

12 November,

Microwave Communication

Objectives

Be able to describe how microwaves are used in communications and be able to evaluate the advantages and disadvantages.

HSW: AF2: Evaluate the effects of technological developments on society as a whole.

Used before in:

Will use again in:

PLTS: Team Workers: collaborate with others to work towards a common goal.

Used before in:

Will use again in:

Keywords

EM Spectrum, Radio, Frequency, Wavelength, Diffraction, Reflection, Refraction, Interference, Ionosphere, Bias, Satellite.

Outcomes

All students should be able to:

- Describe communications devices that use microwaves.

Most students should be able to:

- Describe why we use microwaves and not other types of wave.

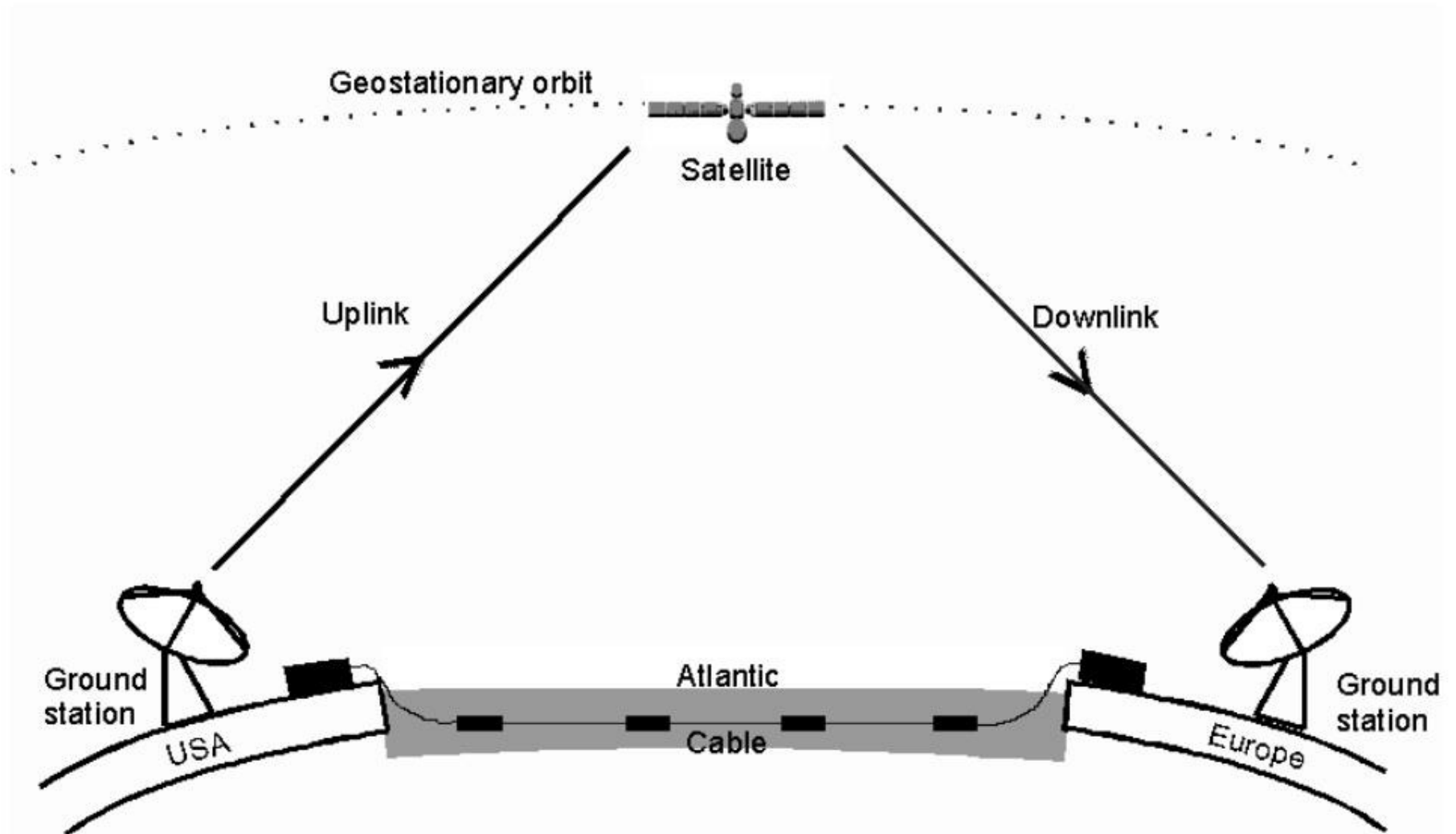
Some students should be able to:

- Evaluate the safety of using microwaves to communicate.

