Newspapers In Education Presents

PHYSICS AND THE PUYALLUP FAIR

Teacher's Guide for Grades 4–12

SEPT. 9-25
DO THE PUYALLUP FAIR
Make Your Escape

Newspapers In Education
The Seattle Times
Inspiring Students To Learn

PUYALLUP FAIR – MAKE YOUR ESCAPE

Physics and the Puyallup Fair

Teacher's Guide

Introduction

Nearly every teacher and student in the Puget Sound region receives a complimentary gate ticket to the Puyallup Fair. This year, our Newspapers In Education program focuses on physics concepts found at the Fair. The guide connects to Washington state physical science standards for grades 4-12 including Science EALR 2 and EALR 4: Physical Science. All of the lessons are to be used with content that will appear in The Seattle Times on September 8, 15 and 22. The guide will appear in September on both The Seattle Times Newspapers In Education (NIE) website (seattletimes.com/nie) and the Puyallup Fair's website (thefair.com).

Note to Educators

Activities in this guide are built on knowledge and information provided in the e-Edition of The Seattle Times on September 8, 15 and 22. On each Thursday, you will find a full page of physics-related content in the newspaper. You can visit the NIE website (seattletimes.com/nie) to find the exact location of these pages in the newspaper. Have students take notes from the in-paper content each week to use in combination with this guide. Teachers are encouraged to modify the guide to fit their individual classroom needs.

The Seattle Times Newspapers In Education (NIE)

To enroll in The Seattle Times NIE program and receive free access to the electronic replica (e-Edition) of the newspaper, lesson plans and curriculum guides, as well as the in-paper content for this guide, please email nie@seattletimes.com or call 206/652-6290.

Table of Contents:

The Puyallup Fair
Sept. 9-25, 2011
web: thefair.com/education
email: info@thefair.com

The Seattle Times Newspapers In Education (NIE)
web: seattletimes.com/nie
phone: 206/652-6290
toll free: 1-888/775-2655
email: nie@seattletimes.com

LESSON 1: PROPERTIES

Materials:

Triple beam balance
Spring scale
Blocks of wood of different sizes
Bowl
Ice cubes
Water
Mayonnaise (regular)
Olive oil
Corn syrup
Rubbing alcohol
Other solid items to measure (in case students forget to bring their own)
Graduated cylinders

Equations and Constants:

Weight = Mass * Gravity
Density = Mass / Volume
Acceleration = Change in velocity / time
Gravity: 9.8 m/s^2

Lesson Steps Part 1: Mass

As a class, determine a definition for mass. Students should record this definition at the top of their notebooks and leave four spaces blank before continuing (they will use that space later to fill in the definitions for density and weight).

Ask students to bring in several small items from home (books, calculators, CDs, etc.). Have students break into groups of two and place a triple beam balance in front of each group. Explain that a balance can measure the mass of an object. Detail how to use the triple beam balance and model taking a measurement. Be sure to go over units of mass and how to read the balance.

Have students create a t-chart with Item on the left and Mass on the right. They should carefully measure and record the mass of five objects (all solids) then switch their five objects with another group. Next, each group will measure the new five objects and record their masses in the chart. Once groups have finished their measurements, they should compare their values with the group they switched with. The values should be the same. If they are not, the two groups will need to work together to determine the real mass.

Ask students to consider how they would measure a liquid. Have them share their ideas with the class. If they do not come up with it on their own, explain that you could measure the mass of a container first, then measure it again when it is filled with a liquid. The difference between the two measurements will be the mass of the liquid.

Have students return to their partner groups to do some measurements of liquids. Each group will need at least two graduated cylinders and water, mayonnaise, rubbing alcohol, corn syrup and olive oil. They should measure the mass of 5 mL of each liquid and record the mass and volume in a chart. Be very precise when you are measuring the volume.

Liquid	Volume	Mass of Container	Mass of Container + Liquid	Mass of Liquid

Lesson Steps Part 2: Density

What is density? Discuss this concept and come up with a class definition. Have students record this in their notebooks under the definition for mass.

There is an equation that can help you calculate density; it is: $d = m / v$

Using the data you collected for the liquids in Part 1 of this lesson, calculate each liquid's density in the chart below. Be sure to show your work in the "Density equation" column and include the units.

Liquid	Volume of liquid	Mass of liquid	Density equation (using your data)	Density of liquid

LESSON 1: PROPERTIES CONTINUED

If you were given the mass and density of a substance, could you solve for volume? Rearrange the equation for density to solve for volume.

Given the measurements below, determine each object's volume.

Object	Mass	Density	Volume
1	5 g	.92 g / cm^3	
2	15 g	1.4 g / cm^3	
3	5 g	.75 g / cm^3	

While you are at the Puyallup Fair, make a list of beverages you can consume, such as fresh milk or smoothies. For each beverage, list its name and all of its ingredients. Try to predict which beverage would have the highest density and the lowest density, then explain your prediction.

