The Physical World

Waves: Make your own radio

ANGELA: So it's time to put our skippers out of their misery and give them back their radios, but we're not going to make it quite that easy, no plain sailing here because Neil and Armand are about to follow in Marconi's footsteps by making their own wireless, a radio stripped down to the bare essentials and, believe it or not chaps, you have got everything here you need to build a radio – you've got your instructions, you've got the bits and pieces. Are you OK to do that?

NEIL: We'll give it a try.

ANGELA: Yes?

ARMAND: Yeah.

NEIL: Are you sure everything's there?

ANGELA: I'm sure.

NEIL: Doesn't look much.

ANGELA: We'll see what you can do with it.

NEIL: OK.

ANGELA: Alright I'll leave you to it.

ARMAND: Right, where shall we start?

ANDREW: The two basic components of any radio receiver or transmitter are just a simple coil like this, and a variable capacitor like this. A coil of wire can store energy in the form of magnetic energy within it, whereas a capacitor can store electrical energy.

ARMAND: And it needs one hundred turns.

ANDREW: Now if these two are connected together in an electrical circuit then as the electrons oscillate backwards and forwards between the two, energy will be transferred from magnetic energy to electrical energy, and back and forth. And that's really the basis of any radio receiver or transmitter.

NEIL AND ARMAND MAKING RADIO

ANDREW: The variable capacitor lets you change the capacitor that's in the circuit, and that lets you change the natural rate at which the electrons oscillate backwards and forwards, and that's what we mean by tuning in a radio.

NEIL AND ARMAND MAKING RADIO

ANDREW: Now it may surprise you to see that our two fishermen don't have a battery in their radio. That's because in a simple radio circuit you can actually extract all the energy you need from the radio signal itself, but to do that you need a very large aerial and they'll need a long piece of wire to pick up enough energy to drive their radio circuit.

ANGELA: So what's the big deal about waves? Well waves aren't just important to our fishermen; waviness is crucial to the way nature works. Sound, radio, water waves – what's the connection? What it is about these periodic oscillations, these waves that makes them crop up everywhere?

ANDREW: Waves tend to crop up all over the place in nature whenever energy is transported from one place to another, whether that's as a water wave, a sound wave, or an electro-magnetic wave. But although these waves are quite different in many ways, they do have one feature in common, and that's in the way we characterise them in terms of their wavelength and frequency. Now the wavelength of a wave, like these water waves here, is just the distance from one peak to the next, so for these water waves it's about 10 or 15 centimetres. The frequency of a wave, that's the number of cycles that pass a given point in a fixed length of time, so again for these water waves two or three waves are passing by every second, so that's a frequency of two or three hertz.

ANGELA: Hi Armand – how are you getting on?

ARMAND: Fine.

ANGELA: Has Neil given up on you?

ARMAND: No, he's out at the car running up the aerial.

ANGELA: Oh right, so is it working?

ARMAND: Yeah, it's working fine, Radio Five, Radio Five.

ANGELA: I can't hear anything on your cans but I've brought an amplifier with me so I can listen in to what you've got, let's have a go, stick that on there.

HEAR RADIO

ANGELA: I'm impressed. Radio Five Live.

NEIL: Is that any better?

ARMAND: Yeah, lovely.

ANGELA: Yeah listen.

RADIO

ANDREW: Of course radio isn't just used at sea, it's used everywhere, and there's to electro-magnetic radiation than just radio waves, in fact there's a whole spectrum of radiation. All the same sort of thing but different in that it has different wavelengths and different frequencies such as you see on a radio dial. As I go through the frequency spectrum here, from low frequency through to high frequency, I go through a whole spectrum of radio stations. And if I went to higher and higher frequencies, I get to TV broadcasts, and eventually to microwave signals used for cooking your dinner, or in mobile phones.