

# Lessons 21–22

## Lake Formation after the Addition of Dams

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### Prepare

In Lesson 11, students traced the flow of the Colorado River. In this set of lessons, students further explore the Colorado River system using maps and a model as they begin investigating the Concept 4 Focus Question: **How do humans interact with Earth’s features and processes?** In Lesson 21, students model the Colorado River using stream tables. In Lesson 22, students use their models to investigate how dams can cause changes in the surrounding environment. Students then use evidence from their investigation to support an explanation for how dams can (1) cause a river to swell and form a lake and (2) cause a different part of the river to dry up.

### Student Learning

#### Knowledge Statement

Human-made structures such as dams can change nearby natural features and processes.

### Concept 4: Human Interactions with Earth

#### Focus Question

How do humans interact with Earth’s features and processes?

#### Phenomenon Question

How do dams affect the environment?

## Objectives

- Lesson 21: Create a model of the Colorado River.
- Lesson 22: Identify the effects of dams on the environment.

## Texas Essential Knowledge and Skills Addressed

- 4.2B **Collect and record data by observing** and measuring, using the metric system, and **using descriptive words** and numerals such as labeled drawings, writing, and concept maps. (Addressed)
- 4.3B **Represent the natural world using models** such as the water cycle and stream tables and **identify their limitations**, including accuracy and size. (Addressed)

## English Language Proficiency Standards Addressed

- 2E Use visual, contextual, and linguistic support to enhance and confirm understanding of increasingly complex and elaborated spoken language.
- 3E Share information in cooperative learning interactions.

## Materials

|                    |   | Lesson 21 | Lesson 22 |
|--------------------|---|-----------|-----------|
| <b>Student</b>     | Science Logbook (Lesson 21 Activity Guides A and B)   | ●         |           |
|                    | Model the Colorado River (1 per group): 1 stream table from Lesson 8, 1 9-ounce clear plastic cup, 1 bucket (or other plastic container) from Lesson 9, water, extra sand and soil (optional)   | ●         |           |
|                    | Science Logbook (Lesson 22 Activity Guides A, B, and C)   |           | ●         |
|                    | Effects of a Dam on a River Investigation (1 per group): 1 stream table from Lesson 8, 1 9-ounce clear plastic cup, 1 plastic dam with small hole, half of a brick or roll of modeling clay, 1 bucket (or other plastic container) from Lesson 9, water |           | ●         |
| <b>Teacher</b>     | Theodore Roosevelt Dam Photograph (Lesson 21 Resource A)  | ●         |           |
|                    | Pre-1903 Colorado River System Map (Lesson 21 Resource B)   | ●         | ●         |
|                    | Model the Colorado River Setup Instructions (Lesson 21 Resource C)  | ●         |           |
|                    | Effects of a Dam on a River Investigation: 2 thin, flexible plastic cutting boards (15" × 11" or larger); scissors; single-hole punch   |           | ●         |
|                    | Dam Gates Photograph (Lesson 22 Resource B)   |           | ●         |
|                    | Present-Day Colorado River System Map (Lesson 22 Resource C)  |           | ●         |
|                    | Driving question board  |           | ●         |
| <b>Preparation</b> | Cue beaver dam video: <a href="http://phdsci.link/1002">http://phdsci.link/1002</a> .   | ●         |           |
|                    | Prepare plastic dams for dam investigation (see Lesson 22 Resource A).  |           | ●         |

# Lesson 22

**Objective:** Identify the effects of dams on the environment.

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## Launch 4 minutes

Show students the photograph of the dam gates (Lesson 22 Resource B).



- ▶ What do you notice about the dam shown in the photograph?
  - *There is water on both sides of the dam.*
  - *There is water coming out of some of the openings in the dam but not others.*

### Agenda

Launch (4 minutes)

Learn (38 minutes)

- Effects of a Dam on a River Investigation (16 minutes)
- Construct Explanations (12 minutes)
- Compare Colorado River System Maps (10 minutes)

Land (3 minutes)

Explain that dams are not usually solid walls and that most dams have gates that can be opened and closed. Point out that two of the gates in the photograph are open while the others are closed.

