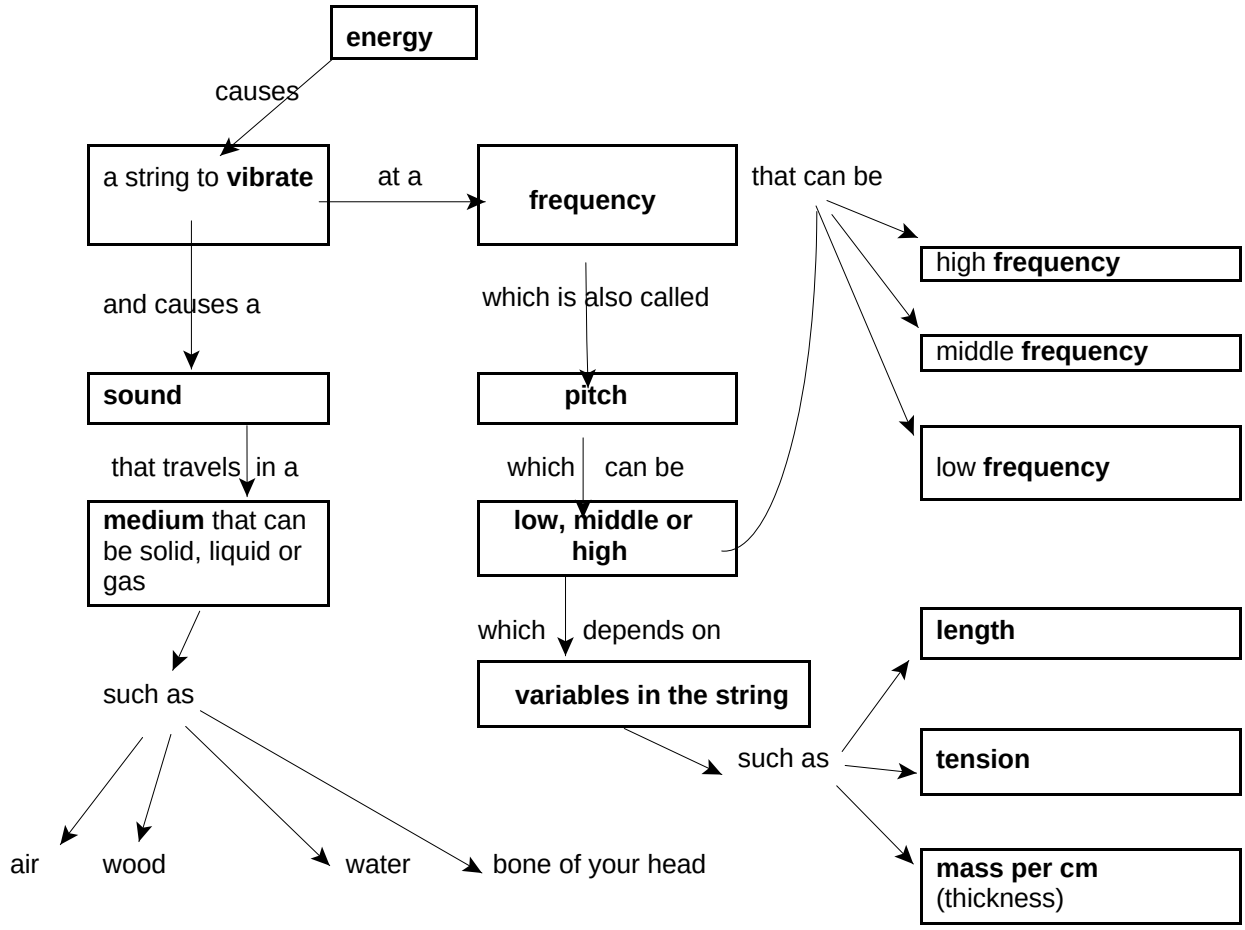
Sound and pitch

Teachers' notes

These notes come from the website www.scienceteachingalive.com, where you find the video ***How to teach sound and pitch*** by Brian Gray and the Solon Foundation. The website also has notes for group leaders, and ideas for student worksheets.

