

Radioactivity and health

This unit is about how scientific ideas can take many years to be accepted. People often do not want to change their beliefs. It also takes a long time to collect the evidence needed to change their minds. A good example of this is the discovery of radioactivity. Only much later were its dangers realised.

Before you start ...

When you think of the word 'radioactivity', what comes into your mind?

Atom bomb

Marie Curie

Nuclear power

Something else?



After you have finished ...

Once you've finished the activities, answer the questions below.

Q1a) Copy and complete the table about our understanding of the dangers of radioactivity.

Scene	What was known about danger of radioactivity	Evidence from the play
Marie Curie (In 1900)		
Quack Cures (1920s)		
Marie Curie (In 1934)		
Hiroshima (1945)		

b) Why do you think it took so long for people to realise the dangers?

Q2) Describe an important benefit of radioactivity.

Q3) 'It's not the science that is dangerous, but the use you put it to'. Do you agree with this statement? Give an example from the play.

Q4) List some things you have learned from the play about how scientists work.

Q5) Many people are exposed every day to another type of radiation - the microwaves from a mobile phone. We do not know whether they are harmful.

Do you think we should take any precautions against microwaves? Refer to the example of radioactivity in your answer.

The history of radioactivity

Overview

This play consists of six short scenes. Each scene contains three to five characters, thus enabling all the class to be involved in performance. The consistent 'narrator/teacher' helps to link the scenes together and provides continuity. It could be a pupil reading this part, but perhaps the teacher would be best.

Scene 1 – Becquerel: the discovery of radioactivity

Becquerel

Research assistants 1,2 and 3

Scene 2 – Marie Curie part 1: her research, unaware of the dangers

Marie Curie

Pierre Curie (her husband)

Irene Curie (their daughter)

Scene 3 – Quack cures: the early misguided uses of radioactivity

Martha

Elizabeth

Amelia

Mrs Bennett

Scene 4 – Marie Curie Part 2: her medical achievements and suffering

Marie Curie

Nurse

Pierre Curie

Irene Curie

Newsreader

Scene 5 – Hiroshima: the legacy of the atomic bomb

Builder 1 and 2

Gardener

Newsreader

Child's voice

Scene 6 – Hospital waiting room: modern radiation cancer treatment

Receptionist

Mr Smith

Ms Hepworth

Mr James

Scene 1: Becquerel

- Narrator:** Through this short play you will learn about the history of radioactive materials, its uses and its dangers. The story begins at the turn of the 20th century with the great physicist Henri Becquerel and his research assistants.
- Becquerel:** The weather is still bad and my experiment is going to be postponed again. It has been in the drawer for days [paces up and down]. I was hoping to see the uranium give off X-rays in the sunlight.
- Research assistant 1:** [enters room] The photographic plates from the drawer, which you asked me to develop. Here they are [gives Becquerel the plates].
- Becquerel:** What is this? There must be some mistake. I expected the photographic plates to be clear, not black like this. There was no light in the drawer. How can there be an image on them? [goes into deep thought]
- Research assistant 1:** Is there a problem?
- Becquerel:** Oh my God! [shouts to the research assistant] I think I've made an amazing discovery! Look at this.
- Research assistant 1:** What is it? What does it mean?
- Becquerel:** This is amazing! I thought uranium needed sunlight to give off rays. But there's an image on the plate. It must have given off rays while in the drawer. So it doesn't need light at all [both Becquerel and his assistant are very excited].
- Research assistant 1:** It can't be X-rays, then. You must have discovered a new type of ray! But what?
- Becquerel:** Yes, Jacques, I think I have. Write this down. The uranium crystal gave out mysterious rays which left a strong image on the photographic plate. I believe we have discovered something important here. I shall call them 'Becquerel Rays'.

Narrator: It was several years before anyone took notice of Becquerel's discovery. However, another pioneer, called Marie Curie, was beginning to work on similar ideas.

