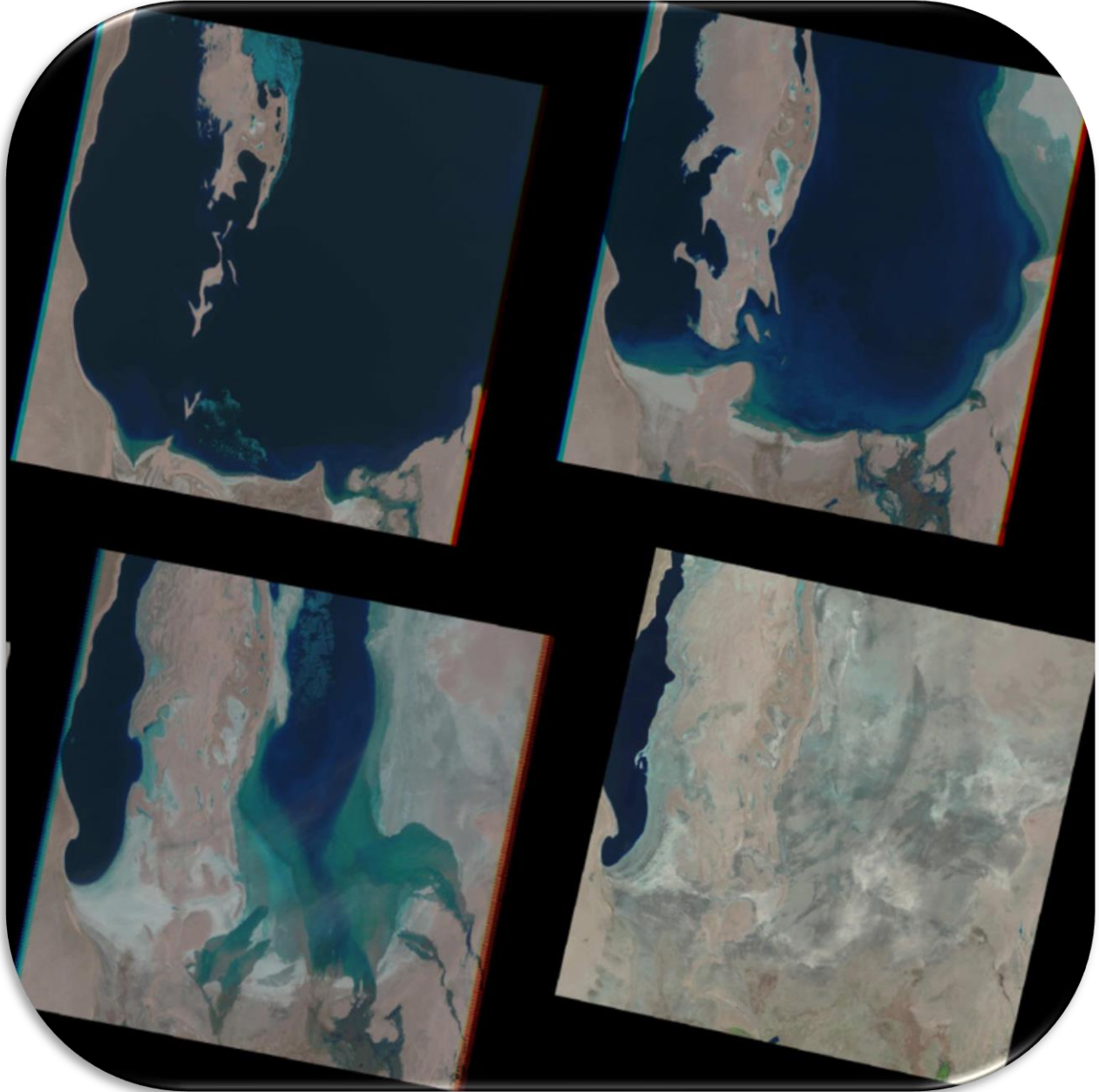


# Earth Science Everywhere

## Exploring Water Use and Quality



A Lesson for Middle School STEM

Developed by AmericaView

[www.americaview.org](http://www.americaview.org)

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This material is based upon work supported by the U.S. Geological Survey under Grant/Cooperative Agreement No. G23AP00683.

