This series of lessons combines young people’s interest in mobile phones with the opportunity to develop their understanding of the effect that microwaves may have on people. The lessons draw on media interpretation of evidence which makes a direct link to Citizenship. It links in with work in science on the electromagnetic spectrum and addresses the idea that there are uncertainties in scientific knowledge.

Students can have fun testing a range of mobile phones to check which ones produce most microwaves. They are then asked to evaluate evidence about the safety of phones. This is to provide evidence for a debate about whether children under 10 should be banned by law from using mobile phones. This enables students to combine their interpretation of scientific ideas with a Citizenship context.

Rationale

This series of lessons combines the investigative aspects of the science programme of study with knowledge and understanding of the electromagnetic spectrum. It develops the idea that science cannot always provide conclusive answers to questions. Students are to use the available evidence to draw conclusions, taking into account this lack of certainty. Both the media and the use of law contribute to the Citizenship programme.

Equipment

Mobile phones
Microwave detectors (COM Environmental Microwave Monitor), 1 per group for lesson 3
Internet access for lesson 5

Lesson 1: Looking at risk

Starter

Ask the class the following questions – see Resource 1:

• Do you travel by car to school?
• Do you catch the bus to school?
• Do you play football after school?
• Do you walk the dog?
• Do you eat beefburgers?
• Do you eat spaghetti bolognaise?
• Do you go out after dark?
Remind students that life is full of such decisions. Can we be sure that we’ll travel safely to school? We’ll probably be safe from injury playing with the dog, won’t we? The idea of probability plays a big part in our lives.

Using the matrix in Resource 1, get the students to plot the activities listed above showing the degree of probability and seriousness of consequence.

**Main activity**
Discuss the following questions with students.

**Q** What about mobile phones? Do you own one? How regularly do you use it?

**Q** Do you recognise any risks associated with using a mobile? Are you familiar with the precautionary principle? What is the probability of a mobile phone affecting your health?

The idea of probability is helpful in understanding scientific research. Many scientists try to understand how we are affected by things. When we hear reports by scientific research, we might expect to have definite answers – 100% proof. This is just not possible.

Ask the students to look at Resource 2 ‘Understanding the headlines’, which raises issues of uncertainty and the influence of the media, and work through the tasks.

**Plenary**
Discuss the outcomes from the discussion of media headlines.

Ideas to discuss include:
- the influence of the media on public opinion;
- press responsibility;
- effects on the public resulting from press influence.

**Homework**
The Government requires that a leaflet is given to all people under the age of 16 when they purchase a mobile phone. Ask students to call into their local mobile phone shop and ask for a copy of it (if they can do so safely and conveniently).
Lesson 2: What is the risk of using a mobile phone?

It is usually through newspapers, television or the internet that we first find out about new scientific research, and we tend to accept uncritically what is written by harried reporters and others under tight deadlines. Even when the science is clean and factual, it can be progressively spun and refocused – both deliberately and unconsciously – to produce a change of emphasis, without any identifiable distortion of the real scientific conclusions.

Starter

Students write the following on a sheet of A3 paper or shared computer:

1. Uses of mobile phones – communication across the world; sending and receiving text messages; keeping in touch with family and friends; photo messaging; multimedia messaging, and so on.

2. Reflecting on the past – how people communicated before the days of mobile phones.

Main activity

Discuss resource 3 which provides information about the pros and cons of mobile phones use.

Now get students to undertake the measuring the radiation from mobile phones following the instructions in Resource 4. This will take about 25 minutes. You will need a Microwave detector (COM Environmental Microwave Monitor) for each group. Students can use their own mobile phones – using different brands of mobiles would be good.

Plenary

Ask the following questions:

Q Do mobile phones give off radiation?

Q When is the radiation level the highest – making a call, receiving a call, sending a text message, as the call is being connected?

End the lesson with a short discussion of how new technologies create new risks and health hazards. This would be the starting point of the next lesson.
Lesson 3 Presentations

Mobile phone use is often a ‘hot topic’. Many newspapers have had varied headlines informing the public about the health potentials of mobile phones.

**Starter**

1. Ask the students to think up three headlines that could be used by newspapers:
   - to promote the use of mobile phones
   - to discourage the use of mobile phones.

2. Tell students to look at the information in Resource 3 and 5, and gather other information from websites either promoting or discouraging the use of mobile phones. The target audience will be teenagers or young adults.

4. In groups of 4 students examine all the information available and imagine that the Government have commissioned them to produce a scientific report on mobile phones.

