

Lesson Update and CRT Addendum	
Lesson/Activity Title: Heavy Lifting	ID: 18-719
Product Number: EG-2009-02-05-MSFC	Grade: 6-12
URL for Lesson: https://www.nasa.gov/pdf/418000main_OTM_Heavy_Lifting.pdf	
Subject: Simple machines, force and Newton’s Third Law, Measurement	
Summary: In this challenge, students follow the engineering design process to: (1) design and build a crane out of cardboard; (2) figure out ways to reinforce the arms so they don’t collapse under a heavy load; (3) build a crank handle; and (4) improve their cranes based on the results of their testing.	
Materials for lesson: (per crane if building the suggested model) • cardboard box (shoebox size or bigger) • 3 strips of corrugated cardboard (2 x 11 inches/5 x 28 cm) • paper clip • large paper cup • 3 sharpened pencils • scissors • smooth string (e.g., fishing line or kite string) • tape • weights (e.g., batteries, pennies, marbles, or gravel).	

Review and Recommendations	
ALIGNMENT TO STANDARDS	
NGSS	MS-PS2, HS-PS2
Common Core State Standards in Mathematics	Lesson is very broad and could be modified or focused to address specific standards.
CULTURAL RESPONSIVE TEACHING (CRT) RECOMMENDATIONS	
5E Lesson/Description	
1. Engage	Consider asking students to express their personal interest or experience with cranes or levers. Ask why cranes are important, why, in their respective communities, would cranes provide a purpose, and what do they look like. The lesson needs to incorporate inferences that will enable students to use prior knowledge and skills to aid in the project.
2. Explore	The activity should be embedded in some greater context that makes the activity have purpose. This could be done by having students infer about how cranes are used in their area. Students can be allowed to design their own cranes from scratch without being given the example.

3. Explain	Allow students to present and demonstrate their cranes and address how they solved any problems that arose during the process.
4. Expand/Enhance	Create a greater design challenge to have students move some object. Challenge them to move the greatest weight or a given height, most efficient size of crane to weight moved...
5. Evaluate	<p>A rubric designed to measure appropriate criteria should be considered.</p> <p>To enhance, consider having students collect data (e.g., measurements, materials, etc.)</p> <p>Consider assessing students on their reasoning for using certain materials and provide clear rationale(s) for their designs... and be ready to defend.</p>

Additional Resources:

https://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Heavy_Lifting.html

<https://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Rockets.html>

https://www.nasa.gov/pdf/153418main_Rockets_Heavy_Lifting.pdf