

# Building A Working Model of The Falkirk Wheel As A Tool For Teaching Physics

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# History



# Previous Locks

- Dismantled and filled in 1933



# Opened by the Queen in 2002

- Opened as part of the Queen's Golden Jubilee Celebration.
- Part of the UK Millennium Commission.
- Millennium commission funded 42% of the £78 million cost.(\$110 million)



# Design Team

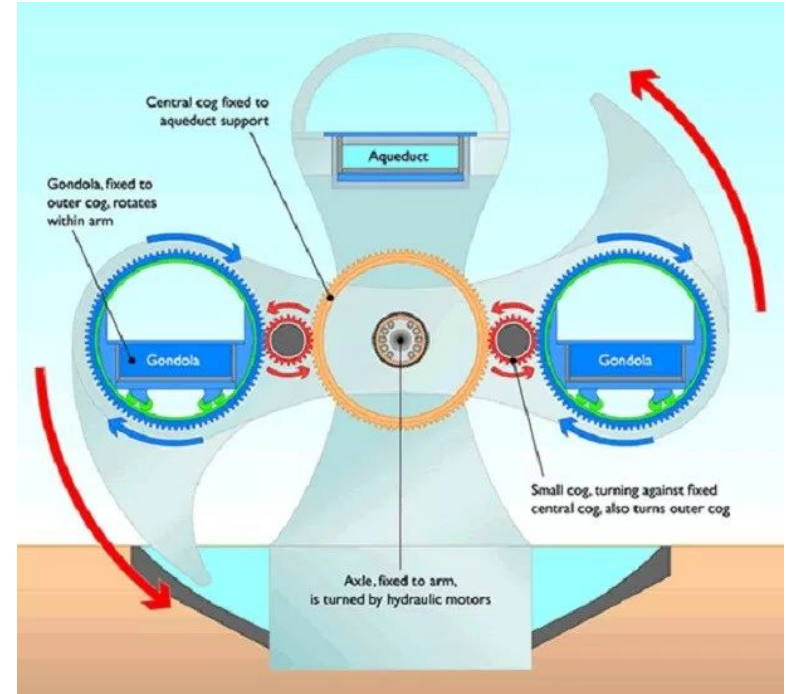
- The original design was not the showpiece the British waterways board was looking for.
- The final design was completed in just three weeks.



# Planetary Gears

# Planetary Gears

- The system of planetary gears in the Falkirk wheel
- Consist of Inner Gear (Sun Gear) and Outer Gears (Planetary Gears)
- The ratio of angular velocities is proportional to the ratio of the number of teeth on each gear
- Gears of same number of teeth will have equal angular velocities