Lesson Steps Part 3: Weight

Determine a class definition for weight and have students record this in their notebooks under the definitions for mass and density. Students will have to understand forces and gravity in order to understand mass. If you have not already discussed this, prep your students with some basic information about forces, including gravity.

Explain what a spring scale is and model its use for students. Have students work in their partner groups again to accurately measure the weights of several objects. They should measure 3-5 objects and keep track of their results in a chart.

Discuss how mass and weight change (or do not change) in other places around our solar system.

At the Puyallup Fair, there are people that will try to guess your weight. If there were a fair on another planet, the weight guesser would have to account for your mass and that planet's gravitational acceleration. Below you will find some other planetary object's gravity in relation to the Earth's. Use that information to answer the questions below.

The moon's gravity is 0.165 of Earth's.

Jupiter's gravity is 2.64 of Earth's.

Mars' gravity is 0.389 of Earth's.

If an object has a mass of 100 grams on Earth, what will its mass be on the moon?

What will its mass be on Jupiter?

If an object has a weight of 200 pounds, what will its weight be on the moon?

What will it weight be on Jupiter?

LESSON 1: PROPERTIES CONTINUED

What is your weight on Earth?

What would your weight be on the moon?

What would it be on Jupiter?

What would it be on Mars?

Try to guess a classmate's weight on Earth. Use this guess to determine what your guess would be on Jupiter and on Mars.

Extension:

As you already know, weight is determined by the mass of a person and the acceleration of gravity. However, as humans, we also have a "perceived weight." When you sit in a chair, the chair supports your weight. If the chair was suddenly removed, you would fall freely to the floor and feel weightless. What ride or rides at the Puyallup Fair would make you feel weightless? Describe what happens on these rides. If you are brave enough to go on them while at the Fair, describe how they make you feel.

LESSON 2: FRICTION

Photo credit: Patrick Hagerty

Materials:

Toy car
Large piece of sandpaper (over 100 cm)
Large piece of paper (over 100 cm)
Stop watch
Measuring stick
Ramp
Tape

Lesson Steps:

Students should break into groups of four. Each group will place a ramp on the floor and mark a specific point on the ramp with a marker or pen where the toy car will be released. On the floor, mark off every 10 cm with tape, up to 150 cm. Put the toy car at the spot you marked on the ramp and release it. Measure the time it takes for the car to travel from the bottom of the ramp (0) to 100 cm. Record the time and distance in the table below. Repeat this step and record the data. Next, determine what the average speed was for the two trials in the row labeled "Average for Floor."

Now, place a long sheet of paper on the floor where the car traveled so the entire floor is covered. Place the toy car at the spot you marked on the ramp and release it. Again, measure the time it took to go 100 cm. Repeat this step and record the data. Next, determine what the average speed was for the two trials in the row labeled "Average for Paper."

Next, place a long piece of sandpaper on the floor completely covering the floor and the piece of paper below it. Place the toy car at the spot you marked on the ramp and release it. Again, measure the time it took to go 100 cm. Repeat this step and record the data. Next, determine what the average speed was for the two trials in the row labeled "Average for Sandpaper."

Trial	Distance	Time	Equation for speed	Average speed during trial
1 – Floor				
2 – Floor				
Average for Floor	100			
3 – Paper				
4 – Paper				
Average for Paper				
5 – Sandpaper				
6 – Sandpaper				
Average for Sandpaper				

LESSON 2: FRICTION CONTINUED

Are there any other surfaces that you would like to test? Before you run your test, predict whether the car will move faster or slower than it did in the other tests (or somewhere in between). Run the test and determine whether your prediction was correct.

Last, set up your own track for the car. You can do any combination of floor, paper or sandpaper, but the track must span at least 100 cm and it must use all three types of surfaces at least once. Draw a diagram of your track below and label each type of surface (and its length).

Observe what happens when the car reaches each type of surface. Record whether it sped up, slowed down or stayed the same at each point on your diagram.

What do you think is happening?

Analyze the table above.

- Which trial had the highest average speed?
- Which trial had the slowest average speed?
- Why do you think this was the slowest?
- Explain what friction is and how it affects the speed of objects.

Extension:

When you go to the Puyallup Fair with your class this year, observe the Giant Slide.

How does friction determine how fast a rider on the slide might go?

What would happen if the riders went down on a plastic sled instead of a burlap sack?

The length of the metal part of the slide is 186 feet. Convert this to meters.

Watch a person go down the slide. Time their travel from the top to the very bottom (of the metal part) and record the time.

Determine the person's average speed on their trip down the slide.

Repeat this for another person. Determine whether the second person was moving faster or slower than the first. What could cause them to move at different speeds?

If your school (or local park) has a slide, measure the height and width of the slide. Use these measurements to determine the length of the slide (remember that in a right triangle, $a^2 + b^2 = c^2$). Now, have a volunteer slide down three times. Each time they slide down, record the time it takes them to get from the top to the bottom in your notebooks. Calculate the average time, then determine their average speed.

