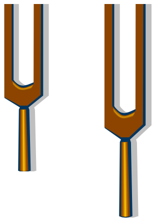

Name ______________________________ 91

EXT: INVESTIGATION OF WAVES

PART 1- RESONATING RINGS

BACKGROUND: Have you ever noticed a single object in your home vibrate vigorously due to the vibrations of loud music? Why is it that only certain objects vibrate and not all objects? This is due to a phenomenon known as resonance.

All objects have a natural frequency or set of natural frequencies at which they vibrate. The natural frequency of an object is dependent upon its length and composition. If an object is forced to vibrate at its natural frequency, a vigorous vibration, known as resonance, will occur. An object can be forced to vibrate by a push, pull, pluck, strum, or even the vibrations of another object. When resonance occurs, it can be seen as a vibration or even heard as a humming sound.

In this activity, resonance is visibly shown using six paper rings mounted on a cardboard base. By physically moving the base back and forth, vibrations are created which cause the rings to vibrate. Resonance will occur in a ring when the frequency of the back and forth motion of the base matches the natural frequency of the ring. In this activity, a pair of matching rings will resonate at the same time. By altering the frequency of the back and forth motion of the base, different pairs of rings will resonate.

MATERIALS: cardboard base (12"x18"), construction paper (12"x18"), ruler, scissors, tape, pen or pencil.

PROCEDURES:

- Prepare a cardboard base by cutting a piece of cardboard to 12"x18".
- Cut out six 1" × 18" strips from a piece of construction paper.
- Take two of the paper strips and cut the length to 15 inches.
- Take another two paper strips & cut the length of each to 12 inches.
- The last two strips should remain 18 inches long.
- Form the strips into rings by taping the two ends together.
- Tape the rings to the cardboard about 2 inches apart as shown in Figure 1.

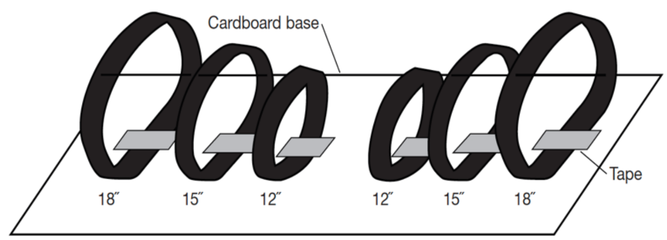

Figure 1.

ANALYSIS:

- Place the cardboard on a flat surface and push it back and forth as shown in Figure 2. Start with a very low frequency and gradually increase the frequency until a pair of rings starts vibrating vigorously and achieves resonance. When this occurs, keep the frequency of the base constant for a short time and observe the resonance of the rings.
  1. What pattern do you see in which rings resonate at the same frequency as you move the base?


Figure 2.

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- Gradually increase the frequency of the back and forth motion of the cardboard base until another pair of rings achieves resonance. When this occurs, keep the frequency of the base constant, and observe.

2. Note any pattern or trend in the resonance of the rings.

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- Increase the frequency of the back and forth motion of the base until the last pair of rings achieves resonance. When this occurs, keep the frequency of the base constant and observe.

3. What is the relationship between the back-and-forth motion of the base and the resonance of different size rings.

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TAKE THE FINISHED PROJECT TO YOUR TEACHER AND EXPLAIN HOW IT WORKS.
EXCHANGE IT FOR SUPPLIES FOR PART 2.

PART 2- TUNING FORKS

PROBLEM: How can we use tuning forks to investigate the different properties of sound?

MATERIALS: (per group): 2 tuning forks with matching frequencies, 1 tuning fork with a different frequency, Rubber Stopper, large tray with 1" water

PROCEDURE AND OBSERVATIONS: Take turns performing each of the tests below and record your observations. Gently strike the tuning forks against the rubber stopper with just enough force to start them vibrating… do NOT strike them hard!!!

A. HEARING SOUND VIBRATIONS: **Strike the prongs of one tuning fork against the rubber stopper and then hold the fork close to your ear.**

1. What do you hear?
2. What happens when you touch the prongs of the fork?
3. Why?

B. INTENSITY OF SOUND VIBRATIONS: **Strike the prongs of one tuning fork gently against the rubber stopper and then hold the fork close to your ear. Strike the same tuning fork a little harder and listen.**

4. How do the sounds differ?
5. Why?

C. FREQUENCIES: **Strike the prongs of two matching size tuning forks at the same time & listen to both.**

6. What do you notice about the two sounds?

Strike the prongs of two different size tuning forks at the same time & listen to both.

7. What do you notice about the two sounds?
8. What do you think the numbers on the tuning forks mean?

D. DOPPLER EFFECT: **Strike a tuning fork and hold it at an arm's length in front of you. Rapidly bring the tuning fork toward your ear then away again.**

9. How does the pitch of the sound change as the tuning fork approaches your ear?
10. How does the pitch of the sound change as the tuning fork is moved away from your ear?

E. RESONANCE: **Strike a tuning fork and bring it within a few centimeters of the other tuning fork with the SAME frequency. Then bring the second tuning fork near your ear and listen closely.**

11. What do you hear?
12. Explain why this happens.

Strike a tuning fork and bring it within a few centimeters of the other tuning fork with a DIFFERENT frequency. Then bring the second tuning fork near your ear and listen closely.

13. How are the results different?

F. INTERFERENCE: **Strike a tuning fork and bring one of the prongs to within 2 or 3 cm of your ear. Slowly rotate the tuning fork completely.**

14. Describe any change in the loudness of the sound.

G. ENERGY TRANSFER: **Strike the tuning fork and touch the surface of the water in the tray with ONLY ONE prong.**

15. What happens to the water? Describe what you see.
16. Where does the energy start?
17. What pattern does the energy travel in?

Strike the tuning fork again and touch the surface of the water with BOTH prongs.

18. What happens to the water? Describe what you see.
19. Where does the energy start?
20. What pattern does the energy travel in?