Experiment Instructions

Chapter 11: The Mighty Motion: Forces at Work and Play!

Gather Your Materials and Mark Below

- ☐ Spring Scale
- ☐ Textbooks
- ☐ String or Twine
- ☐ Measuring Tape or Ruler
- ☐ Small Objects of Various Weights
- ☐ Pen or Pencil

Overview

Detailed steps are in the student notebook pages.

Part 1: Set Up and Measure Force

Begin by gathering all materials and making sure everything is clean, working, and within reach. Use a spring scale to measure how much force (in newtons) it takes to move different objects a short distance, such as 1 meter. Remember to zero the scale before starting, and read the measurement as soon as the object starts moving. Record your force values in your notebook.

Part 2: Measure Distances and Calculate Work

Use a measuring tape to mark different distances—like 1, 2, and 3 meters. For each distance, calculate the work done using the formula: Work = Force × Distance.

Record all your measurements and calculations in a data table so you can clearly compare the results.

Part 3: Analyze, Graph, and Conclude

Look for patterns in your data. How does changing the distance affect the amount of work when the force stays the same? Create a graph to help visualize the relationship between force, distance, and work. Finally, reflect on your hypothesis and summarize what you learned. Explain how both force and distance play a role in the amount of work done on an object.

Title

Date

Objective

Hypothesis

Materials

Check your materials and make sure you have everything you need.

- ☐ Spring Scale
- ☐ Textbooks
- ☐ String or Twine
- ☐ Measuring Tape or Ruler
- ☐ Small Objects of Various Weights
- ☐ Pen or Pencil

Experiment: Test, Tinker, Try

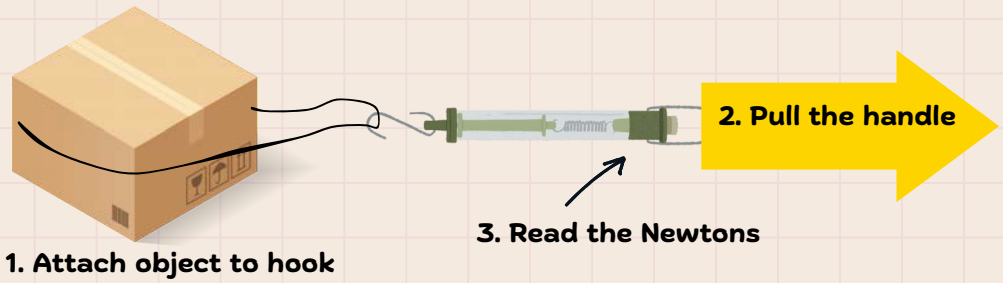
Step 1 : Gather Your Materials

- Make sure you have all the materials laid out on a clean, flat surface within easy reach. Check that everything is in good condition and ready to use.

Step 2 : Measure the Force Required

- Use the spring scale to measure the force needed to move each object a small distance (e.g., 1 meter). Write down the force in newtons (N).
- Example: "Force to move toy car: 2 N"

How to Use a Spring Scale



Step 3: Measure Different Distances

- Use the measuring tape to measure different distances (e.g., 1 meter, 2 meters, 3 meters).

Record & Calculate

Record Distances & Newtons and Calculate Work in Joules

- Record the force in Newtons (N) that you see on the spring scale for each object.
- Record the distance you pulled your object.
- Calculate the Work done by multiplying the Force times the Distance.
- Record the work in Joules.

Object	Newtons (N)	Distance (meters)	Joules

Analyze Your Data

- Compare Calculations:
  - Look at your work calculations for different distances and forces. What happens to the amount of work when either the force or the distance is increased?
- Graph Data:
  - Create a graph to show the relationship between distance, force, and work. Use graph paper for plotting.

Use this space to draw your graph.

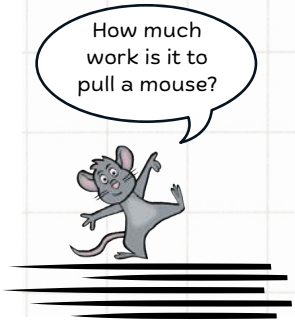
Write Your Conclusions

Reflect on Hypothesis

- Go back to your hypothesis. Was it correct? Why or why not?

Summarize Findings

- Summarize what you found out in a clear and simple way. Explain how force and distance affect the amount of work done.



The Mighty Motion: Forces at Work & Play!