Goonhilly, Cornwall



Satellite Communication



Why are these dishes
larger than satellite
dishes at home?





Why are most of these dishes (at the ASTRA headquarters in Luxembourg) pointing the same way?

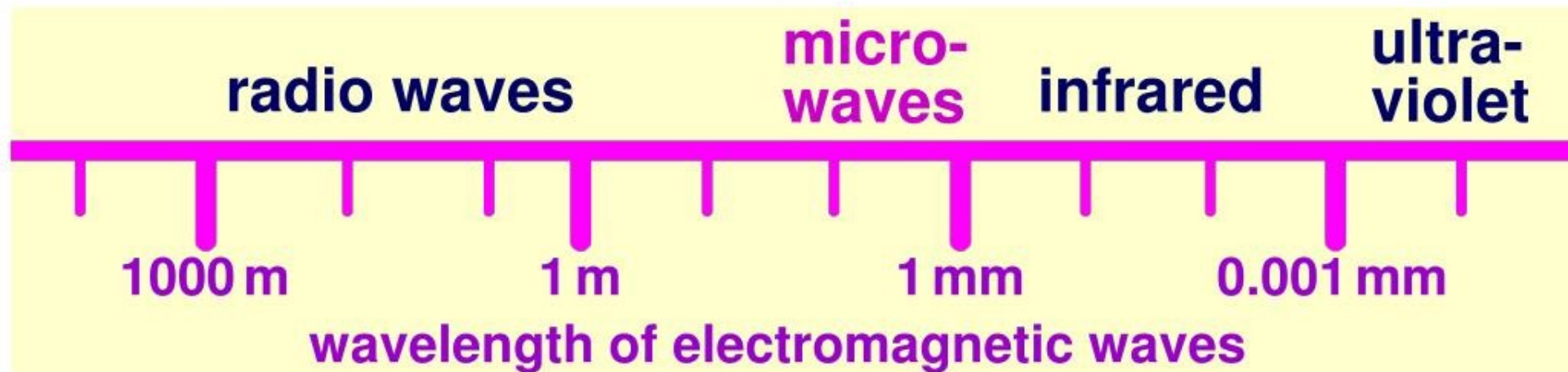
These are the seven Astra
satellites in geostationary
orbit so they don't appear
to move

... unlike the stars which
appear to move due to the
rotation of the Earth

What are microwaves?

Every mobile phone conversation involves the transmission of microwave signals.

Microwaves are a form of electromagnetic radiation. They are very short-wavelength radio waves.



The wavelength of microwaves ranges from **30 cm** (the length of a standard ruler) to **1 mm** (about the size of a full stop).

Microwaves have many uses. How many can you think of?

How are microwaves produced?

Microwaves with different wavelengths have slightly different properties and uses. They are also produced in different ways.

Long-wavelength microwaves are produced by aerials in a similar way to other radio waves. These types of microwaves are used for communications.



Jupiterimages Corporation



Short-wavelength microwaves are produced using a device called a magnetron. These types of microwaves are used by microwave ovens and radar equipment.

How are microwaves used?

- **Heating food**

A microwave oven uses microwaves to generate heat and warm food.



- **Communications**

Microwaves are used to send communications signals to and from satellites. They also carry signals for mobile phones, wireless computer networks and personal digital assistants.

- **Radar (radio detection and ranging)**

Radar equipment bounces microwaves off moving objects to detect them.

- **Astronomy**

Large microwave receivers called radiotelescopes study microwaves emitted from space.