Concept map 1, based on the conceptual approach in the video.

The approach focuses on strings and musical instruments. When talking about music we usually talk about **pitch**; when talking about sound in general we usually talk about **frequency**, but the two words mean the same thing.



This concept map is based on the video.

A more general statement about sound

Energy makes an object **vibrate**; the vibration transfers some of the energy through the **medium** as a **wave**. The wave travels at a certain **speed** depending on the medium (e.g. 340 m/s in air, 1 433 m/s in water, about 4 000 m/s in wood). The vibration can have high, middle or low frequencies; low frequencies have a **long wavelength** while high frequencies have a **short wavelength**. If the vibrating object moves a long distance in each vibration, we say the vibration has large **amplitude** and this usually means the sound is loud. Small amplitudes mean soft sounds.

What are notes and tones?
Physicists talk about **a** frequency, meaning a single vibration. But if you play a **note** on a musical instrument, it vibrates with a lot of frequencies, all at the same time. That pleasant mix of frequencies we call a **tone**.

Two activities to try and then evaluate

Activity 1 A vibration box – do this activity and evaluate it

Work with a partner. You stretch a thin rubber band between your hands and the partner plucks it. Listen to the note you get from the rubber.

Equipment you will need, per group

- ❏ Rubber bands of three different thickness
- ❏ Empty lunch-box or maths-tin or pencil-box or a small, very stiff cardboard box, open at the top.

1 Stretch that rubber band over the empty lunch-box or cardboard box. When you pluck the rubber, is the sound louder?

2 Put thicker rubber bands on the box. Do they all give the same note? Are the frequencies all the same?

3 Write in your notebook: The box makes the sound louder. The reason is that the box _____ when the rubber _____.

4 Answer in your notebook: Thin rubber bands give sounds with higher pitch than the sounds from thick rubber bands. Which rubber bands vibrate faster, the thin ones or the thick ones?

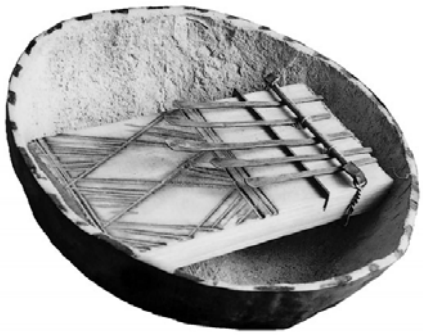
Resonators make the sound louder

The cardboard box or lunch-box is a resonator. It vibrates when the string vibrates. The box is bigger than the string and so it makes more of the air vibrate.

5 Why does a guitar have a wooden box, do you think?
Answer:To make the sound of the strings louder

6 Why does the *mbira* in **Figure 1** have a calabash around it, do you think? Answer:The calabash vibrates with the prongs of the instrument, and this makes more of the air vibrate, and so the sound is louder.

Figure 1 *How does the calabash help the* mbira *to make better sounds? You play the mbira by flicking the iron strips downwards with your thumb-nail.*



Activity 1 ends here; now you should evaluate it. Would you change it for the students in the Grade you teach?

For the next Activity, make sure you know what the variables are that Brian talks about in **3:00** to **4:30**, in the video.

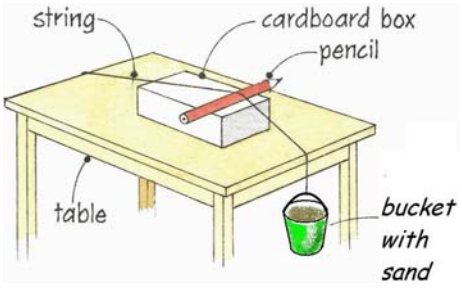
Activity 2 Investigate the variables as you change the pitch of a note – do this activity and evaluate it

Set up the equipment as you see in the picture.

