

A problem of hearing

In this series of one/two lessons (50-60min each) students will:

- Design a simple hearing test;
- Use their test to construct their own definition of what is meant by 'normal' hearing;
- Critically compare their designs and results with others;
- Learn about different types of hearing loss and how they are diagnosed;
- Understand some of the work carried out by an audiologist;
- Act in the role of an audiologist to diagnose common hearing problems from audiograms.

Context



Hearing is important to individuals, as shown by this image of a young boy who suddenly hears for the first time after treatment.

(The actual video may be found at www.youtube.com/watch?v=-GA9gEh1fLs but the image is included in the PowerPoint for the lesson).

It has been estimated that in the UK (adapt if necessary):

- 1 in 6 people have some form of hearing loss;
- 1 in 30 wear hearing aids;
- 1 in 10 would benefit from a hearing aid.

There are many degrees of hearing loss between hearing well and hearing nothing but there is natural deterioration with age.

(Chime Social Enterprise, 2014,

www.chimehealth.co.uk/what-we-do/adult-hearing/about-hearing-loss)

Discuss the implications of this information with the class.

The discussion might include the costs to the country, the health care demands, the trends in the light of an ageing population, the social consequences of hearing loss as well as the mathematical implications about there being more than 1 in 6 older people with hearing difficulties and therefore less than 1 in 6 younger people.

Hearing impairment can result in the following social problems:

- Difficulty participating in conversations
- Difficulty hearing in a group situation, particularly with background noise
- Finding men's voices easier to hear than women's
- Needing the TV louder than other family members
- Misunderstanding what is being said



- Hearing better from one side than the other
- Missing parts of conversations
- Avoiding social situations.

(Chime Social Enterprises, 2014, as above)

Diagnosis and health care for hearing impairment is dependent on the level of hearing and type of impairment. Firstly students will consider what is 'normal' and later examine common types of impairment.

Designing a simple hearing test

Ask the students to work in small groups to design a short hearing test that they can use to measure hearing ranges and construct their own definition of what is 'normal'.

The form of hearing test they devise may be influenced by the level/age of the students, their prior knowledge of the topic of sound and the resources available. Where possible the students should develop their design through group discussion but the following questions may be useful to guide these discussions:

- What are the key variables of the sounds that need to be considered?
- How can sample sounds be generated easily and replicated consistently with or without a measurable loudness and/or frequency?
- Who will be used as the sample and what sample size is appropriate?
- Should hearing be tested for both ears independently or is the combined hearing most appropriate?
- Is the predicted answer of 'normal' hearing going to be a single measurement or a range?
- In what form might the result be best displayed?
- What health and safety controls are needed?

This design brief allows students to explore different ways of generating or recording the sounds for their test using equipment such as a signal generator, mobile phone or computer and using additional equipment such as headphones or disposable ear plugs if available. Alternatively students might choose to design a test using minimal equipment or choose to use another variable such as distance from source in their test. The sample and extent of the testing may be constrained by the situation but students should consider the design features carefully even if they cannot implement their ideal plan. For example, if the tests are conducted within the science lesson then the sample is subject to restrictions of age and sample but students might include the testing of older or younger family members outside the session, if appropriate.

Before carrying out the tests the design needs to be approved. Students should be reminded of the health and safety implications, e.g. damage from high intensity sounds, transfer of infection from re-using earplugs.

Comparison of designs

Ask each small group in turn to briefly describe their design, the results obtained and their interpretation of what constitutes 'normal' hearing to the class.

This should raise a number of points for discussion regarding the accuracy of different methods and the interpretation of results.

After some discussion share the definition of 'normal' hearing as the ability to hear sounds of 20db or above and the banding of level of impairment shown on the audiogram (Handout 1 - to be provided). Explain the main features of this type of graph, which is commonly produced from hearing tests:

- Scales of measurement used
- Use of symbols for left and right ears
- Changes of audible intensity with different frequencies
- The use of a 'pure' tone rather than mixed frequencies.

This may raise further questions and points for discussion regarding students' own tests and results such as the effect of using only younger members of the population or the difficulty of defining 'normal'.

Show the video of the work of an audiologist (with or without sound) <https://www.youtube.com/watch?v=9u9Ja4wyUaU> and/or the images provided from the video (Handout 1) to explain the work of an audiologist. Use the diagram of the ear and notes (Handout 1) to explain where different types of hearing impairment occur and how these are detected. Discuss the audiograms on Handout 1 that show levels of hearing loss, speech sounds and environmental sounds. Ask the students about the social implications.

Working as an audiologist

In this activity students act in the role of an audiologist and examine several audiograms to diagnose the type of hearing loss. Explain that different types of hearing loss require different types of hearing aid so correct diagnosis is important.

Ask the students to work in pairs and discuss the set of audiograms provided on Handout 2. They should try to diagnose the problems indicated by the graphs how the hearing impairment would affect the individual socially. Finally ask them how in the role of an audiologist they would explain the problem to the patient.

As a class discuss the skills and personal qualities required to work as an audiologist.

The following suggested list of key areas may be helpful:

- Ability to communicate well with a range of different people
- Good problem-solving skills
- A scientific educational background
- Ability to work as part of a team

- A caring and understanding attitude
- Good manual dexterity
- Analytical skills.

(Source: British Academy of Audiology, www.baaudiology.org/careers/what-audiology/)

The skills required to be an audiologist are typical of a range of occupations in health care that require a combination of scientific and mathematical knowledge with the personal skills necessary to deal with people whose health issues are often a sensitive area. It is worth noting that in these lessons it is likely that there are students present who actually have some hearing difficulties. These may or may not have been diagnosed. This may require some sensitive handling and some students may prefer not to participate in the testing if they have a known impairment.