

# Making Contact

## Teachers' notes

Upper Key Stage 2 (10–11 year olds)

Lecture 2 of 3: Sparks Will Fly: CHRISTMAS LECTURES 2014

The **CHRISTMAS LECTURES** at the Royal Institution were started by Michael Faraday in 1825, and are now broadcast on national television every year. They are the UK's flagship science series and for the first time, the CHRISTMAS LECTURES 2014, presented by Prof Danielle George, will be accompanied by three primary science lesson presentations and teacher guides. Prof Danielle George is Associate Dean for Teaching and Learning in the Faculty of Engineering and Physical Sciences, and a Professor in the Microwave and Communications Systems research group at the University of Manchester.

A revolution is happening. Across the world people are taking control of the devices we use every day, customising them, creating new things and using the sparks of their imagination to change the world. This lesson takes inspiration from the inventor Alexander Graham Bell and wonders at how we now can even make a phone call from the top of a mountain

### Context

From cable to wireless the telephone has evolved to respond to our modern mobile lifestyle. The original concept of voice transmission was simply by mechanical vibrations eg a string can phone whereas later scientific advances in electromagnetic sound transmitters and receivers enabled the application of this emerging science to a practical telephone patented by Bell in 1876. The lesson focuses on the application of science to solving problems and inventing a new product that can then be tested as fit for purpose.

### Children will be able to work scientifically by:

- Making a testable prediction and revising that prediction based upon evidence gathered.
- Evaluating findings to make further revisions or changes to apply problem solving to a real context

### Children will learn:

- Electricity requires a complete circuit to flow. Some materials are conductors and some materials are insulators.
- Signals require a transmitter and a receiver to transfer information
- New ideas are developed through many changes, adaptations and shared thinking from a number of scientists

### Cross curricular opportunities:

- Design & Technology . Product development process

### Resources suggested

Two can and string telephone, long hosepipe and two funnels (or whispering tubes outdoors), simple radio walkie-talkie/toy, two tablets or other devices that can message/text each other.

A cheap glove (one per pupil group); a range of shiny materials metal and non-metallic e.g. shiny metallic looking wrap, flexible copper wire, aluminum foil, crisp packets, copper metal, conductive thread; scissors; tape.

The teacher would benefit from a laptop with a touch sensitive mouse, or a touch screen phone.

(Optional: A commercially available ghost ball can be useful to show complete circuits and conductivity.)

## Lesson Outline - summary



### Starting the lesson

**Thinking for learning.** Paired talk and simple shared drawing eg whiteboards. Think about How does a text go from one phone to another? Pupils to devise a theory, even if it is silly or extreme. Encourage creative thinking as the majority of adults do not know the answer. The right answer is not relevant or needed. Remember Graham Bell, a renowned scientist, would not know the answer!

**Experiential revisit prior learning.** Pupils handle equipment that allows communication- Tin can telephone, Hose pipe funnels, walkie talkie and a text device. Teacher introduces the process of improvement.



### Main activity

**Investigation.** Try to work your computer touch pad mouse whilst wearing a glove. It does not work. Why not? How does a touch screen work? Predict, make a hypothesis, create, test and amend a glove that will work a touch pad or touch screen without being removed.

**Scientific Explanation and reflection.** Encourage pupils to explain how their new glove works. Key terms include complete circuits, conductors and insulators.



### Plenary

**Reflection:** Make pupils aware that the solving of problems with new inventions is the role of an engineer. Ask pupils to think about problems related to the phone that might be solved by an engineer in the future.

## Lesson outline – detail

**(Pre-lesson option:** Use the school text messaging system to send a text to parents to share with the pupil the night before the lesson - generic or intriguing! *Eg Mr G Bell invites you to think about the science of connections. Find out more tomorrow.*)

**Slide 1:** Check pupils know what a text looks like. Show a phone text image on the first slide. Ask pupils how they think the text message gets from one phone to another. Encourage creative even silly answers. Many pupils, and many adults think this is just magic! Most will accept that there has to be an information output and an information receiver. Ask pupils to draw what they think happens in the middle. Value all ideas.

**Slide 2:** Design improvements often occur to address a problem by tinkering and developing an existing object. Each slide click presents a scenario where the communication needs to be improved. Draw attention to the raising of the question that then leads to a solution.

What if it was a noisy classroom? Demonstrate a string telephone.

What if... the two pupils were a long way from each other? Demonstrate with longer string in the hall.

What if... the two pupils were in different rooms? Demonstrate a hose pipe and funnel telephone.

What if... we wanted to communicate to someone on different floors? Demonstrate a walkie-talkie.

What if two deaf people wanted to communicate and were in different buildings?

The learning in this activity is in changing the device to solve the problem (it is not about sound as vibration).

Note: the importance of understanding the limitation of the communication device. All of those tested are good enough in some situations and no single device is the full answer. Indeed what if the phone battery is flat? The string telephone would then be best!

**Slide 3** Alexander Graham Bell is recognised as using the ideas from many scientists about changing sound to electrical signals to make the first telephone work. Compare and contrast old phones and new ones! One significant difference is the ability to use the phone as a mobile, at any time almost in any place.

Ask What if... you are at the top of a cold mountain and you want to send a message on your touchscreen smartphone?

Use the slide to develop empathy with a meaningful context for the investigation to follow.

**Slide 4** How does a touchscreen or touchpad mouse work? What if you wear a glove when you touch the screen? Ask pupils to put on a glove and predict what will happen when they use the mouse. Try it. How does this new evidence affect the pupil hypothesis about how a touchscreen works. Many pupils will have thought it is pressure but in fact it is not. Pupils will start to think about alternatives including insulators and conductors. (The ghost ball is a great way of showing that electricity can conduct through skin but that contact needs to be made for a complete circuit). In small groups, pupils investigate conductivity of different materials, and use findings to make and test a solution to the problem. Pupils communicate through a poster to explain the science of how things work.

**Slide 5:** Pupils write an e mail to an engineer to describe the challenge or problem. They should think about how solving the problems would impact on the life of the individual. Start with: What if ÷ Example ideas could be an astronaut, deep sea diver or a person on a roller coaster.

Use the video <http://richannel.org/primary-resource-2>: Prof Danielle George will be making new connections beyond our expectations as she seeks to be able to speak to her gran, enjoy a meal with her gran and share a hug even though the two are hundreds of miles apart. Watch her try out the latest technology to see how close we can get to this dream.

**Homelink** A chat challenge: What problems would you encounter if you had been the proud owner of the first ever telephone?

## Websites

Clip link: <http://bit.ly/xmasP2>

The full CHRISTMAS LECTURES can be found at: <http://bit.ly/148WRUs>

## Teacher Science Background knowledge

Mobile phones work through the conversion of sound to electronic signals and then the conversion back of signals to sound. A network of receivers and transmitters are needed to make this connectivity possible. There are network of phone masts across the UK to make this happen easily. Arguably the cell net mast network is a greater invention leap in mobile technology than the changing handset.

For more information about how touchscreens work, teachers can try this infographic <http://bit.ly/1vKWIH2>

A great and easy activity is the transformation of a 2D video on a mobile into a 3D hologram. Science clubs should definitely give this a try. See <http://bit.ly/1wAvTmP>

Science clubs also might like to try making any pair of gloves touchscreen compatible <http://bit.ly/1zuO1vR>

A great range of books to accompany the CHRISTMAS LECTURES, consider for your library corner. <http://bit.ly/18ts5sc>

For more primary science lessons with a topical theme see also <http://bit.ly/1zazXHw>