LESSON 3: WAVES

Photo credit: Patrick Hagerty

Materials:

Paper
Pencil
Calculator
Slinky
Jump rope
Ruler

Lesson Steps:

As a class, discuss what waves are and how they transfer energy. List some different types of waves. Use examples from your school, the Puyallup Fair and the world (sound, light, earthquakes, etc.).

Do a demonstration (using student volunteers) to show different types of waves. Use a slinky to show compressional or longitudinal waves and a jump rope to show transverse waves. Discuss the demonstration and have students draw what each type of wave looked like in their notebooks. Depending upon the age of your students, you may also take this time to discuss refraction.

How does sound travel?

Draw and label a sinusoidal wave. Be sure to label the wavelength, period and amplitude.

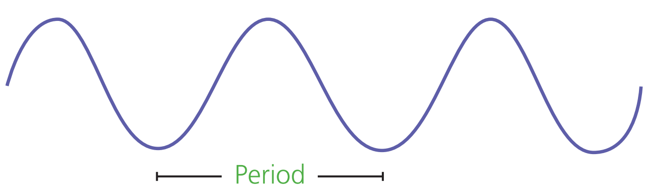
What is wavelength? What does wavelength tell you about the wave?

What is frequency?

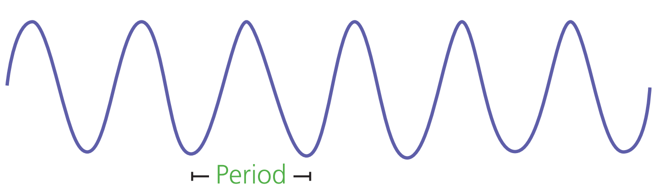
What part of sound does frequency correspond to?

Determine what the relative pitch would be in each of the diagrams below.

Low Frequency Wave



High Frequency Wave



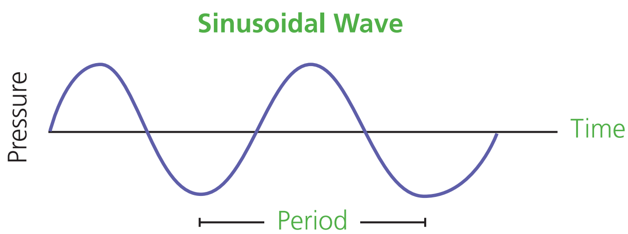
LESSON 3: WAVES CONTINUED

Circle the correct choice in the sentences below.

- A soprano sings at a higher / lower frequency than a bass.
- A tuba is a higher / lower frequency than a bass.
- Typically, men's voices are at a higher / lower frequency than women's voices.
- Dogs can hear higher / lower frequencies than humans.

What is amplitude?

What part of sound does amplitude relate to?



Using the above diagram and a ruler, determine the wavelength and amplitude of the wave.

Extension:

Before you go to the Puyallup Fair, check out this video of The Procrastinators (a percussion group that performs at the Fair): http://www.youtube.com/watch?v=tkA5nkHu4ds

What did you observe in the video? What "instruments" are they playing? Describe the types of sound you hear (pitch, volume, tone) when they hit different instruments.

While your class is at the Fair this year, observe the sounds going on around you. (If you do not make it to the Fair, you can visit www.youtube.com and see various Puyallup Fair videos.) Keep a chart with all of the sounds you hear (include at least 10). For each, describe what it sounds like (high or low pitch, loud, soft, pleasing, harsh, etc.) and how it made you feel. When you get back to the classroom, determine for each sound what the relative frequency and amplitude would be in relation to the other sounds you heard. Put them in a list or graph in order from highest to lowest frequency, then again in order from highest to lowest amplitude. Was there any correlation between frequency or amplitude and the way the sound made you feel?

LESSON 4: MIXTURE

Photo credit: Patrick Hagerty

Materials:

Trail mix
Sand
Small magnetic pieces
Pebbles
Bowls
Magnets
Sifter
Scale

Lesson Steps:

Observe a bowl of trail mix. What do you see in the bowl? Draw a picture.

As a class, discuss what parts make up trail mix. Is this a compound or mixture? Why?

Next, break into groups of three to four students. Have different members of your group measure out five grams of sand, 10 grams of pebbles and five grams of the magnetic material. Combine all of these ingredients together in a large bowl. What have you created?

Why would this be considered a mixture and not a compound?

Now, devise a plan to separate each part of the mixture back to its original pile using the materials on your table. Describe how you separated everything.

What was the easiest item to separate out? Why do you think this was the easiest? Would it have been as easy if the quantities in the bowl were doubled?

What was the hardest? Why? Is there any other tool that may have made this easier for you?

What are some examples of mixtures that occur naturally in the world?

Extension:

In cooking and baking, there are often times where you combine ingredients to make a mixture. While your class is at the Puyallup Fair, create a list of any food items that you see that are mixtures. Include the different ingredients that are part of the mixture.

LESSON 4: MIXTURE CONTINUED

Food item	Primary ingredient	Secondary ingredient	Other ingredient	Other ingredient