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**Introduction:** This lesson seeks to engage students in an examination of how human impacts on Earth Systems. Human activities have significantly altered the biosphere, sometimes damaging or destroying natural ecosystems. But changes to Earth’s environments can have different impacts (negative and positive) for different living things. Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise. This content provides opportunities for students to meet NGSS performance expectation **MS-ESS3-3**, see next page for details. This lesson is best suited for a STEM enrichment class or as an enrichment activity included as part of a larger science curriculum. It was written with a middle school audience in mind but could be adapted for high school students.

This lesson refers to electromagnetic spectrum and remote sensing topics. It is recommended that the “Exploring the Electromagnetic Spectrum” lesson is completed first.

**Keywords:** Natural Resources and Ecosystems, Human Activities, Satellite Imagery, Changing Water Conditions and Quality

**Background Information:** The Aral Sea was once the fourth-largest lake in the world; however, the Soviet Union diverted two major rivers to irrigate farmland, cutting off the inland sea from its water source in the 1960s,. The Aral Sea has been slowly disappearing ever since. Landsat satellite images show how the Aral Sea and its surrounding landscape has changed over the past few decades. The Landsat 5 (1986) and Landsat 8 (2024) images on the front of the Earth Observation Day poster show the changes in the Aral Sea area. Satellite imagery helps scientists to better understand the changes in the environment.

**Time Frame:** 45 minutes

**Materials:** In order to complete the activities in this Lesson, the following materials/resources are essential:

- Internet access
- One computer per pair of students (one-to-one is preferred)
- Google Earth
- Smartboard or other projection system

**Next Generation Science Standards addressed:**

Performance Expectation	Disciplinary Core Ideas	Crosscutting Concepts
<p><b>MS-ESS3: Earth and Human Activity</b>            MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.</p>	<p><b>ESS3.C: Human Impacts on Earth Systems</b>            Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth’s environments can have different impacts (negative and positive) for different living things.            Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.</p>	<p><b>Cause and Effect</b>            Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.</p> <p><b>Patterns</b>            Patterns can be used to identify cause and effect relationships.            Students could construct an argument from evidence for how patterns can be used to identify cause and effect relationships between increases in human populations and negative impacts on Earth.</p> <p><b>Stability and Change</b>            Stability might be disturbed either by sudden events or gradual changes that accumulate over time.            Students could analyze and interpret data on how stability [of] the biosphere might be disturbed either by sudden events or gradual changes that accumulate over time [due to] human activities.            Examples of human impacts can include water usage (such as the withdrawal of water), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).</p>

### **Evidence Statements**

1. Identifying scientific evidence.
2. Evaluating and critiquing the evidence.
  - a. Students evaluate the given evidence, identifying the necessary and sufficient evidence for supporting the claim.
  - b. Students identify alternative interpretations of the evidence and describe why the evidence supports the student's claim.
3. Analyzing and Interpreting Data.

Use graphical displays of large data sets to identify temporal and spatial relationships.  
Students could use graphical displays of large data sets to identify relationships [between] per-capita consumption of natural resources and negative impacts on Earth
4. Constructing Explanations and Designing Solutions.

Apply scientific ideas, principles, and/or evidence to construct, revise and/or use an explanation for real-world phenomena, examples, or events.
5. Engaging in Argument from Evidence.

Compare and critique two arguments on the same topic and analyze whether they emphasize similar or different evidence and/or interpretations of facts. Students could compare and critique two arguments [about the effects of] human activities [on] the biosphere, analyzing whether the arguments emphasize similar or different evidence.
6. Obtaining, Evaluating, and Communicating Information.

