THF

Phys-X

FACTOR

Television talent shows have been accused of using technology to make bad musicians sound better.

We are going to try to do this ourselves, but first we need to know a bit about sound.

We will use a computer package called Audacity.

When you start up Audacity, you will see some control buttons on the screen.

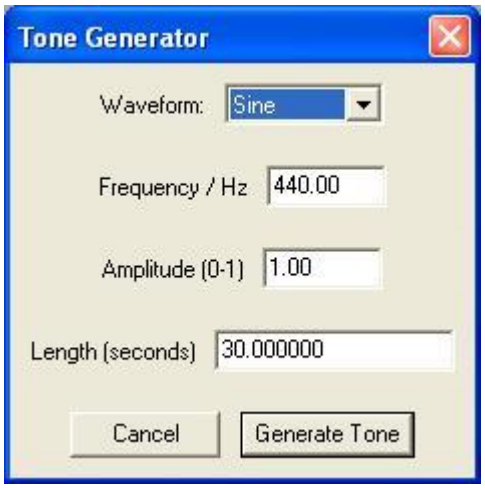
Red circle: start recording

Green triangle: playback

Yellow square: stop

Audacity can generate its own sounds. Go to Generate and choose Tone.

A dialogue box like the one on the right should pop up



Set the frequency to 300 Hz.

Change the length to 1 second.

Click Generate Tone.

At this point, don't worry about what the words and numbers mean.

You should see something like the picture on the right on your screen. Audacity calls this picture an Audio Track.

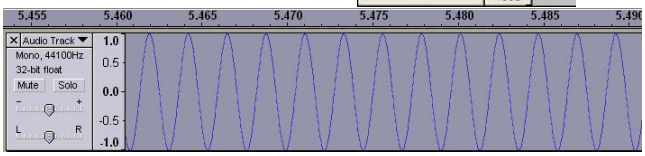
Click the green Play button.

The tone you generated may not sound very musical!

To delete a track, click the cross next to the words Audio Track.

This is shown circled in red in the picture on the right.

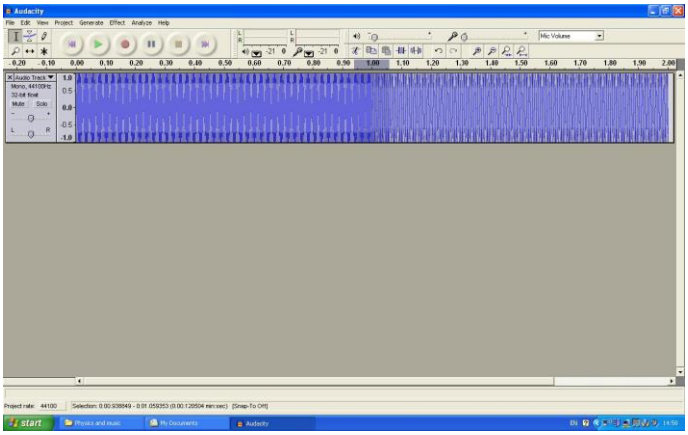
Click the Zoom tool  a few times to have a closer look at what you have created.



It is important to know what this shows. It is a picture of an electrical signal. This signal creates a sound when fed into an amplifier and loudspeaker.

It looks like a wave and sound does indeed travel as a wave. Sound waves don't actually look like the waves in this picture (you can't see them anyway).

Generate another 300 Hz tone, 1 second long. Click at the end of this audio track and see if you can generate another 1 second tone, only make the frequency 200 Hz now.



Play this track from the beginning.

Watch and listen.

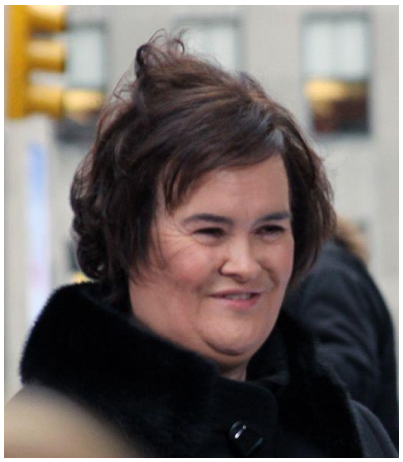
Describe the way the sound changes when you go from the 300 Hz section to the 200 Hz part.

Delete this track. Now try to generate another two tones, but this time, make the frequency 300 Hz for each one. This time, change the amplitude. Keep it at 1.0 for the first tone, but make the second one 0.5.

Play this track from the beginning.

Sketch the audio track this time.

Describe the way the sound changes when you go from the section where the amplitude is 1.0 to the part where it is 0.5.



The Journey so far:

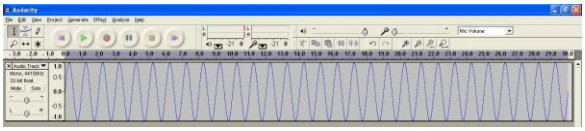
Photo: Wikimedia Commons

- Musicians talk about pitch. Scientists talk about frequency.
- A high frequency note has a high pitch.
- Just as length is measured in metres, frequency is measured in Hertz, or Hz for short. More about what this means later.
- Amplitude is related to loudness or volume. The larger the amplitude of a sound signal, the louder the sound will be.

THE Phys-X FACTOR

Delete your previous track.

Generate a tone of frequency 1 Hz. Make the amplitude 1.00 and the length 10 seconds.

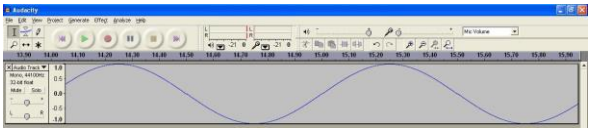


The audio track should look like the one on the right.

If you play this sound, you won't hear anything. Why not?

