Cards](#) and [Arizona Species Cards](#) to the class, taking care to ensure that every card has a match. If there are more students than cards, have students pair up. Answer key can be found here on [Teacher Page – Arizona Adaptations & Species Matches](#).

5. Explain that some cards list characteristics, mechanisms, or behaviors that a specific plant or animal has adopted for survival in Arizona, and that other cards have pictures of specific plants and animals in Arizona. Based on the clues, students find their match. If they have an Adaptations card, they find the Species picture card that it describes. If they have a Species card, they find the person that has the adaptation card that matches it. Encourage all students to move around the room and talk to each other until they find their match.

6. When students have found their match, they must pair up and sit down together. Grades 7 through 12: Tell students not to show their cards to anyone after they have found their match. After playing the game, have each pair of students come to the front of the room individually and begin reading the Adaptation Card clues for their plant or animal one at a time, without revealing the answer. The rest of the class should try to give the species' name correctly after as few clues as possible. ("Knowledge Bowl" style).



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Wrap Up:

Discuss how adaptations enable species to live in their environment. Ask students to summarize water- and heat-related adaptations included in the game by categorizing types of adaptations (avoiding heat, storing water, dissipating heat, etc.).

Optional Investigation Activity (Watershed Model):

We are going to make a model of a land area.

1. Put a piece of (8 ½ by 11 or poster size white paper) down on the table in front of you (blank side up if using scrap paper).
2. Crumple the second piece of (8 ½ by 11 or poster size white paper) blank side facing out if using scrap paper.
3. Un-crumple the paper until you can find all four corners, it should **not** be perfectly flat.
4. Tape all four corners of the crumpled paper onto the flat piece of paper in front of you. Leave the crumpled paper as high as you want. It should now look like mountains or a raised relief map.
5. Using **water soluble** markers, draw symbols that represent different features on your relief map using the following key:
 - a. **Green** marker to draw a line along all the ridges (the up folded areas).
 - b. **Blue** marker to draw a line along all the valleys (the down folded areas).
 - c. **Red** marker to indicate any abandoned mines with a * symbol.
 - d. **Purple** marker to indicate cities with a # symbol.
 - e. **Brown** marker to indicate a farm with a colored-in area.
 - f. Add additional colors as wanted to represent applicable things that you are studying.
6. You have made a model of the land surface or a raised relief model.
7. Predict how water is going to flow on your model when we spray them with water. **What direction will water flow? Why?**
8. Are there areas on your model that have no outlet and will store water?
9. Have students take their models outside where they will spray their model with a spray bottle, in other words they are going to make it rain!

While Outside:

Have students form a circle and place their models in front of them toward the middle of the circle. Share spray bottles and give all students time to make it rain on their models. After students have sprayed their models, ask students to recall the definition of a watershed. **What is the edge or boundary of a watershed?** The high points. **What color are the high points on the model or map that you made?** Green.

- **What are the parts of your watershed?** Have them point out their answers on their maps. The water, the city, the farm, high points, low points, etc. **What is the white area?** If they don't know, ask: **What is the definition of a watershed?** Give them time to think about this. The white is the land area. **What could be on the land area other than cities, old mines, and farms?** Forests, deserts etc.
- Do a circular gallery walk so that students can view other students' models. **How are they the same? How are they different?**



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- Discuss each of the following questions with your students. Did any of your cities flood? If there was pollution on your city streets, could it get into your farm field? Could excess pesticides or fertilizers from your farms go into your cities? Could old mines affect water coming into cities or farms?
- **What is a watershed again? Do you think you live in a watershed?** Yes, we all live in a watershed.
- **What is a watershed a part of?** Give them time to think about this, talking with the person next to them. A landscape or bigger land area, our community, our water supply. It can also be a part of another watershed.