Lesson Title: Banu Musa Brothers

Activity Overview:

Students will reflect on invention as a way of solving communal problems. They will learn about the Banu Musa brothers, their Book of Ingenious Devices, and their other contributions to the Islamic scientific heritage. They will create a model of one of the Banu Musas' devices, and will conduct a mock "Gallery Walk" activity to share their models.

Lesson time: 60 Minutes

Learning Objectives:

- Identify who the Banu Musa brothers were and why their inventions mattered.
- Explore how engineers use observation, creativity, and experimentation.
- Reflect on how scientific discoveries of the Banu Musa brothers reflect Islamic principles of seeking knowledge and serving others.

Sources:

https://www.1001inventions.com/trick-devices/

https://www.newarab.com/features/banu-musa-9th-century-brothers-who-reinvented-mechanics

Materials:

- School Maker Space or an assortment of building materials
- Banu Musa PowerPoint
- Banu Musa invention image handouts
- Gallery Walk Activity Sheet
- Final Reflection half-sheet

Lesson Steps:

1. Intro Journal (5 minutes): Imagine you are living 1,200 years ago. You have no electricity, no computers, and no modern machines. What machines would make life easier? What problems would you want to solve?
2. Content (10 Minutes): Using the PowerPoint provided, the teacher will introduce The Banu Musa brothers:
    i) The Banu Musa ("Sons of Musa") were three brothers who lived in Baghdad during the Abbasid period (9th century): Muhammad ibn Musa, Ahmad ibn Musa, al-Hasan ibn Musa
    ii) Their father was an astronomer, and they grew up during the Abbasid intellectual movement centered around the House of Wisdom.
    iii) They studied mathematics, astronomy, geometry, and engineering
    iv) They wrote a famous book: *Kitab al-Hiyal* ("The Book of Ingenious Devices"); It described around 100 mechanical inventions. Many used water pressure, air pressure, valves, gears, automatic movement.
3. Create a Model of one of Banu Musa's inventions (30 minutes):
    i) Using your school's Maker Space (or a collection of various building materials, such as cardboard, pipe cleaners, recycled containers/plastics, construction paper, etc., if your school does not have one), you will have students create a model of one of the Banu Musa's devices.
        (1) Divide your class into groups. Each member of the group should have a role: research, model design, materials manager, docent (for the next activity).
        (2) Each group will be assigned one of Banu Musa's devices such as:
        (3) Each group will build a model of the device assigned with the available materials. Each model should include a short description of what the device is and how it works.
4. Gallery Walk (10-15 Minutes): After their models are complete, students will rotate as a group around the room to each groups model. At each model, the group docent will explain the model—what the device was called, what it did, how it worked, etc. As each model is explained, students will take notes on Gallery Walk worksheet provided.
5. Closing Activity (5 Minutes):
    i) Give each student an index card or half-sheet of paper.
    ii) Put this prompt on the board:
    iii) The Banu Musa used science and engineering to make people's lives easier. What is one problem in your school, home, or community that you would like

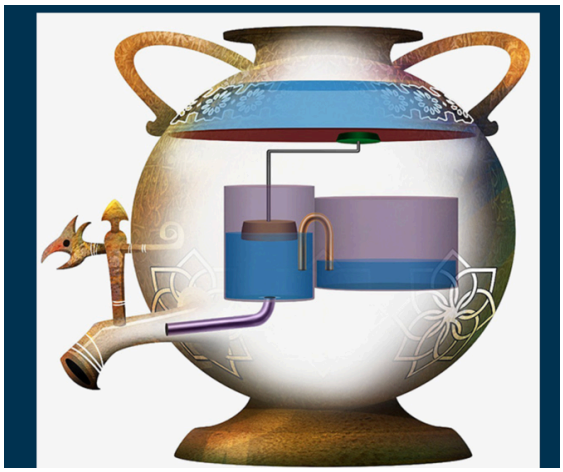
to solve? If you could invent one machine or device to help people, what would it do?

iv) Have them sketch a quick picture and write **2–3 sentences** explaining: What problem it solve, how it would help people, and why solving that problem is an act of serving others.

