Introduction/Motivation

Where does your water come from? Mountains, rivers, reservoirs? What is a reservoir? A reservoir is a human-made lake created by building a dam. Why do we need dams? When you turn on a faucet at home, where does that water come from? Why is there always water coming out? There is always a supply of water because we hold water in reservoirs. To do this, we must build dams.

Why else do we build dams? (Take suggestions; write answers on the board.) Dams are important because they provide water for domestic, industry and irrigation purposes. Dams often also provide hydroelectric power production and river navigation. Domestic use includes everyday activities such as water for drinking, cooking, bathing, washing, and lawn and garden watering. Dams and their reservoirs provide recreation areas for fishing and boating. They help people by reducing or preventing floods. During times of excess water flow, dams store water in the reservoir; then they release water during times of low flow, when natural flows are inadequate to meet water demand. When engineers design and maintain dams, they consider all these purposes.

Bagnell Dam on the Osage River in Missouri.

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For the next several lessons, you are going to be civil engineers working for the company Splash Engineering. Your main client is the government (also known as a "municipality") of Thirsty County. The government of Thirsty County has been receiving complaints from its residents over the last decade. The main problems include:

* Not enough water for people during the summer droughts.
* Farmers have trouble growing food without enough irrigation water.
* During drought periods, the Birdseye River is not deep enough for ships to cross to bring valuable goods to Thirsty County.
* Flash floods ruin houses and stores.
* Air pollution from a nearby coal-fired power plant makes people sick.

The Thirsty County government has hired the Splash Engineering firm (your class) to study the needs of the community and develop a solution that addresses those needs.

Lesson Background and Concepts for Teachers

A dam is built to control water through placement of a blockage of earth, rock and/or concrete across a stream or river. Dams are usually constructed to store water in a reservoir, which is then used for a variety of applications such as irrigation and municipal water supplies. Reservoir water can also be directed to flow through hydraulic turbines, producing electric power for use in homes and industries. Hydroelectric power is considered a renewable source of energy because the reservoir water that is used to generate electricity is continuously replenished. A dam using locks and canals, such as the series of locks on the Panama Canal, enables navigation through a human-made water route that must overcome elevation differences.

The disadvantages of dams include the resulting flooding of large areas of land (destroying flora and fauna), altering the physical characteristics of the river below the dam (also affecting flora and fauna), impeding fish migration, and killing large numbers of fish that pass through hydroelectric turbines. In recent years, engineers and scientists have begun to manage reservoirs and their releases to be less harmful to aquatic and terrestrial wildlife and plants, as well as humans residing below the dam—a method of water resource management called adaptive management.

Vocabulary/Definitions

[*adaptive management:*](https://en.wikipedia.org/wiki/Special%3ASearch?search=adaptive+management) The operation of dams and reservoirs to benefit not only human needs, but also the needs of the aquatic and terrestrial ecosystems impacted by the dam.

[*dam:*](https://en.wikipedia.org/wiki/Special%3ASearch?search=dam) A barrier to obstruct the flow of water, especially one made of earth, rock, masonry and/or concrete, built across a stream or river.

[*engineer:*](https://en.wikipedia.org/wiki/Special%3ASearch?search=engineer) A person who applies her/his understanding of science and mathematics to creating things for the benefit of humanity and our world.

[*hydroelectric power:*](https://en.wikipedia.org/wiki/Special%3ASearch?search=hydroelectric+power) Renewable energy generated by water flowing through turbines.

[*migration:*](https://en.wikipedia.org/wiki/Special%3ASearch?search=migration) To periodically move from one region or climate to another, as by wildlife such as birds and fish.

[*municipality:*](https://en.wikipedia.org/wiki/Special%3ASearch?search=municipality) A political unit, such as a county, city, town or village, incorporated for local self-government.

[*reservoir:*](https://en.wikipedia.org/wiki/Special%3ASearch?search=reservoir) An artificial lake where water is collected and stored behind a dam.

[*turbine:*](https://en.wikipedia.org/wiki/Special%3ASearch?search=turbine) A machine that converts the kinetic energy of falling water (or any moving fluid, including steam, gases or air) into electrical energy by connecting a generator to a rotating shaft that is spun by water pressure pushing blades, buckets or paddles.

Associated Activities

* [How Much Water Do You Use?](https://www.teachengineering.org/activities/view/cub_dams_lesson01_activity1) - Students explore one of the main reasons why dams are built—to satisfy everyday domestic water use. Students track their own water use during one week, and from that data estimate a community's residential water needs from a potential regional dam.

Lesson Closure

Dams can be useful for a variety of reasons. What are some purposes for which we create dams? (Answers: To supply water for irrigation, municipal water, flood control, hydroelectric power generation, river navigation.) What might be negative effects from a dam? (Answers: Upstream flooding that destroys animals, plants, ecosystems and private property; downstream alteration of terrain, ecosystems, plants and wildlife; impeding fish migration, killing fish that pass through turbines, etc.)

In the case of our imaginary Thirsty County, why should the municipality consider building new dams? (Answers: To provide enough water for people and farmers during the summer, to allow boats to cross Birdseye River year round, to help control flash floods, to produce electricity without air pollution.)

Assessment

**Pre-Lesson Assessment**

*Brainstorming:* Ask students to think of all the different ways in which they use water on an everyday basis. Possible answers include drinking, bathing, cooking, swimming, cleaning, etc. Write these answers on the board and then ask the students to tell you where the water comes from for these activities. Students may answer that water comes from rivers, lakes, and streams, in which case you can start a discussion about the need for dams to store water. Be sure to mention that 33% of American citizens get their water from groundwater sources.

**Post-Introduction Assessment**

*Teaming:*After you have introduced the hypothetical Thirsty County scenario, divide the class into engineering teams of 2-3 students each, and ask each team to write a short "proposal" response to the municipality of Thirsty County to address the residents' needs. Proposals should comment on the needs of the residents, some possible solutions (at least a Plan A and Plan B), and benefits/problems associated with each plan proposed. For example, students may write a statement that says their team will "address the residents' needs by designing a dam that provides people with water during summer droughts, protects buildings from flash floods and storms, and produces hydropower as a clean energy alternative to coal-fired power plants." This exercise helps students understand their role as civil engineers working for Splash Engineering firm. Emphasize that engineers must propose multiple plans to the County Board and convince the board members that their design is worth spending taxpayer money. Encourage students to address topics such as water-saving appliances, efficient water use in gardens and landscaping, (both water conservation measures) and not building on land that has a high risk of annual flooding.

**Lesson Summary Assessment**

*Pros and Cons:*Ask students to think of all the benefits of building a dam (such as water storage, hydroelectricity, flood mitigation, etc.). Create a list of these benefits on the board. Next, ask students to think of some negative effects of dam construction (such as impeding fish migration, damaging flora and fauna, etc.). Next to the list of benefits, create a list of these negative effects. Ask students: "What should engineers do when their designs have both positive and negative impacts on society?" Do students think this is a common dilemma for engineers? (Answer: All engineering projects have positive and negative effects. The main job of engineers is to develop plans to help address problems people have without creating new problems or making other problems worse. If Thirsty County has no money for schools and people are starving in the streets, spending money on a dam might not be the best engineering solution to the water issues Thirsty County faces.)

Lesson Extension Activities

Plan a field trip to a nearby dam to give students a real-world sense of these (often) gigantic engineering structures. If a field trip is not possible, show students a library video on dams or photographs of the Hoover Dam, located on the border between the states of Arizona and Nevada; see a link in the Additional Multimedia Support section.