Lab Framework

Text: CORD Applied Math
Unit number and title: 22 – Using Trig Functions

Short Description: Wave phenomena abide by the same rules regardless of the media it is transferred through – or in other words, there are not separate characteristics for light waves, or sound waves, or water ripples. Because of this we can investigate the characteristics of all waves using a coiled spring (slinky).

Developed by: Angela Reed

Contact Information: reedar@puyallup.k12.wa.us

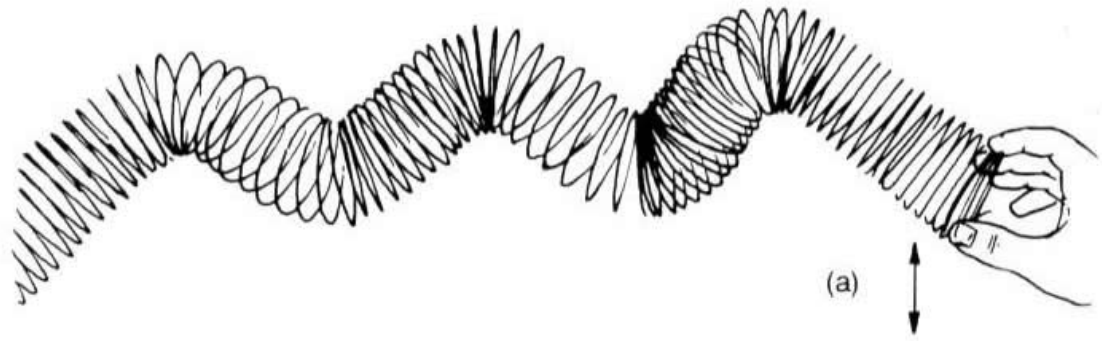
Date: June 23, 2010

Lab Title
Slinky Lab

LAB PLAN

TEACHER: Teacher Prep/ Lesson Plan

- **Lab Objective**
  The objective of this lab is to observe and investigate the basic characteristics of waves, using a coiled spring.
- **Statement of pre-requisite skills needed**
  Inquiry – readiness to learn!
- **Vocabulary**
  MEDIUM: the medium is the material that a wave is transmitted through. For example sound waves are transmitted through **air**, and water ripples are transmitted through **water**.
  TRANSVERSE WAVE: a transverse wave is a wave in which the vibration displacement occurs in a direction perpendicular to the motion of a wave.



LONGITUDINAL WAVE: also known as a compression wave … a longitudinal wave is a wave in which the vibration displacement occurs in the same direction as the motion of the wave.

PULSE: a single disturbance in a media that moves along in a wave.
WAVELENGTH: the length of a single pulse.
AMPLITUDE: the maximum amount a disturbance is from a wave's rest position.
FREQUENCY: the rate at which wave pulses pass a point.

- **Materials List**
  One slinky per group of two

- **State Standards addressed**
  Math
  6.6.B Identify relevant, missing, and extraneous information related to the solution to a problem.
  6.6.F Apply a previously used problem-solving strategy in a new context.
  7.2.D Make scale drawings and solve problems related to scale.
  G.3.E Solve problems involving the basic trigonometric ratios of sine, cosine, and tangent.
  Reading:
  EALR 2: The student understands the meaning of what is read.
  Component 2.1 Demonstrate evidence of reading comprehension.
  EALR 3: The student reads different materials for a variety of purposes.
  Component 3.2 Read to perform a task.
  Component 3.3 Read for career applications.
  Writing:
  EALR 3: The student writes clearly and effectively.
  Component 3.1: Develops ideas and organizes writing.
  Component 3.2: Uses appropriate style.
  Component 3.3: Knows and applies writing conventions appropriate for the grade level.
- **Leadership Skills:**
  1.4 The student will be involved in activities that require applying theory, problem-solving, and using critical and creative thinking skills while understanding outcomes of related decisions
- **SCAN Skills/Workplace Skills**
  Knowing How to Learn
  A. Recognizes and can use learning techniques to
- **Set-up information**
  For this lab, you will need a long hall or large area so that students can spread out and work. Each student pair will need a slinky
- **Lab organization**
  - This lab can be completed in a 50 minute time period.
  - Slinky need to be at front of the room for students to take as they leave the room.

- **Teacher Assessment of student learning** (scoring guide, rubric)

Points	10	9	8	7	6
Performance	Excellent	Good	Average	Fair	Poor
Lab Activity: Followed all lab procedures safely					
Correctly measured or observed					
Worked in cooperation with others					
Cleaned up work area and equipment					
Lab Report: Correctly recorded data in a chart or table					
Used complete sentences with correct capitalization, spelling, and punctuation					
Made appropriate conclusions					

- **Summary of learning** (to be finished after student completes lab)
  Students will be able to see and relate the vocabulary words for wave functions to real life.
- **Optional activities**
  None
- **Career Applications**
  Music
  Electronics

LAB TITLE: Slinky Lab
STUDENT INSTRUCTIONS:

- **Statement of problem addressed by lab**
  Most students LOVE Slinky! The chance to explore waves and how they work with Slinky is a great match. This is designed to be an introductory lab.

