

\* Lesson 1: LETS MOVE IT!

Students are introduced to a need for mechanical advantage and efficient transportation by encountering the problem of moving items without wheels.

#### **Objectives:**

Students will explore the idea of work, effort, and moving items. This lesson will lead them to ask, "How can we do this work faster/easier?"

#### Vocabulary used in this activity:

Signals, work, effort, challenge, force, frame

#### **Standards**

NGSS

K-2nd Engineering Design: K-2-ETS1-2 Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.
K-2-ETS1-1 Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool | K2 ETS1 and 3-5 ETS1: Engineering and design | 3 PS2 Forces and motion

 CCSS-Math
 MP1, MP5, MP6, MP7

 CCSS-ELA
 SL.2.1, SL.2.1.A, L.2.1, L.2.2, L.2.3, W.3.8, W.3.1b, CCRA.I.6, RF.3a.4a

#### Time needed: 35-45 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.

#### **Resources/optional reading:**

<u>Move it! Motion, Forces, and You</u> by Adrienne Mason (students may be able to read this book themselves) or <u>Forces MakeThings Move</u> by Kimberly Bradley.

#### **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. Introducing students to the Gingerbread friend from Unit 1 can help them keep a user in mind who will use their designs.



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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 around and comes back to you. "Was that hard to lift and move? (No!) If it was hard to lift and move, how would we know? What tells us that more work is being done when we're lifting and moving things? What signals could we notice? (Feels bigger, heavier.) So, what if it were five books?" Pass five books and wait for them to come back to you. "Did that feel heavier? Where did you feel it? (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."

#### **Group Exploration - Feel the Work**

Feel the work! "When we lift or move something, we are applying FORCE to get work done. The force comes from us. 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 carry this second group of objects three 'laps' around the classroom. Which is heavier?

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

#### **Instructor Notes and Tips**

You may have students read the suggested book <u>Move it!</u> before the lesson, or read to them <u>Forces</u> <u>MakeThings Move!</u> before or after this lesson to help prime the idea of motion requiring work.

Help students consider feeling their muscles tense or their hands hurt as an indication of work. Encourage students to push the books AND lift/hold them so they have different experiences sensing force.

#### 10 minutes

Create start/stop spots for each group, so that they can line up for this exercise; or have "laps" clearly marked. Have string ready; you may also want plastic shopping bags to wrap around the items to bundle them. Help student tie the string around their "lift" items if needed.

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



# \* Lesson 1: Lets моve IT

#### Group Challenge - Carts and Wheels

(Show the picture of a cart.) "In this picture, someone is using a cart to move more items with less work. Look at your Brackitz pieces. What's missing to make something like this? (Wheels!) You're right, **no wheels to build with today.** What else could we do to make getting the work done more EFFICIENT? (Help students think about how gathering things up may mean a heavier load but only one TRIP.)

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

#### 15 minutes

Pass out trays of planks, 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.

#### Reflection

"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.) I wonder if we can make this less frustrating in the next lesson?"

#### CHALLENGE ADVANCED STUDENTS

In the group exploration, you may ask students if there are things in the classroom they could not push or pull with their own work. What are those things?Then ask, "but are there ways to move them even if we can't do it with our muscles?" Talk about how wheels, machines, etc. help us do work more easily.

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 cases where it won't work well.

#### 5 minutes

Prepare some obstacles in the "course" before students are ready to test their designs. This could be speed bumps under the rug, non-smooth "hills" of items, or classroom "boulders" made of toys, blocks, and other items. 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.

#### 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? How did it feel?" This is a way of helping students identify that they did work.

In the group challenge, ask students what is easier or harder when bringing groceries into their house after shopping: having items grouped together in "bundles" or making an individual trip for each thing bought? Ask the same question for moving into a house: is it easier to carry each thing, or to put them together in boxes?





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## **Student Worksheet**

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

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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? O Yes O No