BANU MUSA ENGINEERING CHALLENGE

1. Automatic Water-Dispensing Jar

A vessel that measured water, paused, and then began flowing again.



Visual reference from the lesson materials.

WHAT DID IT DO?

When the tap was opened, the jar released a measured amount of water, stopped for a time, then began flowing again. The cycle continued until the jar was empty. It is a good example of using mechanics to control how much water is used at one time.

HOW DID IT WORK?

The exact mechanism was hidden inside the vessel. Internal chambers, tubes, siphons, and valves controlled when water could reach the spout. The important idea for your model is that the device did not simply pour continuously: it controlled the flow in stages.

ENGINEERING IDEAS

- controlled water flow
- valves and siphons
- timing / delay
- automatic action

YOUR BUILD CHALLENGE

Build a simplified model that shows a storage vessel, a spout, and at least one hidden chamber or tube that could control the flow. Your model does NOT have to dispense water. Use labels and arrows to show the pause-and-restart idea.

SUGGESTED MATERIALS

- plastic bottle or cup
- straws or flexible tubing
- cardboard
- modeling clay
- tape
- small cup or bottle cap

YOUR MODEL SHOULD SHOW

- The main parts of the device and how they connect.
- Arrows or labels showing what moves, flows, opens, closes, or lifts.
- A short label explaining the problem the device addressed.

DOCENT PREP

- What problem or need could controlled water use address?
- What part of your model represents the hidden control system?

ISLAMIC STUDIES CONNECTION

How can useful knowledge, careful observation, and creative problem-solving become ways of serving other people?

• Why is this more sophisticated than an ordinary jar with a hole?	

Group members: _____

BANU MUSA ENGINEERING CHALLENGE

2. Self-Regulating Oil Lamp

A lamp designed to keep itself working with less human adjustment.



Modern reconstruction based on historical descriptions.

WHAT DID IT DO?

The Banu Musa described improved oil lamps that could regulate the fuel level and, in one design, advance the wick as the oil level changed. The goal was to keep a lamp burning more steadily without someone constantly adjusting it.

HOW DID IT WORK?

As oil was used, a float moved downward. That motion could be transferred through a mechanical linkage to move the wick forward. Other parts of the lamp helped keep the oil at a useful level. The Banu Musa combined earlier lamp ideas with improved fluid-control mechanisms.

ENGINEERING IDEAS

- float as a sensor
- mechanical linkage
- feedback
- automatic adjustment

YOUR BUILD CHALLENGE

Build a NO-FLAME model showing how a falling float could cause another part to move. Your group may use string, a craft-stick lever, or a cardboard wheel to make the connection. Do not use real oil, candles, matches, or flame.

SUGGESTED MATERIALS

- paper cup or small container
- bottle cap or ping-pong ball as a float
- yarn as a pretend wick
- craft sticks
- cardboard gear or wheel
- string
- tape

YOUR MODEL SHOULD SHOW

- The main parts of the device and how they connect.
- Arrows or labels showing what moves, flows, opens, closes, or lifts.
- A short label explaining the problem the device addressed.

DOCENT PREP

- What does the float “sense” in this system?
- How does the device respond when the oil level changes?
- Where do you see the idea of feedback or automatic adjustment?

ISLAMIC STUDIES CONNECTION

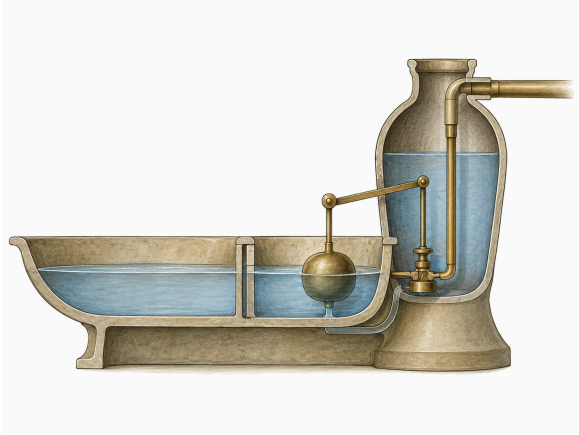
How can useful knowledge, careful observation, and creative problem-solving become ways of serving other people?

