Virginia Instructors of Physics

Spring '03

VIP's mission is to foster communication among teachers of physics and physical science as well as to provide unique learning experiences for teachers and their students.

Upcoming Meetings of VIP

Wow!!! Gone are the days when I would go to VAST and hope for at least one session having something to do with physics!! Now my problem is which ones do I choose? This VAST schedule this past fall had a wonderful spread of physics offerings and I believe VIP has played a large roll in bringing this about. Thanks to all who have helped.
VIP's two sessions were not as well attended as they have been the last couple of years, but I believe that has more to do with the abundance of offerings than anything else – what a great problem to have. Make your plans to attend next fall's VAST conference at the Hotel Renaissance (Portsmouth) **November 12-15, 2003**. Better yet, make plans to present at the fall VAST conference. This will be a new venue and the program coordinator may be familiar to those who run in physics circles – Maria Cooper. I'm sure it will be an amazing conference well worth your effort to attend.

Our **Spring Meeting** will be held at UVA's Physics Building **on April 12, 2003 9:00 AM-4:00 PM.** The theme of this meeting is **PVC – Physics Very Cheap!** This will be a make and take session focusing on demos and labs made from PVC and other cheap materials. Participants will walk away with their very own set of **Physics Spinners, Stadium Horn, PVC String Wave Polarizing Filters, and Thunder Tube and more!** You've got to be there to take home the goodies. Funds and supplies may limit the availability of some items. Limited items will be awarded **in order of RSVP** to me at ajackson@harrisonburg.k12.va.us.

This is one I use when teaching circular motion. The turntables with the magic draw pad, ramp and ball can be found in the earth science section of a few different science catalogs. This lab helps students to view curvilinear motion from the inertial and non-inertial frames of reference and sets the stage. It helps to set the stage for the concept of why Centrifugal force is a fictitious force. – Andy Jackson

As the Whirled Turns

Materials- turntable with “magic draw” pad, steel ball, launcher

Purpose - The student will investigate how a rotating frame of reference causes linear motion to appear to be curved motion. The student will be able to determine which direction this curvature appears in the northern and southern hemispheres, and be able to explain its cause.

Northern Hemisphere

In this part of the experiment, the rim of the turntable is the equator and the center is the North Pole. First, clear the tablet by peeling up the orange sheet. Do this carefully so you do not rip it, or the white sheet beneath it. Place the launcher on the equator, with Velcro, aimed at the North Pole. Allow the ball to roll across. Do this again while rotating the turntable slowly counter-clockwise at a steady speed. Relative to the straight-line path made earlier, which direction does the ball turn, left or right?

Now clear the pad again. Place the launcher on the North Pole aimed directly at the equator. Allow the ball to roll across the pad. Do this again while rotating the turntable slowly counter-clockwise at a steady speed. Relative to the straight-line motion, which direction does the ball turn?

Southern Hemisphere

In this part of the experiment the rim is still the equator but the center is now the South Pole. Clear the pad and place the launcher on the equator aimed directly at the South Pole. Launch the ball. Now launch the ball again while rotating the turntable slowly in a clockwise direction at a constant speed. Relative to the straight-line path, which direction does the ball turn, left or right?

Now clear the pad again. Place the launcher on the South Pole aimed directly at the equator. Allow the ball to roll across the pad. Do this again while rotating the turntable slowly clockwise at a steady speed. Relative to the straight-line motion, which direction does the ball turn?

Just a turntable now

Now the turntable is no longer the Earth, it’s just a turntable. Place the launcher on the edge with the Velcro. Aim it towards the center. Place a small piece of tape on the edge directly across from the launcher. Place a wooden block on the lab bench directly across from the launcher. Launch the ball. Next you will launch the ball while turning the turntable slowly clockwise. Before you do the experiment try answering the two prediction questions. Answer these as if you were the ball.

