A Wiggle in Time and Space Lab

Teacher's Guide

Topic:

Waves

The following information is provided to the student:

Question:
How is simple harmonic motion (mass on a spring, pendulum motion) related to wave motion?

Purpose:
To compare simple harmonic motion and wave motion, identifying ways in which they are similar and different.

A complete lab write-up includes a Title, a Purpose, a Data section, and a Conclusion/Discussion. The Data section should include observations of the wave motion appearing in the animation; these observations could include a well-labeled diagram with notes describing what is observed or it could include a collection of bullet-points describing primary characteristics of wave motion. The Conclusion/Discussion should include a well-written paragraph which responds to the purpose of the lab.

URL: http://www.smgaels.org/physics/home/java/dukes_java/TabbedWaveTrans.htm

Materials Required:

A page from the internet:
http://www.smgaels.org/physics/home/java/dukes_java/TabbedWaveTrans.htm

Description of Procedure:

Students observe a computer animation of a transverse wave. The analyze the up and down movement of the individual particles. They simultaneously view the motion of a mass on a spring. They record their observations and construct diagrams to convey information about each. After about 10 minutes of viewing and note-taking, students then write a paragraph for the Conclusion/Discussion which responds to the question raised in the Purpose of the lab.

Alternative Materials and Procedure:

There are numerous web sites which offer informative animations of wave motion. This one was selected of its clean and reliable interface and because there was no accompanying textual information. Teachers might find several other useful pages by conducting a Google search with the keywords "physics waves animation Java applet physlet".

Safety Concern:

There is always a higher than usual level of risk associated with working in a science lab. Teachers should be aware of this and take the necessary precautions to insure that the working environment is as safe as possible. Student *horseplay* and off-task behaviors should not be tolerated.

Suggestions, Precautions, Notes:

The Laboratory

1. This is a quick activity which involves observation and discussion. There is no manipulation of equipment or collection of quantitative data. This lab and the next lab - Wave Motion Lab - can typically be done in a single period.
2. Students often confuse wave motion (the movement of a wave pattern across the medium from one end to the other end) with particle motion (the back and forth vibrational movement of the particles of the medium). This lab offers a great opportunity to distinguish between the two quantities.
3. A computer lab is not needed for this activity if your classroom is equipped with a computer connected to a television or an LCD projection capabilities. The animation can be shown to your class and repeated over and over again as students observe and write.
4. If using this lab with your students, take the theme of a waves as a wiggle in time extended across space one step further. As the properties of waves are discussed, identify some as spatial properties (wavelength and amplitude) and others as temporal properties (frequency and period) and speed as ratio which combines both spatial and temporal information.
5. This is the one of several labs designed with the intent of conveying the nature of a wave. The labs titled A Wiggle in Time Lab and Wave Motion Lab are excellent complements to this lab. The take-home ideas from the collection of three labs include the following:
    - A wave is a disturbance which is introduced into the medium at one end and travels through the medium by particle to particle interaction to the other end.
    - There is a distinction between wave motion and particle motion. Wave motion is the movement of a wave pattern across the medium from one end to the other end. The wave pattern might be the sinusoidal pattern of alternating crests and troughs or it might be the pattern of a series of compressions and rarefactions. Particle motion is the back and forth vibrational movement of the particles of the medium about a fixed position. The particles might vibrate parallel to the direction of wave motion or perpendicular to the direction of wave motion (or in a circle).
    - A wave is a wiggle in time which is extended across space. Particles of the medium wiggle up and down (or back and forth) over the course of time. Neighboring particles interact with one another so as to create a pattern which is spread through space - from one end of the medium to the other.
    - A wave propagates or travels through space by particle to particle interaction. The disturbance which is introduced to the first particle of the medium travels to the last particle of the medium because the particles interact. The frequency and the amplitude (ideally) of the disturbance is maintained as one particle *passes it on* to the neighboring particle.
    - A wave is an example of periodic motion; particles of the medium undergo continuous up and down (or back and forth) periodic motion.
    - A wave is an energy transport phenomenon and not a material transport phenomenon. Matter (particles, stuff, atoms, material) is not moved from the location of the original disturbance to the opposite end of the medium. The particles simple vibrate about a fixed position as the energy is passed from one end of the medium to the other.
    - There is always something *sinusoidal* about a wave. For instance, the particles vibrate in such a manner that their distance from the resting position varies as the sine of the time. Or the entire collection of particles occupy a position at a fixed moment in time which together creates the appearance of a sine wave.

Auxiliary Materials:

None

Scoring Rubric:

W3.	**A Wiggle in Time and Space Lab**	**Score**
____	Included, labeled and organized all parts of the lab report.	
____	Data section includes observations pertaining to particle motion and wave motion for transverse waves; might be complemented by a well-labeled diagram. Observations are clearly written and relevant to the	____/____

____	question proposed in the Purpose. Conclusion/Discussion includes a well-written paragraph in which wave motion is compared to the motion of a mass on a spring. Ways in which they are similar or different is discussed.	

Connections to The Physics Classroom Tutorial:

The following readings are a suitable accompaniment to this lab:

http://www.physicsclassroom.com/Class/waves/u10l1a.cfm

http://www.physicsclassroom.com/Class/waves/u10l1b.cfm

Connections to Minds on Physics Internet Modules:

Sublevel 1 of the Waves module is a suitable accompaniment to this lab:

http://www.physicsclassroom.com/mop/module.cfm