Lab Handout

Lab 14. Potential Energy

How Can You Make an Action Figure Jump Higher?

Introduction

Teeterboards are typical pieces of equipment found on many playgrounds around the country. They are often used in shows that focus on gymnastic tricks. The picture in Figure L14.1 shows a circus act involving a performer launching another performer high into the air. It is easy to observe how the activity of a teeterboard involves objects' motion. However, that activity also involves energy shifting between forms.

FIGURE L14.1

Circus performers on a teeterboard

The law of conservation of energy states that within a given system the total amount of energy always stays the same—it is neither created nor destroyed; instead, energy is transformed from one form to another. When energy is stored in one form or another, it is called potential energy. Potential energy can be stored in the chemical bonds between atoms in a molecule and in the nuclei of atoms. Energy can also be stored based on the position of an object. Indeed, potential energy can be referred to as energy of position. When potential energy is transformed into motion, it becomes kinetic energy. Kinetic energy can be detected when objects move. Kinetic energy is known as energy of motion.

In this investigation you will explore the relationship between potential energy and kinetic energy as you try to make an action figure jump using a teeterboard.

The Task

Use what you know about the conservation of energy and models to design and carry out an investigation that will allow you to develop a rule that explains how an action figure can be made to jump lower or higher on a teeterboard.

The guiding question of this investigation is, **How can you make an action figure jump higher?**

Materials

You may use any of the following materials during your investigation:

- Ruler
- Meterstick
- Electronic or triple beam balance
- Pencil
- Clay (100 g)
- Action figures
- Safety glasses or goggles

Safety Precautions

Follow all normal lab safety rules. In addition, take the following safety precautions:

1. Wear sanitized safety glasses or goggles during lab setup, hands-on activity, and takedown.
2. Sweep clay up off the floor to avoid a slip or fall hazard.
3. Do not allow the action figure to jump too far from your work area.
4. Remove any fragile items from the work area.
5. Wash hands with soap and water after completing the lab activity.

Investigation Proposal Required? ☐ Yes ☐ No

Getting Started

To answer the guiding question, you will need to design and conduct an investigation that explores changing the potential energy of an action figure. To accomplish this task, you must determine what type of data you need to collect, how you will collect it, and how you will analyze it.

To determine *what type of data you need to collect,* think about the following questions:

- How will you test the ability to make the action figure jump higher?
- How will you measure the height of the jump?
- What type of measurements or observations will you need to record during your investigation?

To determine *how you will collect your data,* think about the following questions:

- How often will you collect data and when will you do it?
- How will you make sure that your data are of high quality (i.e., how will you reduce error)?
- How will you keep track of the data you collect and how will you organize it?

To determine *how you will analyze your data,* think about the following questions:

- What type of calculations will you need to make?
- What type of graph could you create to help make sense of your data?

Connections to Crosscutting Concepts, the Nature of Science, and the Nature of Scientific Inquiry

As you work through your investigation, be sure to think about

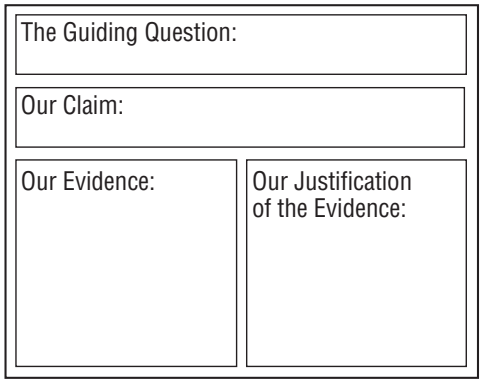
- how defining systems and models provides tools for understanding and testing of ideas;
- why it is important to track how energy and matter flows into, out of, and within a system;
- the difference between laws and theories in science; and
- the different forms of scientific investigation, including experiments, systematic observations, and analysis of data sets.

Initial Argument

Once your group has finished collecting and analyzing your data, your group will need to develop an initial argument. Your initial argument needs to include a *claim*, *evidence* to support your claim, and a *justification* of the evidence. The claim is your group's answer to the guiding question. The evidence is an analysis and interpretation of your data. Finally, the justification of the evidence is why your group thinks the evidence matters. The justification of the evidence is important because scientists can use different kinds of evidence to support their claims. Your group will create your initial argument on a whiteboard. Your whiteboard should include all the information shown in Figure L14.2.

FIGURE L14.2

Argument presentation on a whiteboard



Argumentation Session

The argumentation session allows all of the groups to share their arguments. One member of each group will stay at the lab station to share that group's argument, while the other members of the group go to the other lab stations to listen to and critique the arguments developed by their classmates. This is similar to how scientists present their arguments to other scientists at conferences. If you are responsible for critiquing your classmates' arguments, your goal is to look for mistakes so these mistakes can be fixed and they can make their argument better. The argumentation session is also a good time to think about ways you can make your initial argument better. Scientists must share and critique arguments like this to develop new ideas.

To critique an argument, you might need more information than what is included on the whiteboard. You will therefore need to ask the presenter lots of questions. Here are some good questions to ask:

- How did you collect your data? Why did you use that method? Why did you collect those data?
- What did you do to make sure the data you collected are reliable? What did you do to decrease measurement error?
- How did your group analyze the data? Why did you decide to do it that way? Did you check your calculations?
- Is that the only way to interpret the results of your analysis? How do you know that your interpretation of your analysis is appropriate?
- Why did your group decide to present your evidence in that way?
- What other claims did your group discuss before you decided on that one? Why did your group abandon those alternative ideas?
- How confident are you that your claim is valid? What could you do to increase your confidence?

Once the argumentation session is complete, you will have a chance to meet with your group and revise your initial argument. Your group might need to gather more data or design a way to test one or more alternative claims as part of this process. Remember, your goal at this stage of the investigation is to develop the most acceptable and valid answer to the research question!

Report

Once you have completed your research, you will need to prepare an *investigation report* that consists of three sections. Each section should provide an answer to the following questions:

1. What question were you trying to answer and why?
2. What did you do to answer your question and why?
3. What is your argument?

Your report should answer these questions in two pages or less. This report must be typed, and any diagrams, figures, or tables should be embedded into the document. Be sure to write in a persuasive style; you are trying to convince others that your claim is acceptable and valid!