QUESTIONS FROM THE EXPERIMENT From **the ball's point of view**

Northern Hemisphere

1. When heading North the ball turned __________

2. When heading South the ball turned__________

Southern Hemisphere

3. When heading South the ball turned__________

4. When heading North the ball turned__________

Prediction – answer before doing the experiment

As a turntable

5. The Ball will hit the edge of the turntable with the tape ______

A. in front of the ball B. to the ball's left C. to the ball's right

6. The Ball will hit the edge of the turntable with the block ______

A. in front of the ball B. to the ball's left C. to the ball's right

7. Were your answers correct? If not describe what happened.

(3 pts)Explain why, in the Northern Hemisphere, as air masses move either North **or** south, they tend to turn to their right. (You're to explain both cases)

(3 pts)In the last part of the experiment, you saw that the ball missed the piece of tape but ended up striking the edge of the turntable directly (or very nearly directly) in front of the wooden block. Describe the motion of the ball and why it ended up at the block **from the frame of reference of the tape.**

(3 pts)Describe the motion of the ball and why it ended up at the block from the **frame of reference of the block.**

I use this next lab as my introduction to waves. It brings up many more questions than answers and not all parts can be completed as quantitatively as the lab suggests. You can get very good data on wave speed. You can clearly see how the tension affects the wave speed in both types of waves as well as how little effect the energy of the wave has on wave speed. Amplitude and wavelength are very tough to measure directly and drive home the point that a wave is a moving phenomenon, not a static picture. Envisioning the amplitude of the longitudinal wave also helps point out the difference between the two types of waves to students. Students often need some guidance on figuring out experiments they can conduct that will conclusively let them decide what is going on when two pulses run into each other. Do they bounce off each other or pass through each other? It's hard to tell if you send two equal pulses down the slinky towards each other. I ask them how they can make the waves distinguishable from each other and guide them as needed. – Andy Jackson

CAUTION! Do NOT over stretch or entangle the slinky. It is easy to do and impossible to fix.
Note- New terms that you must learn are presented in **UPPERCASE.** Sometimes they are defined in the lab and sometimes you will need to look them up.

Purpose

The purpose of this activity is to measure the **WAVE SPEED** of **TRANSVERSE** and **LONGITUDINAL** WAVES in a slinky, as well as their **WAVELENGTH, AMPLITUDE** and **FREQUENCY**. You will also make observations of the properties of waves when they encounter barriers and when they interact with each other.

Materials

Slinky, meter sticks, and stop watch.

Procedure

A. Measuring **WAVE SPEED**, **WAVELENGTH**, and **FREQUENCY** of waves

PULSES can be generated in a slinky stretched out on the floor by one person holding one end firmly and another person giving his/her end a single quick jerk sideways and back. This is called a **TRANSVERSE PULSE**. A **LONGITUDINAL PULSE** can be generated by one person giving a single quick push-forward-pull-back motion to one end of the slinky.

Generate a **TRANSVERSE PULSE** and observe the slinky. Now generate a **LONGITUDINAL PULSE**. Describe and identify each type.

WAVE SPEED is the measurement of the rate at which the **PULSE** moves. In other words it is the speed of the **PULSE**. Measure the **WAVE SPEED** for each of the two types of **PULSES**. Record the wave speeds in the data table. Change the tension in the slinky and change the energy with which you "wave". Determine what factors affect **WAVE SPEED**. Do the same factors affect both types of waves in the same manner? Remember that if you want to test a variable you must keep all the others constant to have meaningful results.

Name______________________________
Period_________

Distance (m) __________________

Wave type

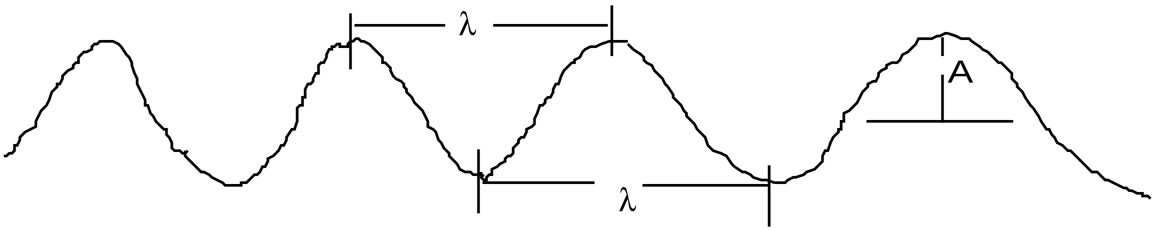
LONGITUDINAL
Describe a longitudinal wave.

TRANSVERSE
Describe a transverse Wave.

Tension	**average time 3 trials(s)**	**Wave speed (m/s)**
high		
medium		
low		
Energy		
high		
medium		
low		
Tension		
high		
medium		
low		
Energy		
high		
medium		
low		

Do the same factors affect both types of waves in the same manner?
What variables are connected and in what manner?

