Comparing Pitch to the Size of the Object Vibrating

Standard VI: Students will understand properties and behavior of heat, light, and sound.

- **Objective 3:** Describe the production of sound in terms of vibration of objects that create vibrations in other materials.
    a. Describe how sound is made from vibrations and moves in all directions from the source in waves.
    b. Explain the relationship of the size and shape (and tightness) of a vibrating object to the pitch of the sound produced.
    c. Relate the volume of a sound to the amount of energy used to crate the vibration of the object producing the sound.
    d. Make a musical instrument and report on how it produces sound.

I. Sounds are vibrations carried through the air in waves.

1. Moving the Rice

1. Materials
    a. Two cans—one with on end cut out and another with both ends cut out
    b. Two 12-inch balloons
    c. Metal spoon
    d. Rice

2. Procedure
    a. Cut the necks of the balloons off
    b. Put a balloon over the open end of the can with one end cut out.
    c. Put a balloon over one of the open ends of the can with both ends cut out.
    d. Put rice on the balloon over the can with one open end.
    e. Put the can with two open ends over the can with the balloon with rice on it.
    f. Hit the balloon without the rice with a spoon.
    g. Ask them to make a conclusion about this experiment.
    h. Write in your log what happened.

2. **Feeling Vibrations**
    a. Materials
        i. One can with both cans cut out
        ii. One 12-inch balloon

    b. Procedure
        i. Cut the neck of the balloon off the balloon.
        ii. Put the balloon over one of the ends of the can.
        iii. With your index finger lightly on the balloon, hum a low pitch into the open end.
        iv. Ask if they could feel the balloon vibrating.
        v. Have them repeat what they did before, but this time to hum a high pitch into the open end.
        vi. Ask if they could feel the balloon vibrating.
        vii. Ask which humming pitch made the balloon vibrate fast.
        viii. Ask which humming pitch made the balloon vibrate slowly.
        ix. Ask them to draw a conclusion about this experiment.
        x. Write in your log what happened.

II. The relationship of the length or size of objects to the pitch.

1. **Observing Vibrations**
    a. Materials
        i. 12-inch ruler
        ii. Desk or table

    b. Procedure
        i. Put the plastic ruler at the edge of the desk with the 6-inch mark at the edge of the desk and the 5, 4, 3, 2, and 1-inch marks are hanging over the desk.
        ii. Holding the ruler with one hand on the table, push the side of the ruler hanging over the edge of the desk down with your other hand a few inches and let it go.
        iii. Observe the vibration of the ruler and the sound it makes.
        iv. Now, move the ruler to the 5-inch mark and repeat the procedure watching the vibration and listening to the sound.

v. Keep moving the ruler to the shorter position each time to the inch marks and repeating what you did before and watching the vibration and listening to the sound.
vi. Ask them to draw a conclusion about this experiment.
vii. Write in your log what happened.

2. Sounds of the Xylophone

a. Materials
   i. A xylophone
   ii. A mallet

b. Procedure
   i. Play the first and last bars on a xylophone.
   ii. Ask which bar has the highest pitch.
   iii. Ask which bar has the lowest pitch.
   iv. Ask why one has a higher pitch and one has a lower pitch.
   v. Ask what they think the bars between the longest bar and the shortest bar will sound like.
   vi. Ask them why they will sound different.
   vii. Ask them how the bars are going to sound as it is played from one end to the other end.
   viii. Ask them why they think that.
   ix. Play it to see if they are correct.
   x. Ask them to draw a conclusion about this experiment.
   xi. Write in your log what happened.

3. Length of a straw

a. Materials
   i. Drinking straw
   ii. Scissors

b. Procedure
   i. Cut an upside down "V" at the end of the straw.
   ii. Press down the same end so it is flat.
   iii. Blow into it.
   iv. Make cuts on the end of the straw as you are blowing into it.
   v. Compare this with a recorder.

vi. Ask them how a recorder works.
vii. Ask them to draw a conclusion about this experiment.
viii. Write in your log what happened.

