Exploring "Work" as a Scientific Term

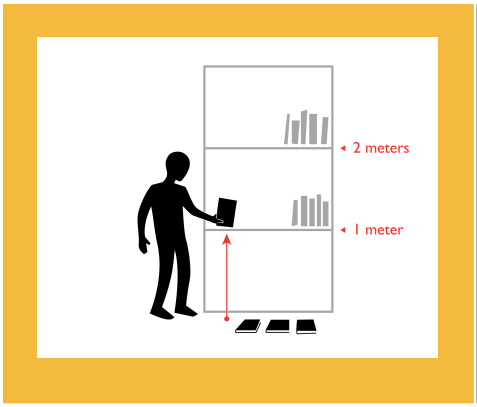
Olivia, Hamza, and Cooper have volunteered to do some **work** for the book fair at their K-8 school. Here's what you need to know:

> *The book fair coordinator has decided to display the books for younger children on a lower shelf and the books for middle school students on a higher shelf. All the books weigh the same. The lower shelf is 1 meter high and the higher shelf is 2 meters high. The books are all on the floor near the shelves. Each book weighs 10 newtons. A newton is a way to measure force. (Think of 1 newton as how much force it takes to hold an apple. It's reasonable, then, to say that the book weighs 10 newtons, right?)*

This is what the students are doing:

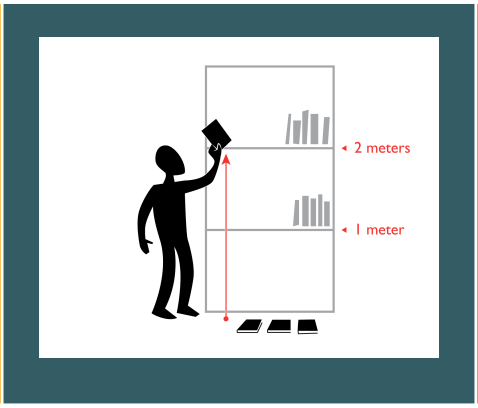
Hamza is...

lifting 1 book at a time and putting it on the 1 meter shelf.



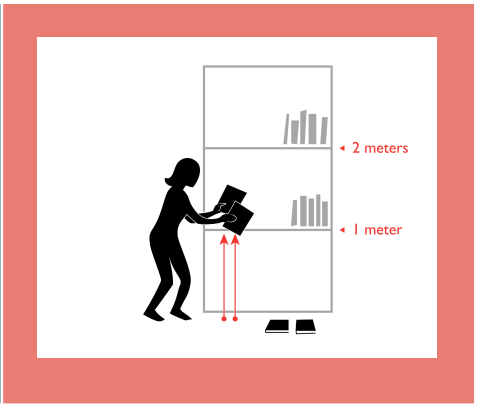
Cooper is...

lifting 1 book at a time and putting it on the 2 meter shelf.



Olivia is...

lifting 2 books at a time and putting them on the 1 meter shelf.



TURN AND TALK

Before figuring this out scientifically, who do you think is doing the most **work**? The least **work**?

- Okay. Here we go with the scientific calculation!
- To figure out **work**, you multiply **force** by distance.
- The **force** needed to hold the book in this situation is 10 newtons.
- The distance the book moves in this situation is either 1 or 2 meters.

→ ***Warm-up Question:*** *If it takes 10 newtons to hold 1 book, how many newtons does it take to hold 2 books?* _____

If you said 20, then you're right!

Joule is a unit that measures **work**.

One joule (1 J) is the amount of **work** done to **apply** one newton of **force** through a distance of one meter.

J = N x m

To determine Hamza's **work**, we multiply 10 newtons (the weight of one book) by 1 meter. So the amount of **work** Hamza did was 10. But to say he **worked** "10" is kind of strange: 10 what? Well, we can measure **work** with something called newton-meters, but most scientists call these units *joules* ("joolz"). So...

> *by lifting 10 newtons 1 meter, Hamza did 10 joules of work.*

By using this system of measuring **work**, can you determine the joules of **work** Cooper and Olivia did?