Becquerel: [Time passes. Scene changes to Becquerel in his sitting room. He is drinking wine, talking to his research assistants.] The problem, my young friends, is that the scientific world appears to have little time for my research. During 1896 I had seven scientific papers on my radiation published. Then in 1897 two papers, and this year 1898, none.

Research assistant 2: [eager to make the talk less gloomy] But sir, this is the dawning of a new age. Others are interested in your work.

Research assistant 3: [said with enthusiasm] Yes, yes. That Marie Curie woman has started doing experimentation – based on your work. She has discovered other substances which are what she calls 'radioactive'. Doesn't that show how important your first discovery was?

Becquerel: [interrupting] Lots of rays have now been discovered. What's special about my original radiation? Wilhelm Roentgen's X-rays take much sharper photographs. And he discovered them first.

Research assistant 2: [enthusiastically] But your Becquerel rays are just as important.

Research assistant 3: I even heard they have discovered some radio waves! [the others look at him with annoyance]

Becquerel: Now my friends, I must tell you I have decided to move on to a new area of research. Thank you for your enthusiasm. But scientific research is not standing still and neither must we. 'Til tomorrow, when our new project begins.

Scene 2: Marie Curie (part 1)

Narrator: After Henri Becquerel, Marie Curie realised that radioactivity is a natural property of atoms. Her findings would have a huge impact on medicine and science. Scene 2 takes place in 1898 in the laboratory, where she and her husband continue the research Becquerel began.

Marie Curie: [looking out the window] Aah! More pitchblende is arriving from the mines of Bohemia. We have spent years refining it just to produce a tiny amount of material. But it is so radioactive [leaning over the equipment and examining the experiment].

Pierre Curie: Marie. This substance gives out much more radiation than uranium. It must be a new element. You must name it. What do you want to call it?

Marie Curie: I will call it radium [looking at the substance and touching it].

Pierre Curie: Why radium? [looking at her]

Marie Curie: Because of the way the liquid in the beakers shine. My new element makes things radiate light [looking at her notes and smiling].

Narrator: The scene moves forward a few years. The first signs of the dangers of radioactive materials are being ignored.

Marie Curie: Look Irene, here in this shed, your father and I have been continuing our experiments into this new substance that I have called radium. What do you think?

Irene: [standing in the shed doorway] Mother, I love seeing the shed at night time. It's so pretty with all the lights coming from the bottles on the benches.

Marie Curie: Now, that light is because of this new substance we found.

Irene: Mother, is that the substance that father has wrapped around his arm where he hurt himself?

Marie Curie: Yes, dear. He has a sample of radium bound to his arm to study its effect on his wound. We want to see whether the rays it produces could be useful for treating people. Perhaps even for curing cancer.

Irene: Father's hands are all scarred. And they shake too. Is he OK?

Marie Curie: Yes, dear. He just works too hard. He's so dedicated to our research. It means so much to him. He even carries around some uranium in his pocket.

Scene 3: Quack Cures

- Narrator:** Scientific discoveries sometimes led to quack cures where people were easily taken in by so called 'miracle cures'. In Scene 3 we visit America in the 1920s where the women are having a demonstration of radium products.
- Martha:** Ladies, I welcome you to an afternoon of enjoyment. Mrs J Bennett has come along to show us the benefits of radioactivity. As you see, she has brought lots of cures – jars, pills and potions. Do help yourselves to tea coffee, and cakes.
- Elizabeth:** [sitting down with her friend, Amelia] I hope this is going to solve Albert's problems. He has had such trouble. His breathing you know.
- Amelia:** [between mouthfuls of cake] I am here to cure my rheumatism! If necessary, I will spend my savings. Nothing the doctor gave me has helped. I've heard the radium products are miraculous. Thank goodness for Marie Curie.
- Martha:** [standing up and tapping the table] Ladies, please welcome Mrs J Bennett! [the women politely clap]
- Mrs J Bennett:** Good afternoon ladies. I am Jacqueline Bennett and I am promoting radioactive products. My good friend Dr Torney tells me they can cure gout and rheumatism, prevent insanity, and slow down old age.
- Elizabeth:** [whispering to Amelia] Well, I'm so pleased to hear this. Let's hope she has a cure for Albert.
- Amelia:** [placing her finger over her lips] Elizabeth, please .
- Mrs J Bennett:** Now, do you know the Hot Springs Spa? Where you can soak in the waters and inhale the air. I am going to show you a jar which will take away all the effort of travelling to a spa.
- [picks up jar] Let me introduce the 'Revigorator', a radioactive water crock. You place water in the jar, which is lined with radium and radioactivity is absorbed into the water. Your own healthful radioactive water. Drink six glasses a day!
- Elizabeth,
Amelia,
Martha:** Well, this is too much! Imagine having a spring in your own home!
- Amelia:** I'm not sure I could drink six glasses of water a day. [the others mime for her to be quiet]
- Mrs J Bennett:** Of course there are other ways of taking in radioactivity. We have a range of radium products: beauty creams, toothpaste, earplugs, chocolate bars and soap. Even, my dears, [embarrassed laugh] contraceptives. If you suffer breathing problems there is the Radium Nose Cup.

