Air And Water Music

Topic

Changing pitch by changing the length of a column of water (or air)

Introduction

In Experiment 6.04, you saw that the pitch of a note produced by a vibrating string can be adjusted by changing its length – the shorter the string the higher the note. In this experiment, you will investigate how the pitch of notes made by tapping water-filled test tubes is affected by changing the depth of water in the test tube. You will also discover how notes can be made by causing a column of air to vibrate strongly (or resonate) by blowing across the top of a test tube. You will then make different notes by varying the length of the column of air in the test tube. This has implications for the size of the musical instruments – the woodwind family – that make use of this phenomenon.

Time required

30 minutes for Part A
20 minutes for Part B

Materials

6 test tubes (150 × 24 mm)
test tube rack
1 liter beaker of water
eyedropper
30 cm ruler
teaspoon
marker pen

Safety note

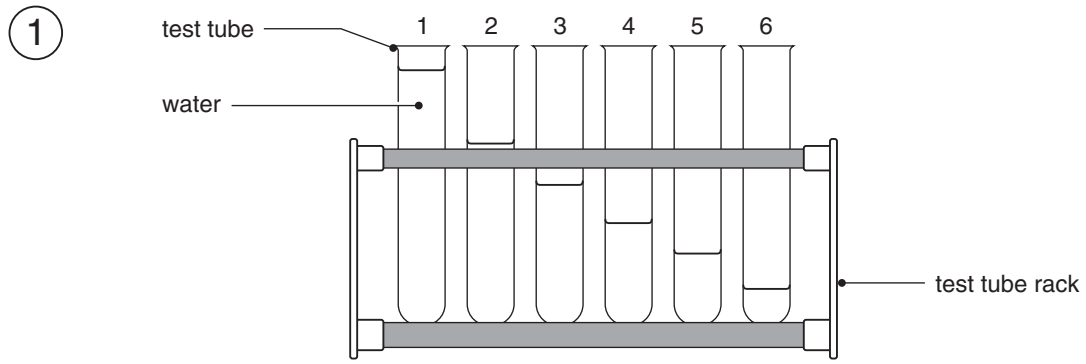
Please click the icon to view the general safety precautions.

Procedure

Part A: Notes from water

1. Using the marker pen, number the test tubes from 1 to 6. Place the test tubes in the rack and pour water into each test tube to the depths indicated in the table adjacent (see also diagram 1 on the next page).

Test tube	Depth of water (cm)
1	12
2	10
3	8
4	6
5	4
6	2



Test tubes filled with different depths of water

2. Using the back of the bowl of the spoon, tap the water-filled part of each test tube in turn starting with test tube 1.
3. Depending on the pitch of the note produced, you may wish to adjust the amount of water in some of the test tubes. Use the eyedropper to either fill or empty the water from the test tubes.

Part B: Notes from air

Use the test tubes as they were filled at the end of Part A.

1. Practice blowing gently over the top of each test tube to produce a note from each. Begin with your mouth about 1 cm away and a little above the lip of the test tube. You may need some practice before you are able to work out how hard to blow and find the best position to blow from.
2. Blow across the tops of all six test tubes in turn starting with test tube 1.
3. Depending on the sound produced, you may wish to adjust the length of the column of air by changing the amount of water in some of the test tubes. Use the eyedropper to either fill or empty the water from the test tubes.

Analysis

Part A: Notes from water

1. What was the effect of striking the water-filled part of the test tube with the back of the spoon?
2. What did you find out from striking each test tube in turn?
3. Why might you want to adjust the amount of water in some of the test tubes?

Part B: Notes from air

1. What did you find out from blowing across the tops of each test tube in turn?
2. Why might you want to adjust the amount of water in some of the test tubes?

Want to know more?

Click here to view our findings.

Part A: Notes from water

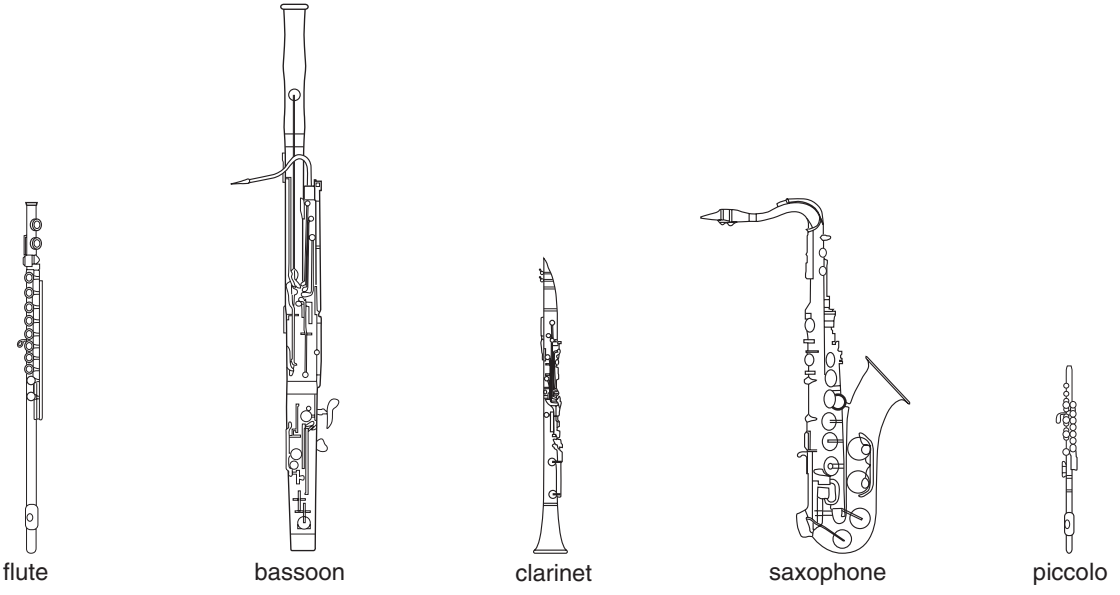
1. A note was heard.
2. A regular progression of notes was heard, which increased in pitch (becoming higher) as the amount of water in the test tube decreased. Striking tube 1 (which held the most water) produced the lowest note and striking tube 6 (which held the smallest amount of water) produced the highest note.
3. By adjusting the amount of water in some of the test tubes, the notes produced

by striking the test tubes can be "tuned" to follow the regular progression of the standard musical scale – A, B, C, etc.

In this part of the experiment, vibrations in the column of water in the test tube make the note. The longest column of water produces the lowest note.

Part B: Notes from air

1 A regular progression of notes was heard, decreasing in pitch (becoming lower) as the amount of water in the test tube decreased – and hence the length of the column of air increased. Blowing across the top of tube 1 (which held the most water and thus had the shortest column of air) produced the highest note. Blowing across the top of tube 6 (which held the smallest amount of water and thus had the longest column of air) produced the lowest note.
2 By adjusting the amount of water in some of the test tubes, the notes produced by striking the test tubes can be "tuned" to follow the regular progression of the standard musical scale – A, B, C, etc.



Woodwind family of musical instruments

In this part of the experiment, vibrations in the column of air in the test tube make the note. The longest column of air produces the lowest note. The woodwind family of musical instruments (see the diagram above) uses the vibrations of a column of air to form notes. The range of notes produced by each instrument is primarily determined by the length of the instrument – for example, the piccolo produces much higher notes than the bassoon.