

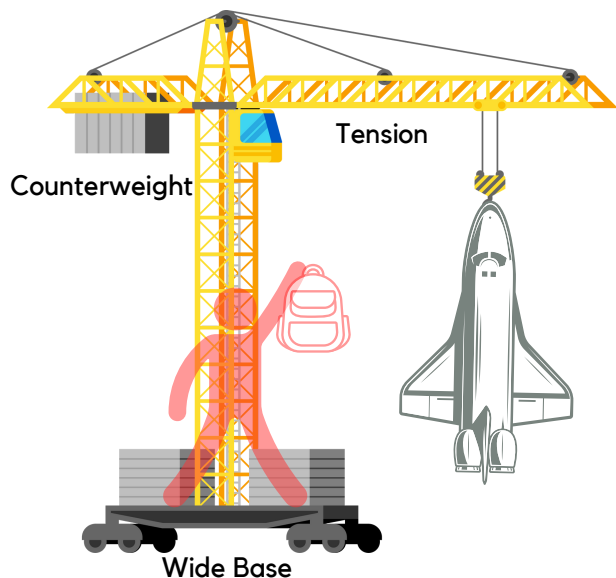


# HEAVY LIFT

How did engineers lift space shuttle *Endeavour* into the Samuel Oschin Air and Space Center?

## 01 GET SET!

- Grab a backpack (bag or pail).
- Add weight to the backpack (i.e., books).
- Create a target within arm's reach.



## 02 LIFT!

01. Place the backpack on the ground. Stand with your feet together.



02. Lift the backpack with one arm. Do not bend your knees.

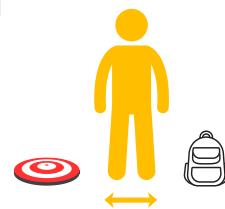


03. Lift the backpack to eye-level. Place the backpack on the target. What did you feel?



04. Stand with your feet apart, and repeat steps 2 and 3.

05. Which position felt easier? What did your other arm do?



06. Try different variables:

- weight of the backpack
- how high you lift the backpack
- use a rope to lift the backpack
- add some "wind" (fan)
- location of the target

## 03 WHAT'S GOING ON?

How is your body acting like a crane? A **wide base** at the bottom helps with the **tension**, or pull, you might have felt in your arm when lifting the backpack. Spreading your legs to form a wider base distributes the weight evenly at the bottom. Did you naturally raise your other arm into the air? That's the **counterweight** that prevents it from tipping over to one side. Once the object's weight and the counterweights are balanced, it is safe to move the heavy object!

