



FUTURE U.

Boeing 360 Experience Companion

Objectives

Students will:

- **Reflect** on the life and work of Ismail al Jazari
- **Create** a water wheel prototype
- **Identify** and **analyze** the pros and cons of hydropower

Ismail al Jazari

Overview

In this hands-on activity, students will explore concepts integral to the work of Ismail al Jazari as they build their own water wheel and investigate its application in today's society.

Standards

ITEA Standards for Technological Literacy

- Standard 1: Scope of Technology
 - F: New products and systems can be developed to solve problems or to help do things that could not be done without the help of technology.
- Standard 2: The Relationship Among Technologies and the Connection between Technologies and Other Fields
 - E. A product, system, or environment developed for one setting may be applied to another setting.

NGSS Standards

- MS Human Impacts
 - MS-ESS3-3: Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

Materials

- Water Wheel Analysis handout, one per student
- Devices with internet access, enough for half the class
- For groups of 2–3 students:
 - 2 strong paper plates
 - 6–8 bathroom-size paper cups
 - 2 wood skewers (used for grilling, kebabs, etc.)
 - Several pieces of duct tape

- For the class to share:
 - Pitchers of water, at least 3
 - Buckets to pour the water into, at least 3

Connect

- Remind students that they recently learned about Ismail al Jazari; a polymath whose work in the 1100s laid the groundwork for engineering and hydraulics work that continues today.
- Guide students in a quick discussion about this scientist with questions such as:
 - What sticks out in your mind about the life of this scientist?
 - What were some of Ismail al Jazari's largest contributions to science and society?
 - One defining characteristic of Ismail al Jazari's work was that it almost always incorporated water. Even though he lived close to a thousand years ago, what water systems do we use or rely on today that we can credit to him?

Be Inspired

- Tell the class that several of al Jazari's innovations incorporated a water wheel—a large wheel driven by flowing water that could be used to power other machinery or raise water to a higher level. Today, the class will be constructing their own water wheels and investigating the pros and cons of hydropower.
- Pass out one Water Wheel Analysis handout to each student, and divide the class into pairs or groups of three. In order to prepare students for the activity:
 - Read through the handout together.
 - Show students where they can find the materials needed.
 - Explain that once their wheel is constructed, the class will use the internet to learn about what the water wheel has evolved into today, as well as its potential pros and cons.

Reflect

Bring the students back together near the end of the class session and guide students in reflecting on the following questions in small groups or all together:

- What are the biggest pros and cons of hydropower?
- How can the effects of hydropower on the environment be minimized?
- Would you recommend that hydropower be used in your community? Why or why not?

Look forward

- Water is not only important for innovation. A clean and constant water supply is also integral for maintaining quality of life. Encourage students to explore water conservation by:
 - Calculating their water footprint. Approximately how many gallons of water do they use on a daily basis?
 - Creating a personal water conservation plan, including ways to reuse and recycle water.
 - Learning more about the concept of water-wise (or water efficient) gardens before they plan and plant their own.

Background: In the past, water wheels were used to convert flowing or falling water into power. The force of the water moved the wheel, and the power of the wheel was transmitted to machinery through the rotating axle (or shaft) in the wheel's center.

Your Job

Step 1: Build

Gather the materials below and work as a group to create your own water wheel prototype that will rotate when water is poured over it.

Materials

- 2 paper plates
- 6–8 paper cups
- 2 wood skewers
- Duct tape

Step 2: Test

Use a pitcher of water and a bucket to test and modify your water wheel until it rotates when water flows into it. As you watch it spin, imagine how it could generate power if it was built on a larger scale.

Step 3: Investigate

1. Today, the water wheel has evolved into the hydropower turbine. Watch this video to learn more about hydropower: youtu.be/tpigNNTQix8
2. Then read the following articles about the pros and cons of hydropower. As you read, take notes below.

Pros: tinyurl.com/34p4yfju

Cons: tinyurl.com/swk9f247

Pros	Cons