Materials List

- Spring Scale
- Measuring Tape or Ruler
- Small Objects of Various Weights (e.g., toy cars, small boxes)
- String or twine
- Notebook
- Pencil

Objectives

- Describe the concepts of force, energy, and work
- Engage in a hands-on experiment
- Measure the amount of work done when moving objects
- Explore how different forces and distances affect work

Research

- **Describe Force, Energy, and Work:**
  - **Instruction:** Ensure students read sections 11.1 to 11.6 from their textbooks. Discuss key concepts such as force, energy, work, balanced and unbalanced forces, and the equation for work: ({work} = {distance} X {force}). Have students describe force, energy, and work in their own words.
- **Review Key Vocabulary:**
  - **Instruction:** Go over the key vocabulary with students, ensuring they understand terms such as force, work, energy, balanced forces, unbalanced forces, and acceleration.

Question Formulation

- **Step 1: Write Down Questions**
  - **Instruction:** Encourage students to write down questions they have about force, energy, and work.
  - **Examples:**
    - Open-ended: "How does the amount of work change with different forces?"
    - Closed-ended: "What happens to the work done if the distance is doubled?"
- **Step 2: Improve the Questions**
  - **Instruction:** Help students refine their questions by converting open-ended questions to closed-ended questions and vice versa.
  - **Example Refinement:**
    - Open-ended: "How does the amount of work change with different forces?"
    - Convert to closed-ended: "Does increasing the force used to move an object increase the work done?"
    - Closed-ended: "What happens to the work done if the distance is doubled?"
    - Convert to open-ended: "In what ways does doubling the distance affect the work done?"

- **Step 3: Prioritize the Questions**
  - **Instruction**: Assist students in selecting the most interesting or important questions to explore in the experiment. Encourage balancing both open-ended and closed-ended questions for a comprehensive investigation.
- **Step 4: Record Your Question**
  - **Instruction:** Have students write down their prioritized question in their notebooks. Ensure they label whether the question is open-ended or closed-ended.

Conducting the Experiment

- **Step 1: Gather All the Materials**
  - **Instruction:** Ensure all students have the necessary materials laid out on a clean, flat surface within easy reach. Check that all equipment is in good condition and ready to use.
- **Step 2: Measure the Force Required**
  - **Instruction:** Have students use the spring scale to measure the force required to move each object a small distance (e.g., 1 meter). Record the force in newtons (N).
  - **Example:** "Force to move toy car: 2 N"

How to use a spring Scale

- Zero the Scale: Ensure the spring scale reads zero before use. Adjust it if necessary.
- Attach the Object: Hook the object you want to move onto the spring scale securely.
- Pull or Push: Gradually apply force to pull or push the object while observing the scale.
- Read the Measurement: Once the object starts moving, note the reading on the scale. This value represents the force required to move the object.
- Video recommendation: https://youtu.be/i3rsVYQdHzs?si=7jk8PgTorYMmxG9j

- **Step 3: Measure Different Distances**
  - **Instruction:** Using the measuring tape, have students measure different distances (e.g., 1 meter, 2 meters, 3 meters). Record these distances in their notebooks.

Step 4: Calculate Work Done

- **Instruction**: Guide students to calculate the work done for each force and distance using the formula ({work} ={distance} X {force}).
  - Example: "Work to move toy car 1 meter: (1 {meter} X 2 {newtons} = 2 {joules})"

Step 5: Record Data

- **Instruction**: Ensure students record all their measurements and calculations in a table for easy comparison.

Observations

- Note Patterns:
- Guide students to observe any patterns in their data. For example, does the work done increase when the distance increases for the same force?

Record Observations:

- Ensure students jot down their observations in their notebooks, noting any noticeable trends or anomalies.

Analyze Data

- **Compare Calculations:**
  - **Guide students** to compare their work calculations for different distances and forces. Discuss what happens to the amount of work when either the force or the distance is increased.
- **Graph Data:**
  - **Assist students** in creating a graph to visualize the relationship between distance, force, and work. Use graph paper for plotting.

Draw Conclusions

- **Reflect on Hypothesis:**
  - **Have students** revisit their initial hypothesis and discuss whether their data supports it.

Summarize Findings

- **Guide students** to summarize their findings in a clear and concise manner. They should explain how force and distance affect the amount of work done.

Share Results

- **Presentations:**
  - **Have students prepare presentations** to share their findings with the class. They can use visual aids such as charts and graphs to illustrate their data.
- **Written Reports:**
  - **Encourage students** to write a detailed report summarizing their experiment, including their research, question, hypothesis, methods, observations, data analysis, and conclusions.
- **Group Discussions:**
  - **Facilitate a class discussion** where students compare their results and discuss any differences or similarities.

Further Exploration

- **New Questions:**
  - **Encourage students** to brainstorm new questions based on their findings. For example, “What happens if we use different surfaces for our experiment?”
- **Design Follow-Up Experiments:**
  - **Guide students** to design follow-up experiments to test their new questions. Help them outline the steps they would take and the materials they would need.
- **Research Extensions:**
  - **Suggest that students** research additional topics related to their findings, such as the concept of kinetic energy or real-life applications of work and energy.

Notes