

brackitz®

U2 L1a
V2.3

LESSONS

LET'S MOVE IT!

WHEELS & AXELS



★ Lesson 1: LETS MOVE IT! ★

Students are introduced to a need for mechanical advantage, and to efficient ways of moving things (transportation), by encountering the problem of how to move objects without wheels.

Objectives:



Students will explore the ideas of work, effort, and moving items. This lesson will lead them to ask, "How can we do this work more easily?"

Vocabulary used in this activity:

Work, effort, exert, challenge, obstacle, lift, move, force, frame, box

Standards

NGSS 3-5 ETS1, ETS1.A, ETS1.B, ETS1.C, ETS1-1, PS3.C, LS1.A

CCSS-Math MP2, MP3, MP6, MP7, MP8

CCSS-ELA SL.4.1, SL.5.1, SL.4.1c, SL.5.1c, SL.4.1d, SL.5.1d, CCRA.L1, CCRA.L.6, W.4.2, W.5.2, W.4.8, W.5.8

Time needed: 35-40 minutes

Materials and Supplies:

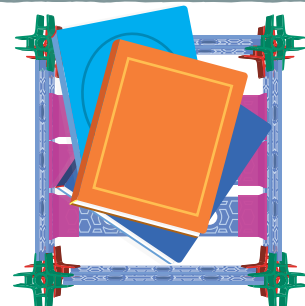
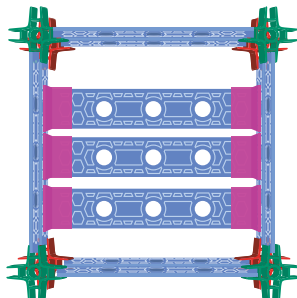
String, paper, pencils/crayons, Brackitz planks (1x1 and 1x2 lengths), 3 and 4-way hubs, as well as 1-way pivoting hubs; but no tires, axle-splines, or lock washers.

Set-up and Preparation:

Prepare trays of Brackitz building materials so that they are ready to be handed out; help students cooperatively form groups of 2-3 to work together.

Background Knowledge:

Prior to this lesson, students do not need special background knowledge.



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35-45 minutes

Whole Class - What Is Work?



10 minutes

"I'm going to hand you one book, and we'll pass it around our circle/group." Pause while book is passed and comes back to you. "Was that hard to lift and move? (No!) Now let's try three books. How does that feel? (Heavier) Ok, but how do we know they are heavier? (See if students separate feeling the work from the idea that there were more books in number.) Ok, now we'll do just this one book. Pass it around. Is it heavier? If it was hard to lift and move, how would we know? What do we notice when something is bigger and heavier? (Hands/fingers, arm muscles.) That's one way to understand that moving something from one place to another is WORK. Today we're going to think about how much work we have to do to move things."

Instructor Notes and Tips

First, use similarly sized chapter books - one vs. three.

Then, use a large book. An old style dictionary may work.

Help students consider that more/bigger doesn't have to mean heavier. Bean bag chairs may be bigger than a box of rocks, but the box of rocks is heavier. We know because we can feel it in the amount of force we apply from our muscles. Feeling their muscles tense or their hands hurt is an indication of work. Encourage students to push the books AND lift/hold them so they have different experiences sensing force.

Group Exploration - Feel the Work



10 minutes

Feel the work! "When we lift or move something, we are applying FORCE to get work done. Where does that force come from? (Our muscles tensing and exerting.) We're going to practice different ways to move these books. Let's try it two ways:

1. In your group, carry these items three 'laps' around the classroom.

2. Now stand and hold the items for 20 seconds.

Now, did you feel the work in your body? Did you feel it during both ways of handling the items? Did you feel it in different places?"

Create start/stop spots for each group, so that they can line up for this exercise; or have "laps" clearly marked. Have timers ready or have start and stop times for each "stand and hold" turn.

Each student's turn moving the items should take thirty seconds to one minute; "feeling the work" should take six to seven minutes.



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Group Challenge - Carts and Wheels



15 minutes

(Show the picture of a cart.) "In this picture, someone is using a cart to move more items with less work. As I'm sure you can see from your pieces, we aren't using any wheels today. I've built this obstacle course. Even though we have no wheels, what else could we do to make the work easier? (Help students think about how gathering things may mean a heavier load but only one TRIP where they are exerting force.)

Okay, let's build a frame that could contain the things we want to move using Brackitz."

Prepare obstacle courses ahead of time before students are ready to test their designs. Add different obstacles. This could be speed bumps under the rug, non-smooth "hills" of items, or classroom "boulders" made of toys, blocks, and other items.

Pass out trays of planks and connectors (but no wheels and axles) that are already prepared for groups. This is a chance for students to begin building. Watch to make sure groups are able to share tasks and ideas functionally.

If your books are too heavy or wide for student-made Brackitz frames, consider using blocks or other toys.

Reflection



5 minutes

"Let's each take thirty seconds to use our frame to push or pull these items through the course. What's happening when we try to get over and around these challenges and obstacles? (Frames falling apart, items falling out and tipping over, frames/boxes of items getting stuck.) What do we use to move lots of things at once? What could we build or make differently to make this work easier?"

If students made frames of different sizes and shapes, help the class observe which shape does best? Why? This gives advanced students a chance to consider how distributing weight and balance can factor into cart design and use.

CHALLENGE ADVANCED STUDENTS

In the group exploration, you may pose the question to students WHY standing and holding something without moving it caused them to feel their muscles exerting, and talk about gravity.

In the group challenge, make more than one obstacle course - one with hills, one with turns, etc. so that students can see if their frame has particular use, and cases where it won't work well. Have them make predictions about where it will work best/worst and specify why they are making that prediction.

SIMPLIFY FOR YOUNGER GROUPS

In discussion, ask, "Have you ever had to hold or lift something that was too heavy for you? What was it?" This is a way of helping students identify that they did work.

In the group challenge, make two obstacle courses - one where they simply need to turn and come back, and one with hills, ramps, bumps, etc.

Name _____

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Student Worksheet



Today we carried books to move them. Is there an easier way?
Write a sentence about it:

You made a frame or box to hold the books - draw it here.

What shape was your frame? _____

Did your frame work to hold the items in the obstacle course? ☐ Yes ☐ No

Name

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What could have helped your frame hold the books better?

What parts of the obstacle course made it hardest for your frame to hold the books and keep moving?

What do we use to move lots of things at once? What could we build or make differently to make this work easier?