- **Grouping instructions and roles**
  Students will be groups in pairs. One person is going to check out the Slinky and that same person will be responsible for returning the Slinky.

- **Procedures** – steps to follow/instructions

Record you observations in your lab notebook, and number them so you can tell them apart after. Be careful not to tangle the slinky.

I. LONGITUDINAL WAVES

1. Stretch the slinky down the hall about 8 meters on the floor (use 3 floor tiles as 1 m). Send a pulse down the slinky by tapping it at one end.
   a. Describe the motion of the medium, in this case the slinky, as the pulse moves through it.
   b. Use the length of the slinky and a stopwatch to measure the velocity of the wave pulse ($v = d / t$). Try this several times using different methods for initiating the pulse (*tap it, push it, hit it, etc.*). Be sure to take note whether or not hitting the slinky differently affected the velocity of the pulse.
   c. Repeat Part b. with the slinky at lengths of 7 m, 6 m and 5 m. Record your results in the table below in your lab notebook.

8 m	7 m	6 m	5 m

   d. How did changing the characteristics of the medium (length/tightness) change the velocity of the pulse?

II. TRANSVERSE WAVES

1. Stretch the slinky across the floor again for a distance of 8 meters. Generate a transverse wave pulse by moving your hand quickly to either the left or the right.
   a. Describe the motion of the medium, in this case the slinky, as the pulse moves through it.
   b. Use the length of the slinky and your stopwatch to measure the velocity of the pulse. Try this several times changing the height (amplitude) of the pulse each time. Be sure to mention in your answer whether or not the size of the pulse affected the wave speed. Also compare this velocity to the velocity you found for the longitudinal wave of the same length.
   c. Now try generating more than one pulse. Slowly move you hand side to side at a constant rate. Describe what you see.
   d. Now move your hand side to side at a faster rate. Describe what you see. Include in your answer what happens to the speed, the frequency and the wavelength of the wave pulses.
   e. What conclusions can you draw about how changing the frequency and changing the amplitude of a wave pulse affects the other characteristics of a wave?

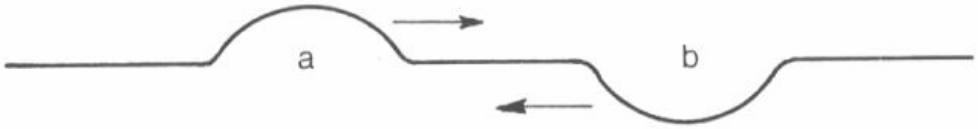
III. Wave Boundaries

1. Have your partner hold one end of the slinky strongly. Send a wave down to them and let it reflect back. This is a fixed end reflection because the end of the slinky is not allowed to move. What do you notice about the shape and motion of the reflected wave as compared to the initial wave?

IV. Multiple Wave Interaction

1. With one person on each end of the slinky, have each person create one transverse wave of about the same size with a disturbance in the same direction. Describe what happens when the disturbances meet along the medium and after they meet. Sketch a picture of what you see.

2. Now have each person creates a transverse wave, but this time make the disturbances in opposite directions (one right one left). Describe what happens when the disturbances meet along the medium and after they meet. Sketch a picture of what you see.



3. Now make one big pulse and one small pulse. Describe what happens when the disturbances meet along the medium, and after they meet. Sketch a picture of what you see.

- **Outcome instructions**
  Explore waves using Slinky and then we will talk about what the student discovered

- **Assessment instructions** (peer-teacher)
  Hand in lab once they are finished

Lab Data Collection

Student: _____ **Date:** _____

Unit: 22 – Using Trig Functions

Lab Title: Slinky Lab

Criteria: The objective of this lab is to observe and investigate the basic characteristics of waves, using a coiled spring.

Data Collection: Record the collected/given data

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    b. Use the length of the slinky and your stopwatch to measure the velocity of the pulse. Try this several times changing the height (amplitude) of the pulse each time. Be sure to mention in your answer whether or not the size of the pulse affected the wave speed. Also compare this velocity to the velocity you found for the longitudinal wave of the same length.

    c. Now try generating more than one pulse. Slowly move you hand side to side at a constant rate. Describe what you see.

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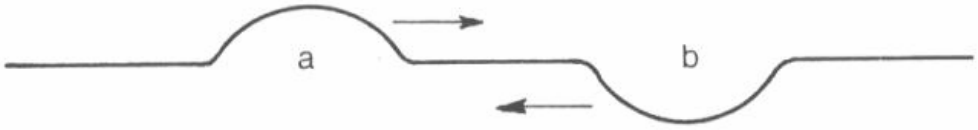

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Calculations: Complete the given calculations to solve for an answer(s)
None

Summary Statement:
Through this lab, students should be able to communicate with written words about waves, and their properties.

Other Assessment(s)
Students could show teacher what wavelength is by example.