Evaluate data, hypotheses, and/or conclusions in scientific and technical texts in light of competing information or accounts. Students could evaluate data and conclusions in technical texts [related to] engineered activities and technologies [that can help reduce] negative impacts on Earth [from] consumption of natural resources.

### **Warm-Up: 10 minutes**

Display page 6 on a screen for the entire class and pose the following questions:

“What is going on in this part of Earth?”

“What kind of differences do you notice?” and

“What do you wonder?”

Have students turn to their neighbor and give them a few minutes to discuss their ideas. Then have the students discuss their ideas as a class.

### **Notable features in the image:**

Lake: Dark feature on the image. What happened to the lake since 1986? Got much smaller.

Size of the lake: These Landsat 5 and 8 satellite images were acquired in 1986 and 2024 showing how the lake area was changed.


Dry landscape: The areas that dried

### **Reading Activity: 10- 15 minutes**

Once the warm-up discussion has ended, direct the students to the NASA Earth Observatory website and have them read the “[World of Change: Shrinking Aral Sea](#)” article and view any [videos associated](#) with the article.

### **Google Earth Exploration: 10 -15 minutes**

Have the students enter “Aral Sea” into the search bar of Google Earth (<https://earth.google.com/>) and zoom to the location. What do they notice? Aral Sea was one of the largest lakes of Earth. Discuss ideas about what affected the lake and its water quality. While it can be a source of human disturbance and ecosystem alteration, it can also provide more land for farmers. Notice the large area of farmlands in the south of the lake.

Next, have the students zoom out to see this location as it relates to where they live. Have them use the measure or ruler tool  to find out how far away it is from their home. Have them list the countries having parts of the lake.

Time permitting, students should view Google Earth Engine’s [Timelapse page](#): Have students scroll down to “Drying of the Aral Sea” to view its change since 1984.

### **Career Exploration: 5 minutes**

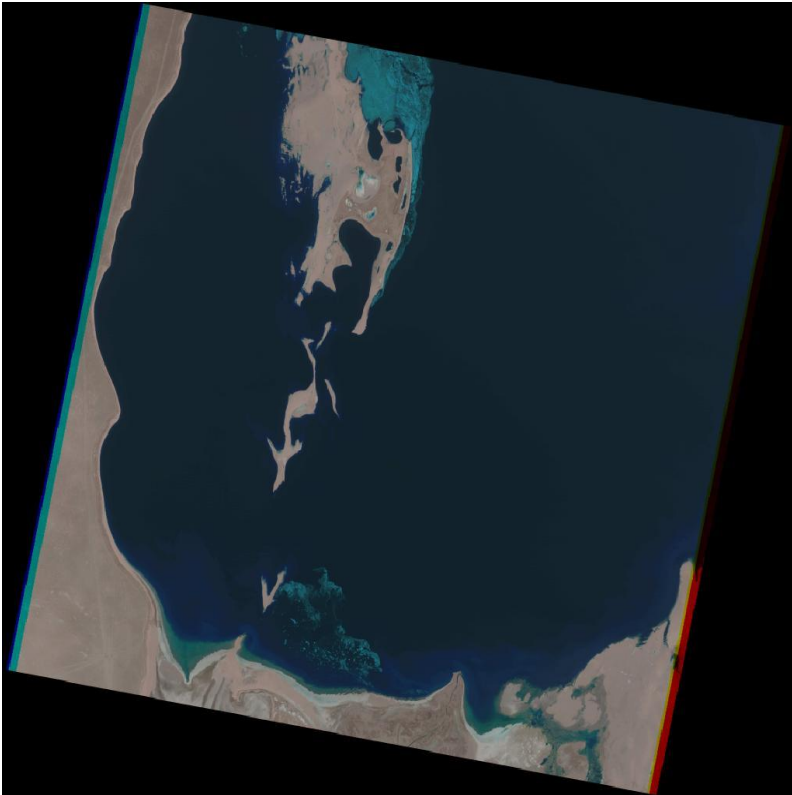
Have the students navigate to the below website to explore Environmental Protection Specialist careers within the U.S. Department of Interior. This page gives details about job qualifications and if they scroll towards the bottom of the page, they can explore more specific jobs within that category. <https://careers.doi.gov/occupational-series/environmental-protection-specialist>