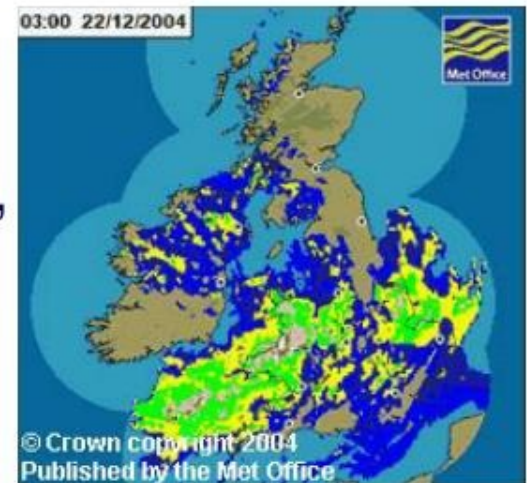
How can microwaves monitor rainfall?

Weather radar uses microwaves to scan for raindrops in the atmosphere.

The radar sends out pulses of microwaves, which are reflected by raindrops. By listening to the reflected pulses, the radar works out the rain's location and intensity.

In general, the more intense the reflected signals, the higher the rain intensity. The distance of the rain is determined from the time it takes for the microwaves to travel to and from the raindrops.

Radar images displayed in television weather reports use a colour scale to represent the different intensities of rainfall.



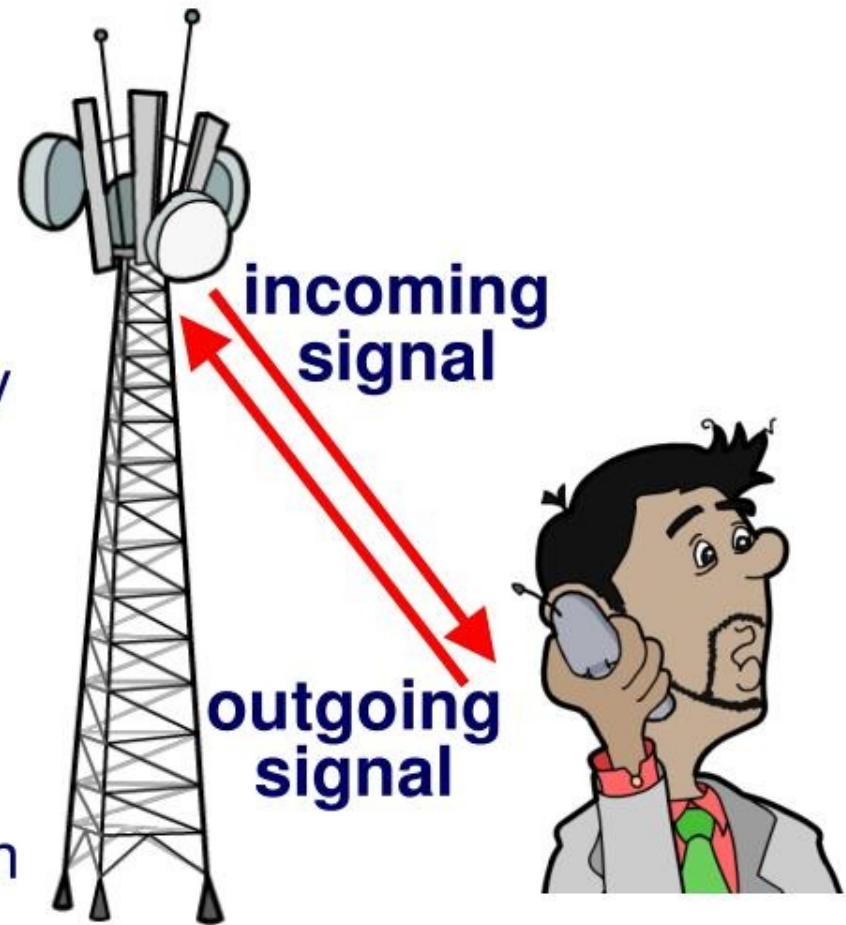
How does my mobile phone work?