# ARCHIMEDES' PRINCIPLE

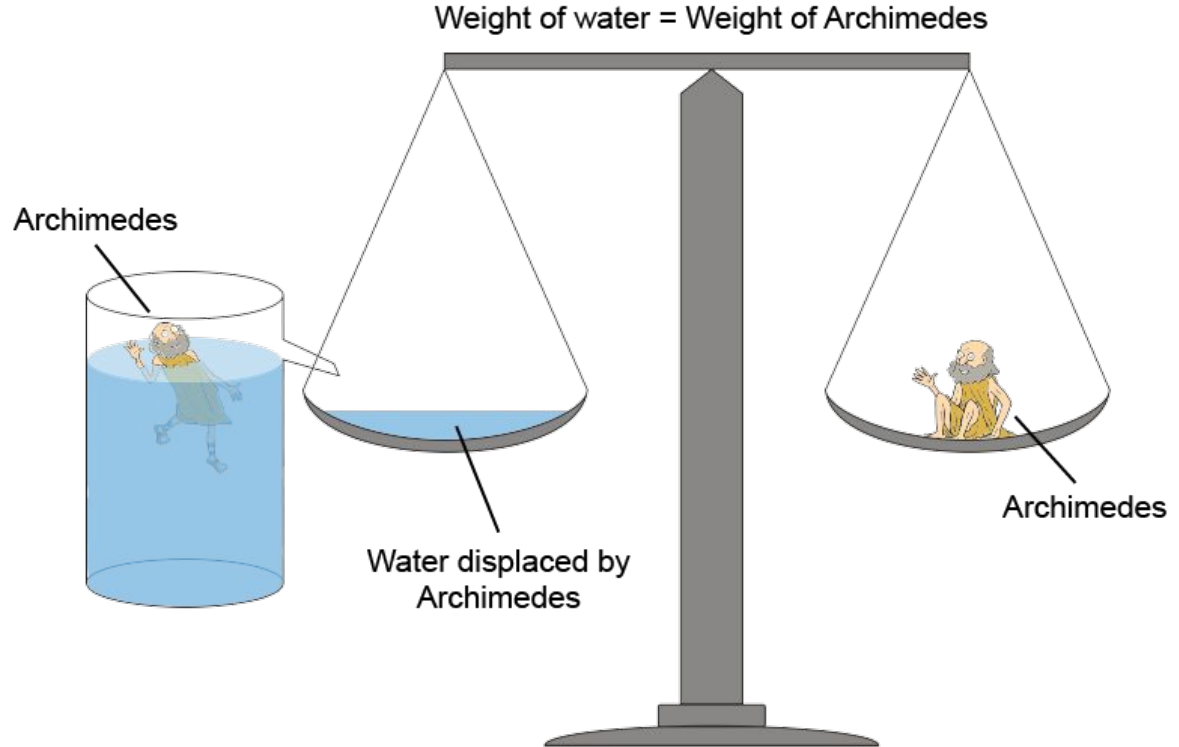


# Archimedes' Principle

- A body completely or partially submerged in a fluid receives an upward buoyant force equal to the weight of the fluid it displaces
- As a consequence **a floating object displaces its own weight of fluid.**

# Archimedes' Principle

- Weight of water displaced is equal to weight of boat.
- Creates a net torque of zero on the arm, making it balanced.



- Only torque required is to overcome the friction of the gears & Inertia of the system



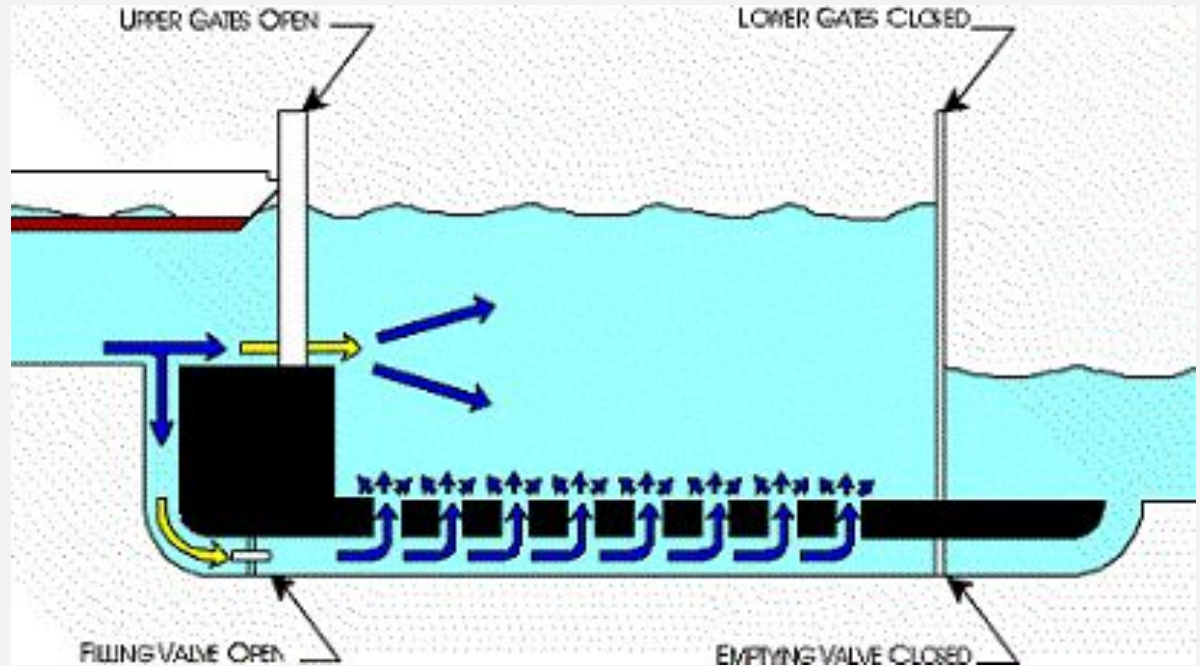
# Efficiency

- The Falkirk wheel uses 1.5kWh per half turn.
- Uses about as much power as a household dishwasher.