4. **Blowing over the tops of bottles**
   a. Materials
      i. Plastic pop bottle
      ii. Water

   b. Procedure
      i. Blow over the top of an empty plastic pop bottle.
      ii. What pitch do you hear, high or low?
      iii. Put water into the plastic pop bottle about 1/4 full.
      iv. Blow over the top of it.
      v. What pitch do you hear compared to the last one?
      vi. Put water into the plastic pop bottle about 1/2 full.
      vii. Blow over the top of it.
      viii. What pitch do you hear compared to the last one?
      ix. Keep putting water in the bottle and blowing across the top.
      x. Is it the length of the water in the glass that is carrying the sound or it is the empty space at the top that is carrying the sound?
      xi. How do you know?
      xii. Ask them to draw a conclusion about this experiment.
      xiii. Write in your log what happened.

5. **Hitting Bottles with Water in them.**
   a. Materials
      i. 3 one-pint canning jar bottles
      ii. Water

   b. Procedure
      i. Fill up three bottles with different amounts of water.
      ii. Strike each one lightly with a mallet of sorts.
      iii. What do you hear from each one?
      iv. Is it the length of the water in the glass that is carrying the sound or is it the empty space at the top that is carrying the sound?

v. How do you know?
vi. Ask them to draw a conclusion about this experiment.
vii. Write in your log what happened.

6. Pulling Sting inside of a can.

a. Materials
i. Two cans different sizes
ii. Hammer
iii. Nail
iv. String
v. Paperclip
vi. Wet wipie

b. Procedure
i. Put holes in the middle of the lid of the can.
ii. Thread separate strings into the holes of the cans.
iii. Tie a paperclip to the strings on top of the lids so the string doesn't slip back out of the hole.
iv. With the wet wipie, pull down on the string of one of the cans.
v. What pitch do you hear?
vi. With the wet wipe, pull down on the string of the other can.
vii. What pitch do you hear?
viii. Explain why the pitch is different.
ix. Ask them to draw a conclusion about this experiment.
x. Write in your log what happened.

III. The relationship of the tightness of stretched rubber bands to the pitch.

1. The Rubber Band Stretch

a. Materials
i. A stringed instrument
ii. Yardstick or ruler

b. Procedure
i. Show a Ukulele
ii. How do we change the pitch of the strings?

iii. Tell the students that we will see how the strings work to make different pitches.
iv. Get a rubber band and cut it so it is long.
v. Mark inch marks on the rubber band.
vi. Take the end of the rubber band and stretch it to a certain length on the ruler.
vii. Have a partner pluck the rubber band noting the pitch.
viii. Go to the next inch on the rubber band and stretch it to the same inch on the ruler.
ix. Have your partner pluck the rubber band noting the pitch. Was it higher or lower than the previous test?
x. Go to the next inch on the rubber band and stretch it to the same inch mark as the others.
xi. Have your partner pluck it again. Was it higher or lower than the previous test?
xii. Keep doing this until the rubber band can't be stretched to the given length.
xiii. Explain why the pitch is different.
xiv. Ask them to draw a conclusion about this experiment.
xv. Write in your log what happened.

2. Make a rubber band sting instrument

a. Materials
   i. Two-liter bottle
   ii. Exacto Knife
   iii. Rubber bands

b. Procedure
   i. Put a hole about 2 inches by three inches in a two-liter bottle
   ii. Put four rubber bands that are same around the bottle that go over the holes.
   iii. Play each one—pretty much sound the same.
   iv. Tighten them to make the different sounds.
   v. Put them in order of the scale
   vi. What can you do now to go lower?

Explaining The Sound Experiments

1. Explain why the rice moved when you hit the balloon on the can above the rice.

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2. Explain what you felt as you hummed in the cup with the balloon on it.

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3. Explain what you heard as you let go of the ruler at the different inch marks.

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4. Explain why the longer tone bell or xylophone key has a lower pitch than the shorter tone bell or xylophone key.

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5. Explain why the straw has a lower pitch when it is long and a higher pitch when it is short.

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6. Explain why the pop bottle's pitch becomes a higher pitch as it is filled with more water.

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7. Explain why the canning bottle's pitch becomes lower pitch as it is filled with more water.

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8. Explain why the pitch of a larger can with a string in the middle of it is lower that the pitch of a smaller can with a string in the middle of it.

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9. When the rubber band stretches from inch to inch, explain why the pitch gets higher.

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10. Explain how you were able to adjust the rubber band on the string instrument to make higher and lower pitches and why it worked.

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