Mobile phone networks divide areas into smaller areas called “cells”. There is a base station at the centre of each cell.

Your mobile phone is a two-way radio that uses microwaves to communicate with the nearest base station.

Different frequencies are used for the incoming and outgoing signals. This allows you to listen and talk at the same time.

When you move from one cell to another, the network detects a weakening signal and hands over to another base station which is detecting a stronger signal from your phone.



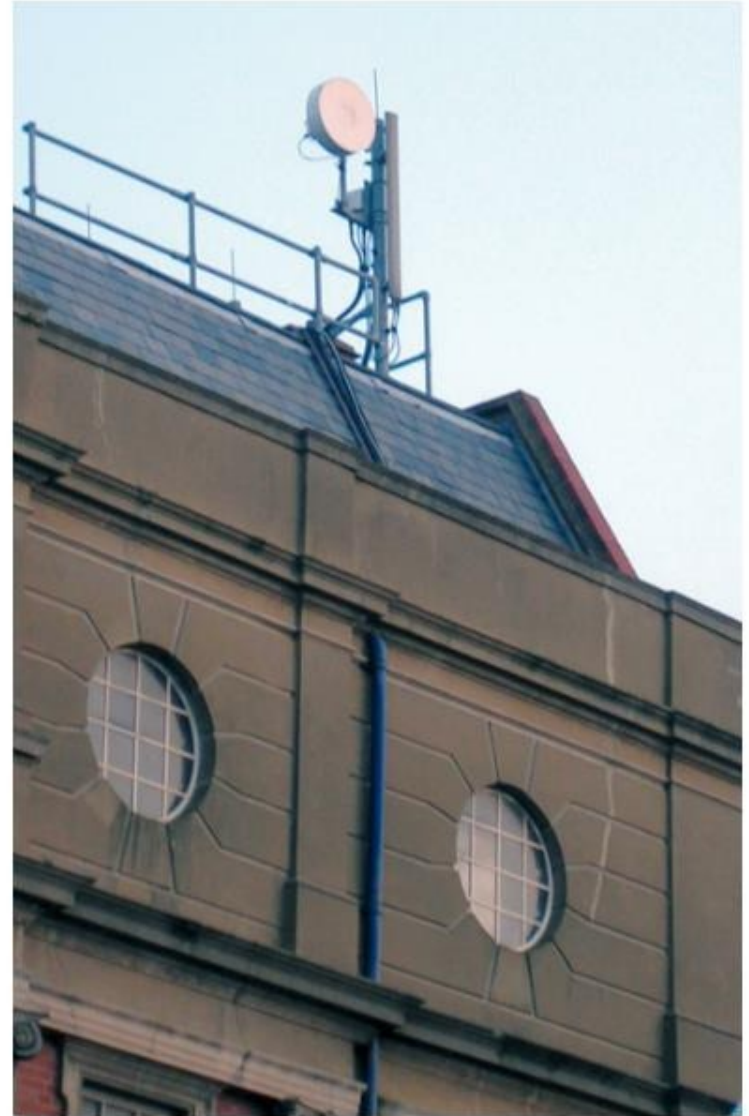
What affects my mobile phone reception?

Mobile phone reception is affected by a number of factors.

Microwaves lose intensity as they travel, so the distance between the phone mast and the mobile phone is important.

Another factor is tall buildings, which can create pockets with no reception.

To overcome this, mobile phone companies use lots of low power transmitters to fill in the gaps caused by the buildings.



Practical Time

- Why do we use microwaves and not some other type of EM radiation for mobile phones?
- Radio – possible – but used for Radio/TV
- Microwave – Yes – Why?
- Infra-red – we use for short range communication, why not mobile phones?
- Visible – is this possible?
- Ultraviolet – is this possible, dangerous.
- X-ray – ionising radiation
- Gamma – ionising radiation

Let's Test

We are going to see why we don't use visible or infra-red radiation. We will put some materials in the way and see if we can send a signal through them, tick if it does, cross if it doesn't:

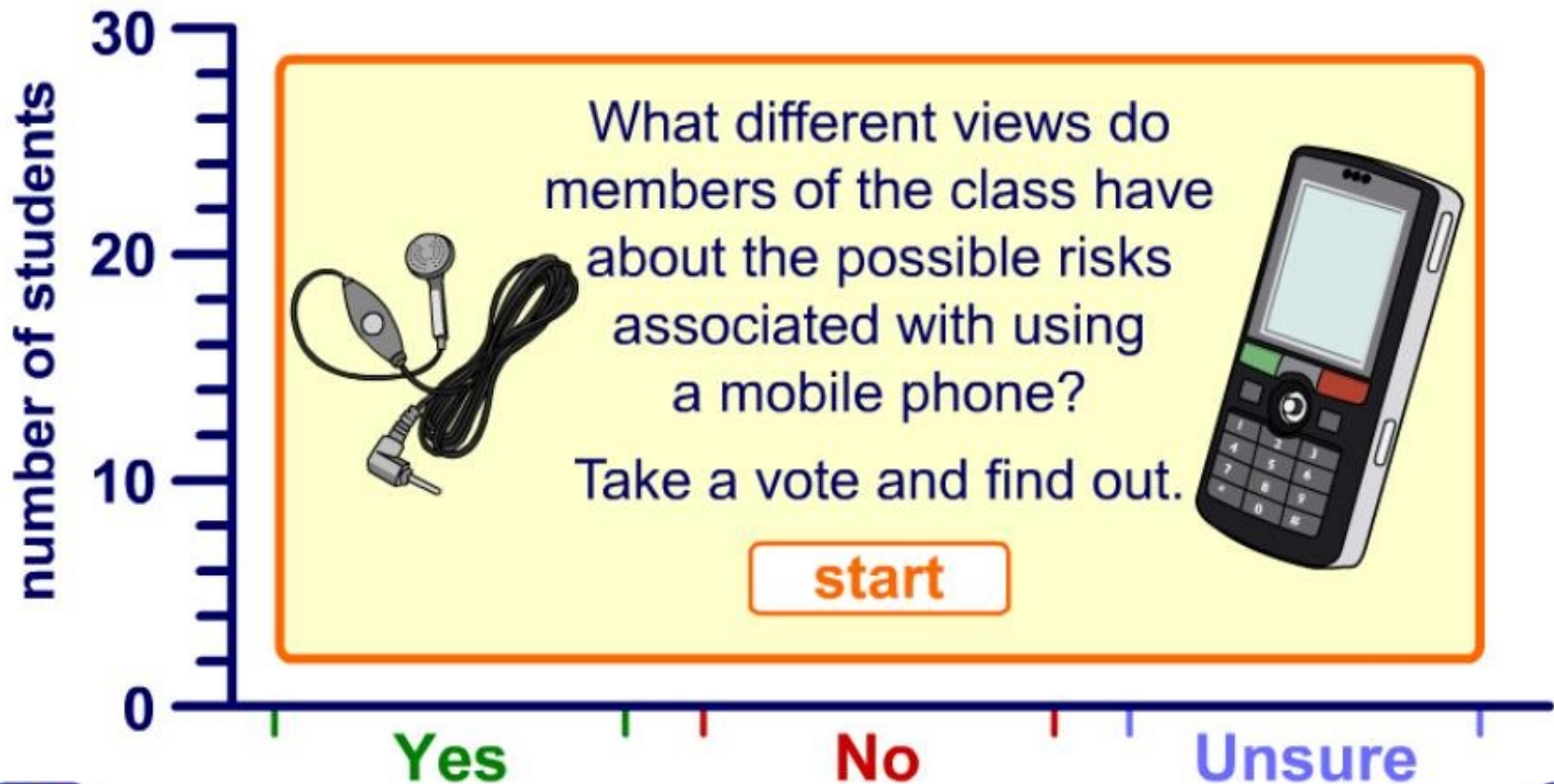
Material	Visible	Infra-Red	Microwave
Glass			
Plastic (transparent)			
Plastic (opaque)			
Wood			
Metal			
Cardboard			

Conclusion: what is the best wave to use for mobile phones? Why?