Elizabeth: At last . . . help for Albert' snoring!

Amelia: Well! I'm very surprised she mentioned those contraceptive things – dreadfully shocking! [eating cake furiously]

Martha: Amelia [through a mouthful of cake], you do have to move forward in your thinking.

Amelia: Well, really!

Mrs J Bennett: And here we have 'Ray Cura'. Each bottle of the liquid contains two measures of radium. Eben Byers, the well known industrialist, is so convinced about this product he drinks three bottles a day.

Elizabeth: Didn't he die recently? Are you sure it's safe?

Martha: Yes, of course it's safe! [pause] But he was drinking too much of the cure. Moderation in all things, Elizabeth – you should know that!

Mrs J Bennett: Finally, for smokers there is the Lifestone Cigarette Holder. The radium [quietly to the women] reduces the nicotine and gives you a beautiful face. And we all know the benefits of a that! Please look at the samples, and I will take your orders.

[The ladies clap quietly and move towards the product table.
Scene fades.]

Scene 4: Marie Curie (part II)

- Narrator** Those women may seem ignorant to us, but back then people weren't aware of the dangers. In Scene 4 we return to Marie Curie in 1934. She is ill with leukaemia in hospital. But she has saved the lives of many people.
- Marie Curie:** [sitting in a wheelchair and sighing.] I am tired and I find it hard to see. My fingers have been burnt by my "dear" radium. Radioactive materials have been around me for so long, in my pocket and in every room of the house [sighs sadly]. Nurse can you help me please?
- Nurse:** Yes, Madame Curie.
- Marie Curie:** I would like to look at my photographs [looks over to the cupboard where a photograph album lies].
- Nurse:** Shall I help you turn over the pages?
- Marie Curie:** Yes [the nurse sits on the bed opens the page at a picture of a group of people, standing around in a garden]. That is my husband, that is Ernest Rutherford and these [pointing a very scarred finger to the picture] are other famous scientists.
- Nurse:** What does your husband have in his hand?...
- Narrator:** We flashback to the scene in the photograph
- Pierre Curie:** Ladies and gentlemen we have come into the garden on this warm night to celebrate my wife's work. I ask you to observe this [from his waistcoat pocket he takes a tube which he shakes and it become luminous]
- Rutherford:** What is happening? The tube - it has lit up the darkness [all stand and stare at the display of wonder].
- Pierre Curie** My wife discovered this phenomenon and we have spent a considerable time examining the substance which causes this. She has called it radium [holding the tube with scarred and inflamed fingers].
[Scene fades back to the hospital.]
- Nurse:** Surely he wasn't actually holding the tube with the radioactive substances in it, without protection? It could be dangerous. Did you know that at the time?
- Marie Curie:** [pause reflecting] No, we did not. He did find it difficult to hold the tubes in the end, when his fingers became very sore. But he was so proud of our work, and wanted to show others what it could do
[enter Irene, Marie's daughter]
- Nurse:** [getting up] Your daughter is here. I will leave you together [taking flowers from Irene] and go and find a vase.
- Irene:** How are you mother? [looks down] Photographs...lets have a look. This one was from our American trip, wasn't it?