Group members: _____

BANU MUSA ENGINEERING CHALLENGE

3. Constant-Level Animal Watering Trough

A float-and-valve system that helped keep water at a steady level.



Modern reconstruction based on historical descriptions.

WHAT DID IT DO?

One Banu Musa design applied a float valve to an animal drinking trough. As animals drank and the water level fell, the system could admit more water. When the trough refilled to the desired level, the rising float helped close the valve again.

HOW DID IT WORK?

A float rested on the water. The float was connected by a linkage to a valve in the incoming water pipe. Low water made the float drop and the valve open; rising water lifted the float and moved the valve toward closed. This is an early example of feedback control.

ENGINEERING IDEAS

- float valve
- feedback loop
- water-level control
- sensor + response

YOUR BUILD CHALLENGE

Build a simplified trough showing a water source, a valve, a float, and a linkage between the float and valve. The model may be dry. Make the float or linkage movable if possible so you can demonstrate what happens when the water level rises or falls.

SUGGESTED MATERIALS

- shallow plastic container
- plastic bottle
- straw or flexible tubing
- bottle cap / ping-pong ball float
- craft stick or pipe cleaner linkage
- tape or clay

YOUR MODEL SHOULD SHOW

- The main parts of the device and how they connect.
- Arrows or labels showing what moves, flows, opens, closes, or lifts.
- A short label explaining the problem the device addressed.

DOCENT PREP

- Which part is the sensor? Which part does the controlling?
- How does the system correct itself when the water level drops?
- Where might we see a similar idea in modern life?

ISLAMIC STUDIES CONNECTION

How can useful knowledge, careful observation, and creative problem-solving become ways of serving other people?

Group members: _____

BANU MUSA ENGINEERING CHALLENGE

4. Mechanical Clamshell Grab

A tool for retrieving material or lost objects from underwater.



Modern reconstruction based on historical descriptions.

WHAT DID IT DO?

The Banu Musa described a clamshell-style grab used to recover objects from the beds of streams or other underwater places. A later history of Islamic technology describes two hinged copper half-cylinders that could be lowered open, pulled shut around material, and raised again.

HOW DID IT WORK?

Two scoop-like halves were connected by hinges. One rope lowered the open grab. After it reached the bottom, another rope pulled the halves together so they trapped an object or material. The closed grab could then be lifted back to the surface.

ENGINEERING IDEAS

- hinges and pivots
- tension in ropes
- gripping force
- simple machines

YOUR BUILD CHALLENGE

Build a small clamshell grab that can open and close. Try to make it pick up a light object such as a pom-pom, paper ball, or eraser. Focus on the hinge and the string system—not on lifting weight.

SUGGESTED MATERIALS

- 2 paper or plastic cups / 2 spoons
- craft sticks
- string
- brass fastener or tape hinge
- cardboard frame
- tape

YOUR MODEL SHOULD SHOW

- The main parts of the device and how they connect.
- Arrows or labels showing what moves, flows, opens, closes, or lifts.
- A short label explaining the problem the device addressed.

DOCENT PREP

- What problem would this tool solve that hands alone could not?
- How does pulling on the rope change the position of the jaws?
- Why would this be useful for canal, river, or well work?

ISLAMIC STUDIES CONNECTION

How can useful knowledge, careful observation, and creative problem-solving become ways of serving other people?

Group members: _____

Museum Exhibit Card

Name of Device: _____

Purpose: What problem did it solve?

How It Worked: (2–3 sentences)

Engineering Principle Used

☐ Water Pressure

☐ Air Pressure

☐ Valves

☐ Gears

☐ Automatic Movement

Modern Equivalent

Banu Musa Brothers Gallery Walk

Name: _____
Date: _____

Directions

As you visit each group's model, listen to the docent's explanation. Record what you learn about each invention.

Invention	What problem did it solve?	How did it work?	One interesting fact or question
1.			
2.			
3.			

Reflection

1. Which invention impressed you the most? Why?

_____

_____

_____

2. What do all of the Banu Musa's inventions have in common?

_____

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