**Main activity**

Students produce a 2-minute report to present to the rest of the class on whether the Government should make people aware of the dangers of mobile phones.

Then debate whether the Government should pass a law banning children under the age of 10 from using mobile phones. Consider how this law could be enforced.
Mobiles Resource 1 Comparing risks

- Do you travel by car to school?
- Do you catch the bus to school?
- Do you play football after school?
- Do you walk the dog?
- Do you eat beefburgers?
- Do you eat spaghetti bolognaise?
- Do you go out after dark?

<table>
<thead>
<tr>
<th>RISK</th>
<th>Serious consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Low probability</td>
</tr>
<tr>
<td>Trivial consequences</td>
<td></td>
</tr>
</tbody>
</table>
Mobiles Resource 2 Understanding the headlines

Here are some headlines from newspaper reports of science research. Notice that none of these headlines is definite. They all contain uncertainty.

**Only huge emissions cuts will curb climate change**
To have half a chance of stopping the world warming by 2°C, greenhouse gas emissions need to fall by up to 70% by 2050, a new study suggests.

**Coral reefs create clouds to control the climate**
When temperatures soar, coral reefs might create cool shade by releasing chemicals into the atmosphere that promote cloud formation.

**Pollution fighter turns clot buster**
A material used to clean up car exhaust fumes might one day be used in surgical dressings to prevent infections, clots, and even MRSA.

**To do**

1. Look at these headlines and suggest what effects they might have on people reading them.
2. Would the headlines upset the general public?
3. Can you think of headlines that might be spread across the front page of a tabloid to bring this science information to the general public?
4. Does the headline of a newspaper make a difference?
**Mobiles Resource 3 Pros and cons**

<table>
<thead>
<tr>
<th>Are mobiles worth the risk?</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Yes</strong></td>
</tr>
<tr>
<td>Radio waves given off by mobiles can heat up body tissue, having damaging effects</td>
</tr>
<tr>
<td>Magnetic fields created by mobile phones can affect the way that your body cells work</td>
</tr>
<tr>
<td>People who make long mobile phone calls sometimes complain of fatigue, headaches, and loss of concentration</td>
</tr>
<tr>
<td>Mobile phone users are 2.5 times more likely to develop cancer in areas of the brain adjacent to their phone ears</td>
</tr>
<tr>
<td>The International Agency for Research on Cancer found a link between childhood cancer and power lines. Like mobile phones, power lines also emit radiation</td>
</tr>
<tr>
<td>Radio frequency waves similar to those in mobile phones altered the gene expression in nematode worms</td>
</tr>
</tbody>
</table>

*Based on BBC website*
Mobiles Resource 4
Detecting strengths of microwaves (radiation) from mobile phones

Equipment
Microwave detector (COM Environmental Microwave Monitor)
Mobile phones

To do
1. Ensure that all mobile phones are switched off.
2. Place the microwave detector and the mobile phone about 1 m apart on a table. Switch on the mobile phone and NOTE what happens to the strength of the microwaves detected.
3. Switch off the phone and NOTE what happens on the detector.
4. Without moving the phone or the detector, make a call. NOTE how the microwave strength varies. THINGS TO NOTE ARE:
   - Variation in strength once the mobile phone is connecting with the mast
   - Signal strength when you are not talking
   - Signal strength when you are talking.
5. Repeat the experiment by:
   - Sending a text message
   - getting someone to call the phone.
NOTE what happens to the signal from the phone when a call is being received.
A media release reported that: ‘mobile phones, even when used regularly for as long as 18 years, don’t increase the risk of developing brain cancer…’ The study was of 420,000 Danes who used cell phones for between 4 and 18 years.

Back in 1995, an Optus brochure titled: ‘Health effects of mobile phones’ said that:

‘After more than 6000 scientific studies the world over, there is still no convincing evidence for any adverse health effects caused by electromagnetic fields from mobile phones … The international body of scientific research concludes there is no link between mobile phones and adverse health effects.’

Research indicates that between 20% to 60% of the energy emitted from a mobile phone is absorbed by the user’s head. The percentage absorbed depends on the design of the phone, type of aerial or antenna and how far it is to the nearest base-station mast, as the weaker the base station signal, the more the phone will power up to maintain contact with the network.

Mobile phones and base stations emit RF radiation. In both cases levels of exposure generally reduce with increasing distance from the source.

For mobile phones, exposures will be principally to the side of head for hand-held use, or to the parts of the body closest to the phone during hands-free use.