A **WAVE TRAIN**, or just simply a **WAVE** can be generated by repeating rhythmically the motion used earlier. All waves have **WAVELENGTH** and **FREQUENCY**. The **WAVELENGTH** is the distance between any two adjacent identical points. (See diagram)



B. Generate a **TRANSVERSE** wave and measure its **WAVELENGTH**. In what way does this give you a different idea about waves than if you just study them in a textbook?

C. The **FREQUENCY** of a wave is a measurement of how often the wave repeats itself in a given unit of time. Measure the **FREQUENCY** of each type of wave. Explain how you measured the **FREQUENCY**.

The **AMPLITUDE** of a wave is a measurement of how far its maximum **DISPLACEMENT** is from the **EQUILIBRIUM** position. Measure the **AMPLITUDE** of each type of wave you are generating.

D. Determining the relationships between wave properties: Conduct experiments that will allow you to answer the following questions.

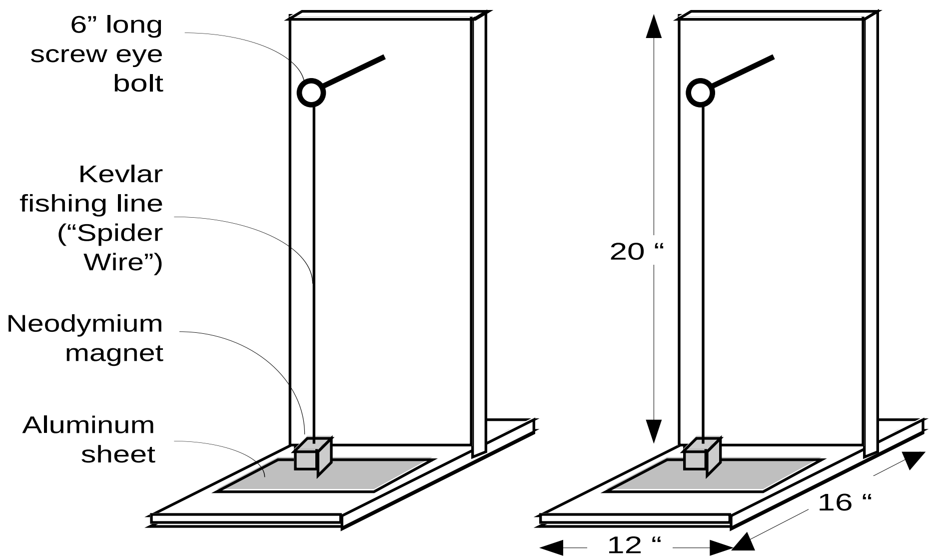
1. How are **FREQUENCY** and **WAVELENGTH** related?

2. What happens to a **PULSE** when it reaches the end of the slinky?

3. What happens when two different **PULSES** run into each other?

Induction Braking Demo
- The Lenz's Law Pendulum -

Faraday's Law of Electromagnetic Induction says that when the flux is changed in a piece of metal or coil an emf is induced. Lenz's Law says that the induced emf, due to a change in flux in metal or coil will move to oppose any change in flux. In this demonstration, a pendulum has a magnetic bob that swings within 1 millimeter of a piece of aluminum. The magnet is a round donut magnet. The center of the magnet has a dowel poked into it. The dowel rod is held onto magnet by a coating of epoxy. I used JD Weld. The epoxy itself was magnetic and evenly covered the magnet. As the magnetic bob swings over the metal, the flux in the metal changes. An emf and counter magnetic field in induced in the metal and the pendulum bob comes to rest quickly –within 2 swings.



Use particle shelving board. This board, from a hardware store, has a white plastic coating. This gives you project a nice durable finish with out doing extra work.

The thicker the aluminum sheet, the more dramatic the effect.

Notice that all these pieces can be cut from one 4 foot long piece of wood

Go to our website, http://www.vast.org/vip, to see enlarged color construction pictures. A great source I found for LOW COST Neodymium magnets is http://www.engconcepts.net/magnets/magnets.htm. I used the "Super Magnets -0.75 in, OD, 0.375 in ID, 0.25 in thick: Price - 4 for $3.00 plus shipping.

By Tony Wayne