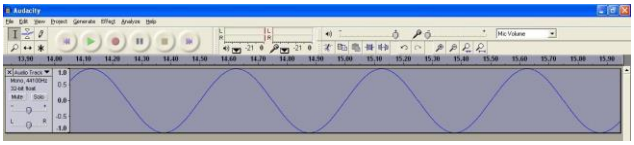
The picture can represent a sound wave.

Zoom in on the track until it looks like the picture on the right.



Look carefully. How many complete waves are there in one second? (Use the time scale at the top of the audio track. A complete wave goes from one peak to the next.)

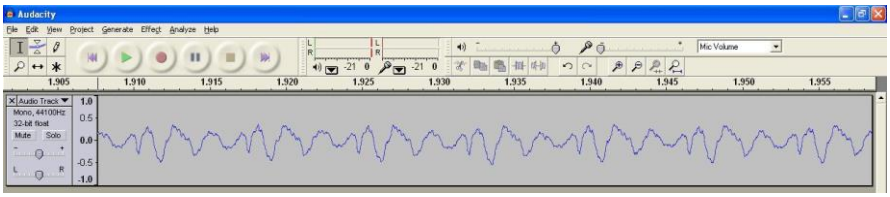
Now repeat for a tone of 2 Hz.



How many complete waves are there in one second?

If you generated a tone of 300 Hz, how many complete waves would you expect in one second?

Think carefully about how you could see whether or not you were right. Try your idea!



The track above was created by recording the sound from a real musical instrument. As you can see, it looks much more complex than the tones generated by Audacity.

It is still possible to find its frequency by finding the number of times the pattern repeats in one second.

Your teacher might let you design an experiment to find the range of human hearing.

The Dream Continues..

Photo: Wikimedia Commons

- Frequency is the number of complete waves in 1 second.
- If the frequency of the sound is 300 Hz, there will be 300 complete waves in 1 second.
- Frequency can be found by counting the number of complete waves in a particular time, then dividing by the time.

Example: There are 40 waves in 5 seconds.

Frequency = 40 ÷ 5

= 8 Hz

Example: There are 20 waves in 0.1 seconds.

Frequency = 20 ÷ 0.1

= 200 Hz

THE Phys-X FACTOR

If you can get your hands on a musical instrument and a computer microphone, your teacher may let you create your own music tracks for this activity.

Case 1:

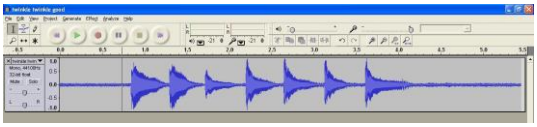
Little Jim Wagner is the cutest boy imaginable. His dream is to have a top-selling single. He's had a tremendously hard life but has climbed the mountain and is ready to fly.

Unfortunately, he's not a very good singer.

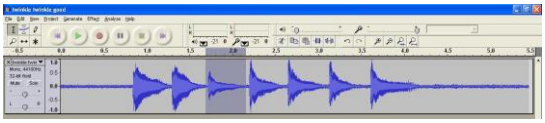
Sometimes during a song, he sings too loudly and sometimes too quietly.

Can technology help little Jim?

Go to File and Open. Load the file ***Twinkle twinkle third note quiet*** into Audacity.

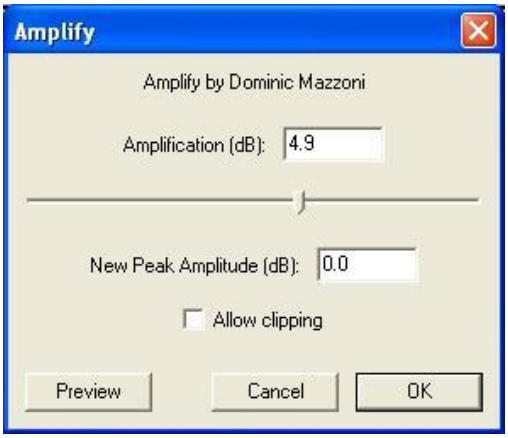


Play the audio track from the start. You will notice that the third note is too quiet.



Drag over this note, as shown on the right.

Go to Effect and choose Amplify.



Audacity will automatically choose a setting to make the quiet note as loud as the others.

Click OK.

Replay the audio track from the start.

You could experiment with different amplifications (including negative ones).

Case 2:

Sandy Simmer also has a dream. She wants to have a top-selling single. She's had a tremendously hard life but has been on a journey and is ready to soar. The newspapers have been full of stories of a feud between her and one of the judges. The British public are on her side.

Unfortunately, she's not a very good singer.

Sometimes she sings the wrong note.

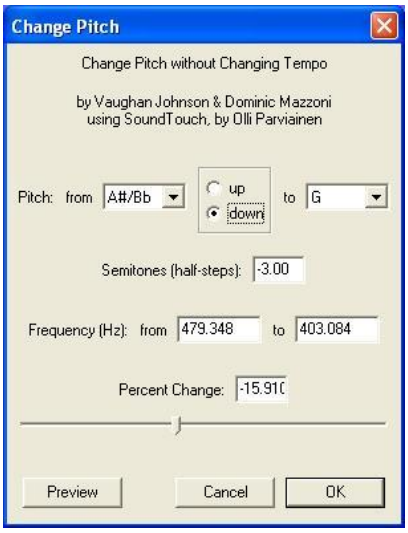
Can technology help poor, put-upon Sandy?

Go to File and Open. Load the file ***Twinkle twinkle bad*** into Audacity.

Play the audio track. You will notice that the last note is too high pitched.

Drag over this note as shown on the right.

Go to Effect and choose Change Pitch.



The note should be a G (around 400 Hz).

Make sure you are shifting the pitch down, not up.

Once you have entered the correct pitch or frequency, click OK.

Replay the audio track.