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	CONCEPT B	CONCEPT C
With levers and pulleys, mechanical advantage increases with an increase in the distance over which work is done.	The change in an object's motion depends on the sum of the forces and the mass of the object	To determine buoyancy, both weight and density need to be considered.
ESSENTIAL QUESTIONS A	**ESSENTIAL QUESTIONS B**	**ESSENTIAL QUESTIONS C**
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?	How does a sailing ship use the wind and water for power and stability? How do changes in design affect motion?	How can a boat design be modified to increase weight without a loss of buoyancy?
VOCABULARY A	**VOCABULARY B**	**VOCABULARY C**
Effort force, load, lever arm, fulcrum, mechanical advantage, directional advantage, fixed pulley, moveable pulley	Force diagram, vector, gravity, air resistance, friction, wind push, supportive force (buoyancy), coming aft, coming about	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