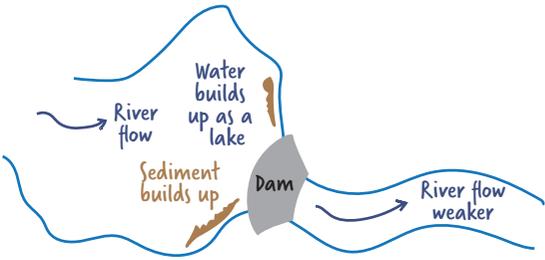
Show students one of the plastic dams they will be using in their investigation. Ask students how they think placing the dam will change the amount of water that flows into the bottom part of their model river. Guide students to consider how the hole will act as a gate to control water flow.

# Learn 38 minutes

## Effects of a Dam on a River Investigation 16 minutes

Allow students to return to their groups from the previous lesson and retrieve their stream tables. Distribute the plastic dams and instruct students to follow the directions for investigating the effects of a dam on a river in their Science Logbooks (Lesson 22 Activity Guide A).  As students work, circulate the classroom to support teamwork and encourage students to record detailed observations.

*Sample observations:*

| Observations  |  |
|---|--|
| <p style="text-align: center;"><b>Notes</b></p> <ul style="list-style-type: none"> <li>▪ <i>Water got backed up behind the dam and formed a pool.</i></li> <li>▪ <i>Sediment built up near the dam.</i></li> <li>▪ <i>There was less sediment in the river after the dam. The water looked cleaner.</i></li> <li>▪ <i>There was a lot of sediment in the water pooling before the dam. The water looked muddy.</i></li> <li>▪ <i>The part of the river after the dam slowed down and dried up.</i></li> </ul> | <p style="text-align: center;"><b>Drawing</b></p>  |



### Teacher Note

As the investigation proceeds, students should observe that the addition of the dam to the model river causes water to pool behind the dam, the flow of water to decrease after the dam, and sediment to accumulate next to the dam.

If water is not pooling for some groups, consider allowing successful groups to work with those having difficulty. Also explain that the clay used to anchor the dam should be pressed into the stream table to make a seal so that water cannot flow underneath the dam.

Students may need to make multiple attempts. If there are sufficient materials, students may need to create a new river system due to degradation over trials (3E).

Support each group as needed by prompting with questions and providing feedback. If time permits, allow students to view other groups' stream table investigations in a Gallery Walk.

## Construct Explanations 12 minutes

Ask students to revisit the predictions they made about dams in the previous lesson. Have students discuss with their groups whether their observations from the investigation support their predictions.

Next, ask students to work in their groups to make a claim based on the evidence they collected during the investigation. Each group should write their claim along with evidence to support the claim on a whiteboard or chart paper. Once all groups are ready, have students participate in a Chalk Talk or Gallery Walk to provide feedback to other groups. Students should pay close attention to whether the evidence provided supports the claim made by each group.

Summarize students' discussions by recording example claims with evidence on a class claims chart.

*Sample class claims chart:*

| Impact of Dams  |   |
|---|---|
| Phenomenon Question: How do dams affect the environment?  |   |
| Claims  | Evidence  |
| <ul style="list-style-type: none"> <li>▪ <i>Building a dam on a river causes a lake to form behind the dam.</i></li> </ul>  | <ul style="list-style-type: none"> <li>▪ <i>In the stream table, water backed up behind the dam to form a pool.</i></li> </ul>  |
| <ul style="list-style-type: none"> <li>▪ <i>Building a dam on a river can cause part of the river to dry up.</i></li> </ul> | <ul style="list-style-type: none"> <li>▪ <i>After the dam was put in place, there was less water flowing to the area after the dam. That part of the river dried up.</i></li> </ul> |

Discuss the claims and evidence provided by students. Highlight claims that have strong evidence from the investigation to support them. Groups may adjust their claims or evidence based on peer feedback or the class claims chart before recording it in their Science Logbooks (Lesson 22 Activity Guide B).

Student groups should then work together to develop reasoning for why they believe each piece of evidence supports their claim. Student groups should meet with at least one other group to share their reasoning statements before recording them in their Science Logbooks (Lesson 22 Activity Guide B).

*Sample reasoning statements:*

- *Our claim that building a dam on a river can cause a lake to form was supported by our observations from the investigation. When we added a dam to our model river, water backed up and formed a pool behind the dam. This makes sense because if water flow is blocked, the water will build up unless it can go somewhere else.*
- *We observed that the flow of water stopped after we added a dam to our model river. Once the pool behind the dam filled up, a small amount of water came through. This shows that building a dam can cause less water to flow and can make rivers dry up.*
- *Our claim that building a dam can control the amount of water in the river was supported. During the investigation, when we added a dam to our model river, the flow of water after the dam decreased or stopped. We could have increased the water again by making the hole in the dam bigger or removing the dam completely.*

**Check for Understanding**

As students analyze their evidence, they should form statements by using the Claim, Evidence, Reasoning format to evaluate each claim.

