

Lesson Title:

How Humans Changed the Santa Cruz River

Essential Question(s):

Can humans help restore an ecosystem?

Where did the river go, and why is it coming back?

Time:

4 class periods (55 min each) + a field trip to the river

Overview:

Students will investigate how human consumption of water resources has impacted the Santa Cruz River and evaluate how restoration efforts have affected the riparian ecosystem. Students will analyze historical photos, groundwater data, maps, biodiversity observations, and information about reclaimed water before constructing a CER argument. The lesson will include a field trip to the river with students nature journaling along the river and possibly collecting some biodiversity data.

Learning Objectives:

- I can explain how human water use has altered the Santa Cruz River
- I can analyze multiple sources of evidence
- I can construct and engage in evidence based argument about human impacts on ecosystems.
- I can describe how restoration efforts influence biodiversity.

Arizona Standards:

8.E1U3.8 Construct and support an argument about how human consumption of limited resources impacts the biosphere.

- Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing extinction of many other species. But changes to Earth's environment 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.

Vocabulary

- Biodiversity
- Habitat
- Riparian ecosystem

- Groundwater
- Reclaimed water
- Species richness
- Restoration
- Consumption
- Biosphere
- Evidence

Lesson Flow:

Day 1

Driving Question	Where did the river go?
Activity	Teacher Actions
I Notice, I Wonder, It Reminds Me Of	10 min Using slides or physical photos, provide students with pictures of the Santa Cruz River at different time periods and conditions: • Early 1900s with flowing water • 1980's when it was dry • Recent picture with restored flow For each picture, students should write observations using the I Notice, I Wonder, It Reminds Me Of protocol. 10 min Partner Share Students compare observations with partners, 10 min Small Group Assign each group one photo to focus on and have them create an anchor chart of their observations for that photo. The focus should be on getting observations, questions, and connections on paper, not on answering questions.
Explore Historical Data	20 min Provide students with several pieces of data that have contributed to the changes in the river:

	• Population growth of Tucson • Groundwater levels in Tucson • Maps of the river and surrounding areas For each data piece, students should answer the following questions: 1. What is the graph/chart about? 2. What story is the data telling you? 3. What questions do you have about the data?
Exit Ticket	5 min Students will answer the question: • Based on evidence from today, what do you think happened to the Santa Cruz River?

Day 2

Driving Question	How did humans change the river?
Activity	Teacher Actions
Data Investigation Stations	Review answers from exit tickets Set up stations for students to rotate through: • Station 1 - Groundwater Levels ○ Students will analyze graphs showing declining groundwater over time. ○ Questions ■ What trend do you notice? ■ What could be the cause of the trend? • Station 2 - Water Consumption ○ Students will analyze graphs showing annual water use and population growth. ○ Questions ■ What trends do you notice? ■ What relationship exists between the two graphs? ■ Is there anything confusing to you? • Station 3 - River Flow

	○ Students will analyze graphs or charts showing the flow of the river over time. ■ What do you notice? ■ What has changed? ● Station 4 - Riparian Habitats ○ Students will compare photos of the same area, but different time periods. The photos should show the healthy riparian area when the river was flowing, a dry wash when the river had no water, and the restored riparian habitat. ○ Questions ■ What provides shade from sunlight in each photo? ■ How does the vegetation differ in each photo? ■ What type of wildlife do you think might live here? ● Station 5 - Biodiversity ○ Students will analyze the biodiversity of the Santa Cruz River over time (birds, dragonflies, trees, turtles, fish, etc. ○ Questions: ■ What trends do you notice? ■ How might water availability affect biodiversity?
Class Discussion	Whole group Discussion Questions: 1. After analyzing all of this data, what has happened to the Santa Cruz River? 2. How are all of these events related? Individual After discussing the two questions, have students create a cause and effect chain. Whole Group Create a class anchor chart of the cause and effect chain. Students should work to create the consensus model. Afterwards, students can return to their chain and improve their model.

	Example: Population Growth → More consumption of groundwater → Groundwater declines → River stops flowing → Riparian Habitat lost → Biodiversity declines
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Day 3

Driving Question	Can humans restore ecosystems?
Activity	Teacher Actions
Field Trip (if possible)	Coordinate with Pima County Environmental Education to coordinate an “Ecosystem Discovery” Field Trip. Field Trip Request Form See Pima County Website for more info. Field trip should include nature journaling, learning about restoration efforts, and collecting species richness data while at the river. *If a field trip is not possible, provide students with photos and video that show current river conditions as a virtual field trip. Explain restoration efforts. Provide students with recent raw data on any of the following: • Species Richness • Bird Counts • Plant Diversity • Dragonfly and Damselfly counts • Turtle counts • Water Depth • Temperature • Flow Questions: 1. What patterns exist? 2. What evidence suggests restoration is working? 3. Can restoration fully undo what has been done?

Exit ticket	What is one piece of evidence you would tell someone about to show that restoration efforts should continue?

Day 4

Driving Question	Can humans help restore ecosystems?
Activity	Teacher Actions
CER	Review • Evidence from field trip (or evidence provided) • Observations from photos • Historical data Review Claim, Evidence, Reasoning (CER). Look at an unrelated example. Provide students time to write their own CER. • Prompt: Construct an argument explaining how human consumption of water resources has impacted the Santa Cruz River. • Students must use: ○ Historical evidence ○ Data Graphs ○ Biodiversity data ○ Field observations • Use rubric for evaluating CER.