

**Curriculum Unit
Title**

Kalmar Nyckel: Using a 17th century Dutch Pinnace to Teach Physics and More

Author

Terri Eros

KEY LEARNING, ENDURING UNDERSTANDING, ETC.

- An object’s motion depends on the sum of the forces acting on it.
- Simple machines can provide mechanical and/or directional advantage to make work (change in motion) easier (use less force).
- Buoyancy is connected to relative densities. Density is the ratio of mass to volume.

ESSENTIAL QUESTION(S) for the UNIT

- How can levers and pulleys be arranged to provide mechanical advantage?
- What is the relationship between distance, force and mechanical advantage?
- How do sailing ships use wind power?
- How is density related to buoyancy?

CONCEPT A

With levers and pulleys, mechanical advantage increases with an increase in the distance over which work is done.

CONCEPT B

The change in an object’s motion depends on the sum of the forces and the mass of the object

CONCEPT C

To determine buoyancy, both weight and density need to be considered.

ESSENTIAL QUESTIONS A

To achieve maximum mechanical advantage, where should the effort force and load be in relation to the fulcrum?
Using a combination of fixed and moveable pulleys, what is the best arrangement to maximize mechanical and directional advantages?

ESSENTIAL QUESTIONS B

How does a sailing ship use the wind and water for power and stability?
How do changes in design affect motion?

ESSENTIAL QUESTIONS C

How can a boat design be modified to increase weight without a loss of buoyancy?

VOCABULARY A

Effort force, load, lever arm, fulcrum, mechanical advantage, directional advantage, fixed pulley, moveable pulley

VOCABULARY B

Force diagram, vector, gravity, air resistance, friction, wind push, supportive force (buoyancy), coming aft, coming about

VOCABULARY C

Mass, weight, buoyancy, displacement, upward thrust, density, hull design, volume

ADDITIONAL INFORMATION/MATERIAL/TEXT/FILM/RESOURCES

Materials to construct simple levers-binder clips, pencils, rulers
Selection of pulleys for students to use in fixed and moveable configurations
CoMPASS Project. “Pulley Simulation.” University of Wisconsin <http://www.compassproject.net/sims/pulley.html>
<https://phet.colorado.edu/en/simulation/buoyancy>
<https://app.discoveryeducation.com/learn/videos/simplemachines>
<http://www.kalmarnyckel.org/>
“The Way Things Work”, “The New Way Things Work”, “The Way Things Work Now” all by David Macaulay