Using mobile phones



If mobile phones caused cancer, would you use one?



How do microwaves affect living tissue?

How do microwaves affect living tissue?

Microwave signals are used in mobile phone communications.

To understand if microwaves could affect people, you need to know what affect they have on molecules and living tissue.

Click "**start**" to find out more about microwaves.



start



Why limit the use of mobile phones?

Some people are concerned about mobile phone use because the handsets emit microwaves close to the body.

The government recommends that users take reasonable steps to limit their exposure to the microwaves by following the **ALARA** principle.



**As
Low
As
Reasonably
Achievable**

This involves the following precautions:

- Using a hands free kit or shield.
- Using a phone which emits less radiation.
- Not talking on a mobile for a long time.
- Under 16s only using mobiles when essential.

Opinions on mobile phones

Should children be allowed to own a mobile phone?

The following people have all been asked if they think children should own a mobile phone.

Click on each person to find out their opinion.



What do you think?

- Read the following extract from a newspaper and then answer the questions that follow.

- Residents of Stag Hill Court, a luxury block of flats, are shocked at the plans to site a mobile phone mast on the roof of the flats. They oppose the mast on health grounds, quoting research in Germany that has found a possible increase in cases of cancer around mobile phone masts.
- A spokesperson for the telecoms company said, 'The residents should not worry. The research carried out by our own scientists has found no link between ill health and mobile phone masts'.
- This has not reassured the residents, who argue that new independent research is urgently needed.

- (i) Explain why living near a mobile phone mast could cause ill health.
- (ii) Suggest **two** reasons why the residents have **not** been reassured by the research carried out by the telecoms company.

- (i)
 - *any mention of alpha, beta, gamma waves scores 0 marks*
 - emit / uses / transmit / receive microwaves 1
 - *accept radiation for microwaves throughout*
 - *ignore radio waves*
 - some microwave / energy absorbed by / enters the body 1
 - *ecf for their given electromagnetic wave*
 - *do **not** accept goes through the body*
 - raises temperature of (body) cells / tissue / water 1
 - *accept reference to water molecules vibrating faster*
 - *accept it could cause mutation / harm / kill cells*
 - *do **not** accept answers in terms of ionisation*
 - *ignore references to cancer*
- (ii) any **two** from: 2
 - research (may be) biased **or** may have been misled in the past
 - *accept not independent **or** may be lying*
 - some research suggests a link
 - long-term effect not proven / studied
 - *accept not studied for long enough*
 - residents may not have seen the research

What do you think?

- 2 Some people worry that using a mobile phone may be bad for their health.
- Look at this information taken from a recent newspaper article.
- • Scientists in Sweden found that the regular use of a mobile phone increases the risk of a cancerous growth between the ear and the brain.
- • Some people who use mobile phones for a long time complain of headaches and tiredness. The same effect has not been noticed in laboratory tests.
- • There is no reliable evidence to link using mobile phones with ill health.
- • The waves from a mobile phone are not strong enough to cause long-term heat damage to cells in the body.
- (i) Complete the following sentence by drawing a ring around the word in the box that is correct.
- The evidence from different scientists doing the same investigation is reliable if
- all the scientists get different/identical/random results (1)
- (ii) What information in the article supports the idea that mobile phones are bad for your health?
-
- (2)
- (iii) Some scientists say that using a mobile phone is totally safe. What information in the article supports this view?
-
-
- (2)

- (i) identical 1
 - (ii) • increased risk of cancerous growth
(between ear and brain) 1
 - • complaints of headaches and
tiredness 1
 - (iii) any **two** from: 2
 - • tests in a laboratory did not give
effects of tiredness or headaches
 - • waves not strong enough to cause
long term heat damage to cells
 - • evidence to link mobile phones
and ill health is not reliable

Using mobile phones

HW: What do you think?

Do the advantages of mobile phones outweigh the disadvantages of using microwaves?

Create a poster about the issues.

Do it with bias. As either a phone maker or a campaigner against them.

You will get marked on the scientific content, your arguments for or against and the presentation.