[http://www.axiomimages.com/aerial-stock-footage/view/AX109\\_141](http://www.axiomimages.com/aerial-stock-footage/view/AX109_141)

# Traditional Boat Lock



[https://www.teachengineering.org/lessons/view/cub\\_dams\\_lesson03](https://www.teachengineering.org/lessons/view/cub_dams_lesson03)

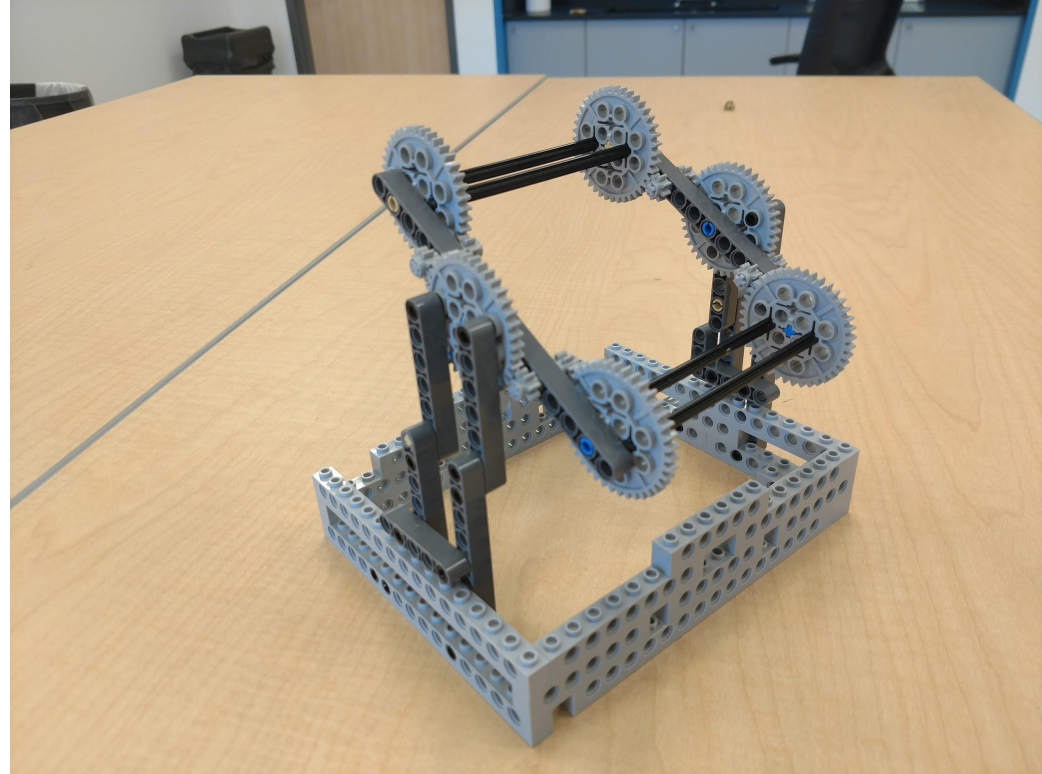
The system  
of Locks  
of  
The Falkirk  
Wheel



# Design Process

# Design Process

- Phase 1: LEGO Model
  - Understand Planetary Gears
  - Demonstrate Concept
  - Not Final Size





# Design Process

- Phase 2: Cardboard Model
  - Sense of Scale
  - No Moving Parts



# Design Process

- Phase 3: Final Model
  - Putting Everything Together
  - Wood Frame
  - CNC Routed Arms
  - VEX Robot Gears and Hardware
  - PVC Tubes for Troughs



# Design Process

## -Challenges

- Engineering Challenges  
(fastening, cutting, sizing,  
etc.

- Troughs Syncing  
Improperly

# Conclusion

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- Learned about Planetary Gears
- Learned Manufacturing Skills
- Learned Teamwork Skills
- Learned Engineering & Design Process
- Helped remember Archimedes' Principle



<https://www.youtube.com/watch?v=ucg1O-5jsnM>

**The End**