**Evidence**

Look for evidence that all students

- include the claim they developed, and
- use reasoning to connect evidence they gathered during the investigation to support their claim.

**Next Steps**

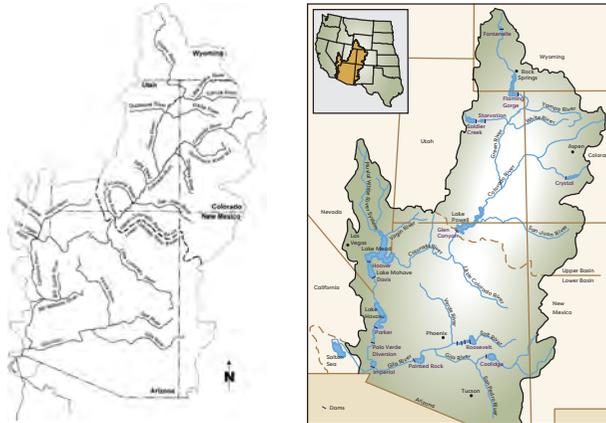
If students are struggling to form statements using the Claim, Evidence, Reasoning format, guide them to make connections between the evidence (data) from their investigations and its relationship to their claim.

**Compare Colorado River System Maps** 10 minutes

Display the pre-1903 map of the Colorado River system (Mueller and Marsh 2002, 9) (Lesson 21 Resource B) and the present-day map of the same region (Lesson 22 Resource C). Ask students to examine the maps and to trace the Colorado River on each one. As before, clarify any confusion about which parts of the maps represent the river. 

**Teacher Note**

The present-day map may not include some rivers that became smaller or only flow during rainy seasons due to dam construction. For example, portions of the Bill Williams River are perennial (flow year-round), but other parts are ephemeral (only flow during rainy seasons). This observation should be supported by the stream table investigation (2E).



Have students work with a partner to compare the Colorado River system maps by completing the comparison chart in their Science Logbooks (Lesson 22 Activity Guide C).

Sample comparison chart:

| What is similar between the two maps?  |  |
|--|--|
| <p><i>The Colorado River is in the same place.</i></p> <p><i>Other rivers touch the Colorado River, like the Green River and the Gila River.</i></p> |  |
| What is different between the two maps?  |  |
| Pre-1903 Map   | Present-Day Map  |
| <i>There are no lakes, only rivers.</i>  | <i>There are new lakes (Mead, Powell, Havasu, and others).</i> |
| <i>No dams are shown.</i>  | <i>Many dams are shown. They are near lakes.</i>               |
| <i>There are more rivers than in the present-day map.</i>  | <i>Some rivers aren't there.</i>                               |

After students have compared the two maps, provide the following prompt:

- ▶ **How do the Colorado River system maps support or refute your claims about how dams affect the environment?**
  - *The maps support our claim that building dams on rivers causes lakes to form because there were no lakes on the old map but there are lakes around the dams on the present-day map.*
  - *Some of the rivers are missing on the present-day map, which supports our claim that building dams can cause rivers downstream to dry up.*

Use this discussion to guide the class to agree upon an answer to the Phenomenon Question **How do dams affect the environment?** 🐙

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## Land 3 minutes

Display the driving question board and discuss with the class whether what they have learned about dams helps them answer any of their questions. Also ask whether they have any new questions they would like to add.

- ▶ **What questions do you still have about dams?**
  - *Is forming a new lake good or bad for the environment?*
  - *What happens to the environment when a river dries up?*
  - *Can fish get past the dam?*
  - *Do people ride boats in the lakes next to dams?*
  - *Do dams ever break?*

Point out that students still have many questions about dams. Tell students they will continue their study of dams in the next lesson as they investigate the Phenomenon Question **Why do people build dams on the Colorado River?**



### Extension

Students learned about erosion in Lessons 8–11. To show how dams cause erosion when water is released from a dam, consider having students watch a video of a dam release and discuss how dams affect the environment below the dam.

## Optional Homework

Students investigate a dam located in Texas, such as the Canyon Dam on the Guadalupe River, the Mansfield Dam on the Colorado River, or a dam in their local area. As a connection to their social studies learning (SS.4.8A), students should complete research to locate and compare maps of the area before and after the dam was built and determine whether any additional observations they make support their claims from this lesson.