If there is additional time or if you want to make this a longer activity in the future, begin at the below link. Students can click on “Find Your Path” then “Get Started” to search careers based on their personal interests.

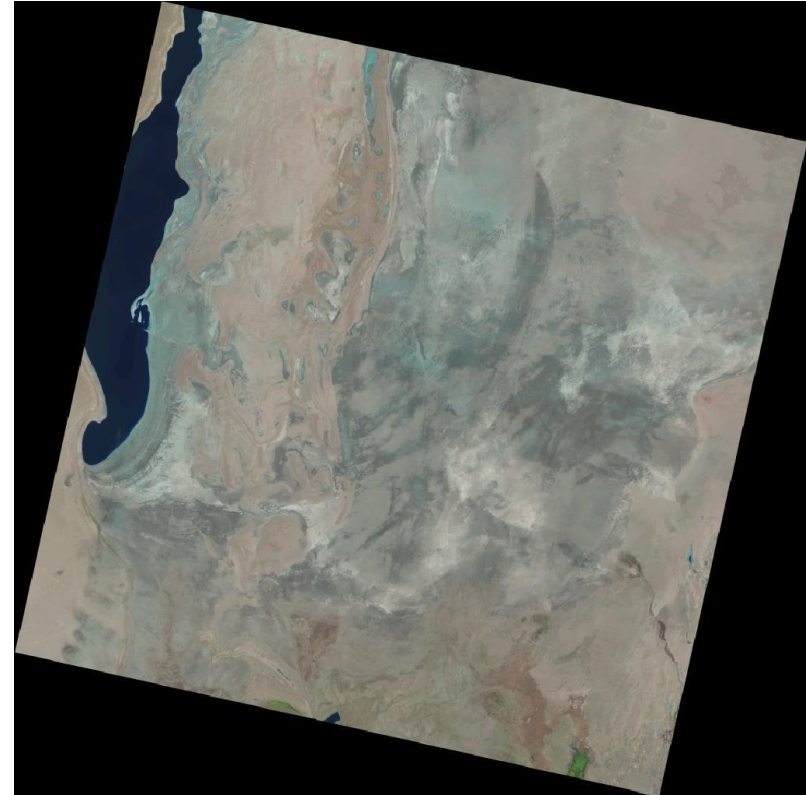
<https://careers.doi.gov/>

**Wrap-up: 5 minutes**

Have the students play the [online game](#) to test their comprehension of the main topics of the lesson. The printable quiz is also provided on page 7.



Landsat 5 Satellite image, Date Acquired: 04/10/1986



Landsat 8 Satellite image: Date Acquired: 06/05/2024

*Note: Each image covers 185 kilometers by 185 kilometers (or 115 miles by 115 miles)*

What is going on in this part of the world?

What kind of differences do you notice?

What do you wonder?



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1. Why do lakes dry up?

A  Due to human activities and/or climate change

B  Too much rain fall

C  Less evaporation of water from lakes

2. What happens to the fish when a lake dries up?

A  The fish will be happy and dance      B  The fish will die

C  Nothing will happen to the fish

3. What happens to the chemicals dissolved in a lake's water when the lake dries up?

A  The chemicals will disappear

B  The chemicals will be exposed, which can be harmful to people

4. What is the largest lake dried up?

A  Lake Michigan      B  Lake Ontario      C  The Aral Sea

5. What is it called when a lake dries up?

A  A dry lake bed, also known as a playa      B  Rock

C  River