INNOVATION AT PLAY

VIDEO TOPIC SERIES ACTIVITY

EXO-SKELETON SOLUTIONS

Have you ever considered where your muscles get the energy they need to power your body?

In this challenge, you and a teammate will investigate different forms of energy as you explore how technology can help your muscles be even more efficient!

STEP 1: CONNECT

When we think about careers, we often think about the academic skills that they require. But what about physical skills? Find a teammate and discuss how muscle function is important in a wide range of fields—such as manufacturing, construction, healthcare, sports science, and more!

STEP 2: INVESTIGATE

ATP is a molecule that stores and transfers energy within cells. Read this article (https://tinyurl.com/allaboutATP) and be ready to discuss the role that ATP plays in muscle functioning.

STEP 3: DISCUSS

What did you and your partner learn about ATP and the role it plays in energizing our bodies?

Be sure you both understand that ATP is a key molecule for storing and transferring energy within a cell. It captures the chemical energy obtained from the breakdown of food molecules and makes it available for other cellular functions—such as powering muscles.

Now let's show off some of the energy that your muscles can use. Stand up and do 20 jumping jacks!

Do you feel a little warm? Why do you think this may be?

When your body converts chemical energy into the mechanical energy needed for muscle movement, the process isn't 100% efficient. Some of this wasted energy is released as heat, which is why you may feel a little warm after physical activity.

STEP 4: MATERIALS

Let's connect what you have been learning to Industry 4.0 applications—or, in other words, a world where humans, computers, and robots can work together to accomplish tasks!

You'll need:

- Device with internet access
- Book
- Ruler or measuring tape
- Stopwatch

- Scale
- Model materials, such as:
    - Cardboard
    - Toilet paper or paper towel rolls
    - String or rubber bands
    - Straws or craft sticks
    - Tape and glue
    - Paper clips or paper fasteners

STEP 5: THE CHALLENGE

Your team's challenge is to create an exoskeleton model designed to help humans perform a physical task. To prepare:

1. Choose a teammate to be your model. Place the book on the floor in front of them.
2. Observe as they lift the book from the floor to over their heads and back down to the floor several times in a row.
   Discuss: What muscles are they using?
3. Use the scale, ruler, stopwatch, and the following formula to calculate the kinetic energy generated during this physical activity:

   KE = ½ x m x v2

   m = the mass of the object in kilograms

   v = the velocity of the book in meters per second
4. Then hypothesize: If someone had to perform this activity continuously over a long period of time, what may happen to their body?
5. Develop a model of an exoskeleton that would result in less energy exerted to complete this task. Your exoskeleton may or may not be life-sized. What is most important is that it clearly shows how it would help a human body repeatedly complete this task.

WHAT EXACTLY IS AN EXOSKELETON?

Wearable Suit: An exoskeleton is a special suit you can wear that covers part or all of your body.

Helps You Move: An exoskeleton helps you move by giving your muscles extra strength and support.

Comes in Various Forms: Exoskeletons can be made for different uses, like helping people walk again or helping people carry heavy gear more easily.

STEP 6: SHARE

Once your exoskeleton model is complete, create a quick video that shows off and explains your model *and* explains how technology can help optimize human labor and energy expenditure. Post your video with the hashtags #InnovationAtPlay and #ExoStrength so others can learn from you too!

NGSS STANDARDS

- HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
- HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form.

COMMON CORE ELA STANDARDS

- CCSS.ELA-LITERACY.CCRA.SL.4: Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.