Name:______________________________ Class: ________ Date: __________

Visual Model of the Doppler Effect

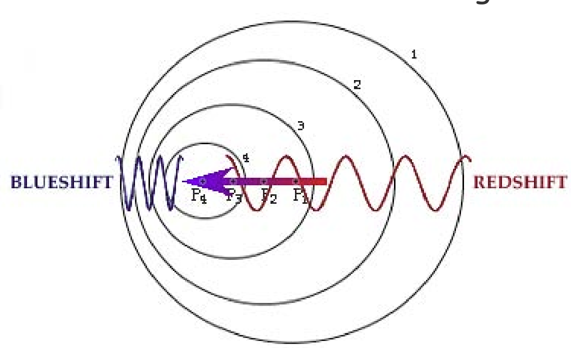
Learner Outcomes:

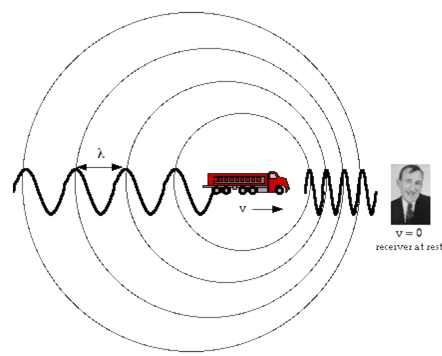
- Describe and apply techniques for determining the position and motion of objects in space.
    - o Describing in general terms how parallax and the Doppler effect are used to estimate distances of objects in space and to determine their motion.

Key Terms:

Doppler Effect | Frequency
Wavelength | Pitch

Background Information: The change in the frequency or wavelength emitted by an object when an object and an observer are moving away or towards each other is called the Doppler Effect. In Aerospace navigation, the Doppler Effect is used in radars to determine the speed of a flying object. We perceive objects moving towards us as making a higher frequency sound, and objects moving away as having lower frequency sound. In Astronomy, the Doppler Effect has been used to measure the speed at which stars and galaxies are approaching toward or receding from us. This is used to detect the speed of rotation of stars and galaxies. Since blue light has a higher frequency than red light, the spectral lines from an approaching astronomical light source show a slight change in color called a "blueshift" and those of receding sources show a "redshift".





This activity has been adapted from:
http://www.education.com/science-fair/article/visual-model-doppler-effect/

Research Question:

How can we create a model of the Doppler effect?

Materials:

Construction paper	Tape
Scissors	Small toy car

Procedure:

1. Cut the construction paper long-ways into strips about 1" wide.
2. Cut the strips into lengths of decreasing size, each strip being about 2" shorter than the previous. (If you are working with smallish paper, begin by taping strips together so as to get more length. It doesn't matter exactly how long the strips are as long as they regularly decrease in length).
3. Now tape the ends of each strip together to make circles.
4. Let's pretend these paper circles are sound or light waves. When the car is still, sound waves move outward from the car. Lay the circles on the floor inside each other and put the racecar right in the middle. This is a model of sound coming from an idling, not moving, racecar.
5. Now, we're going to race the car. Pretend it's going fast, but we'll do it in slow motion so we can see what's happening. Drive the car in one direction, letting it push on the rings in front of it. What's happening to the rings? (The rings, being pushed by the toy car, should be getting bunched together in front of the car and getting farther apart behind it.) That is exactly what happens to the sound waves as a racecar speeds by you. The waves in front of the car get closer together and the waves behind the car get further apart. Close together waves make a high sound. Far apart waves make a low sound. Thus, the Doppler Effect. Vroom!

Analysis:

1. How would the quality of the sound of the car be different as it moved toward you? How about when it moved away from you?

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2. Do the sound waves that are produced by the car actually change, or does how you perceive the waves change? Explain.

3. Can you tell by sound whether a fire-truck is moving toward or away from you? Explain.

4. How is this apparent shift in sound similar to the shift that happens in a star's spectrum?

5. Why would scientists want to know the direction and speed of a star?

Conclusion:

Extension:

Investigate and prepare a visual or auditory presentation identifying, describing and explaining one additional technology that uses the Doppler Effect.

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