Fasten one end of the string underneath the table. Load enough sand into the bucket to make the string tight.

Now pluck the string to make it vibrate. The string makes the box vibrate. Listen to the note that comes from the box. Play this note softly, then play it loudly.

Figure 2 *Fasten one end of the string under the table and put weight in the bucket to stretch the string tightly across the box.*



Investigate what happens when you make the string shorter or longer.

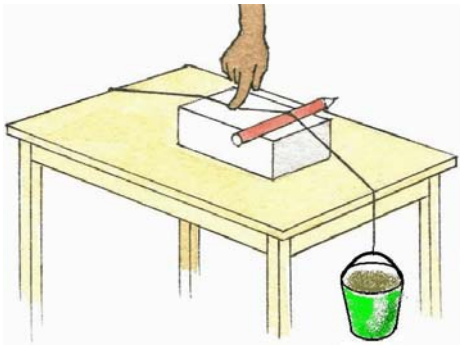
1 Which parts of the string vibrate? Look closely at the string.

You see that the part between the box and the pencil vibrates.

2 Press your finger onto the string as you see in **Figure 3**. Pluck the string again. The pitch of the note changes. Which part of the string is vibrating now?

3 Move your finger closer and closer to the stick each time you pluck the string. The vibrating part of the string gets shorter and shorter. How does the pitch of the note change?

Figure 3 *Press the string onto the box. You are making the vibrating length of the string shorter.*



Investigate what happens when you stretch the string tighter

Load more stones or sand into the little bucket, to stretch the string more tightly.

4 If you make the string tighter, how does the pitch of the note change?

5 Explain to your teacher or your partner: Here are **two** ways you can get notes with **high pitch** and **low pitch** on this instrument.

Complete the sentences in your notebook:

6 If the vibrating part of the string is **long**, then the pitch of the note is **low**. If the vibrating part of the string is short, then the pitch is _____.

7 If the string is stretched very tight, then the pitch of the note is _____. If the string is not so tight, then the pitch of the note is _____ .

Activity 2 ends here; now you should evaluate it. Would you change it for the students in the Grade you teach?

In Activity 2 we are actually teaching students how to control the variables in the investigation. The basic idea is that you **change only one variable at a time**, and that means you keep the other variables constant.

In Activity 2, the learners compare the pitch of the note from a long string, and the pitch as the string is made shorter and shorter.

Next, they compare the pitch of the note from a tight string and a **very** tight string; the pattern is that as the string gets tighter, the pitch goes higher.

So you are developing the children's skills of observing (Q1) comparing (Q2), looking for a pattern (Q3 and 4), and stating relationships between variables (Q5, 6 and 7).

We can organise the variables in tables like this:

Keep tension and length constant and vary the **thickness / weight** of the string (Activity 1)	
Thin, light string gives a	high pitch
middle weight string gives a	middle pitch
thick, heavy string gives a	low pitch

Keep thickness and tension the same, and vary the **length** (Activity 2)	
long string	low pitch
mid-length string	. . . . .
short string	. . . . .

Keep thickness and length the same, and vary the **tension** (= the tightness) (Activity 2)	
String at low tension	. . . . .
String at mid-tension	. . . . .
String at high tension	. . . . .

There is a relationship between the pitch of a note and each of the variables. For example, there is a relationship between the **length** of the string and the **pitch** of the note.

The children need to learn how to **state a relationship** in English. For example, we can write "the pitch of the note depends on the length of the string", but this is not clear enough. HOW does it depend on the length? We have to be more precise and write something like:

"The longer the string, the lower the pitch." Or "The shorter the string, the higher the pitch."

(We assume the thickness and tension are kept unchanged.)

Now try these statements of relationship:

The thicker the string, the _____ .

The greater the _____, the _____ .

_____

You can take ideas from this worksheet-starter and create your own worksheet.