Remember how the newspapers were full of stories about your discoveries. How they led to X-ray machines which helped all those soldiers in the war. We were met by the President. Do you remember mother? [they both look at a postcard bought during their trip to America]

Marie Curie: Of course, dear. I still remember how they introduced me at the Waldorf Astoria. "Madam Curie, a woman who has done more to comfort humans than anyone. The woman who discovered radium, a substance that can cure cancers."

Irene: I am worried about you. You are not improving. The nurse says that you are permanently tired. And that you refuse to have removed the radium salt removed from your table [looking at her mother].

Marie Curie It reminds me of our American experience. The money purchased a gram of radium to continue my research [pauses]. They tell me I am dying from too much exposure to radiation. But I know my research has been worthwhile [Scene fades with her slowly going to sleep.]

News reporter: Marie Curie has died of leukaemia at the age of 67. Her research brought us the atomic age of science and new treatments for cancer. She was an inspiration for women around the world. However, if you want to look at her scientific notebooks, you do so at you own risk. At least for the next thousand years, until the radioactivity of the pages drops.

Scene 5: Hiroshima

- Narrator:** Scene 5 moves forward to 1995, to Hiroshima in Japan. The place where radioactive materials were used in the form of an atomic bomb, killing 100 000 people. The setting is the building site for a memorial garden. Two builders and a gardener are constructing a monument, and landscaping the area around it.
- Builder 1:** Here's the spot! [looking at the map in his hand]
- Builder 2:** It's small. The architect implied it would be bigger. Building the statue here is not going to be easy.
- Builder 1:** It's not a statue! It's like a small house, to add to the other international peace shrines.
- Builder 2:** Well, there won't be much peace around here while we're building it!
- Gardener:** C'mon, let's get started. I have my plans here. Do you want to check them with yours?
- Builder 1:** Fine. Let's put both sets of plans together [they pore over the plans].
- Gardener:** I want to show that the city was built on the Ota river delta, so I need [notices a whistling sound]...what's that noise?
- Builder 2:** I don't know. But it sounds very eerie. I'm not happy about this job you know.
- Narrator:** The area they are standing in turns misty. It is 1945. The sound of a B29 bomber fills the space. The bomber appears. Written on the side is the name 'Enola Gay'. Suddenly, a bomb, nicknamed 'Little Boy', drops from the plane towards the city below. A minute later it detonates.
- Newsreader:** Today, at 8:15 Japan Standard Time, a bomb exploded on Hiroshima. It is the largest bomb ever seen. When the heat wave reached ground level it burnt everything, including people. The shock waves levelled most buildings in the city. Witnesses said, "The explosion was like having another sun in the sky."
- Narrator:** Back to the Peace Memorial Park, as the mist clears.
- Gardener:** This place gives me the shivers. I thought I just felt a sudden heat and a strong wind.
- Builder 2:** That's strange. I just had this really odd taste in my mouth, like lead. A weird picture appeared, a cloud, but shaped like mushroom. It's very peculiar! I'm not sure about this place either.
- Builder 1:** When you two have quite finished! While you've been staring into space I've been examining the plans.
[The other two just stare at him, as if they are in a trance.]
- Child's voice:** [screams are heard]

A huge roar shook our village, and the sky became dark. Later, cinders and paper and other things fell from the sky [screaming continues].

My mother was lying on a futon bed. She had brown burns all over her back and the smell was awful. That terrible gas had entered her body [screaming fades].

Gardener: I want to create a garden to remind the world what awful suffering happened here. A message to all powerful nations about what atomic warfare really means [wiping his eyes].

Builder 2: My grandmother was living in Hiroshima in 1945. She died of cancer after giving birth to my mother. My mother was deformed because of radiation poisoning and died when I was born. I wanted this job so I could build something to..... [wipes a tear away]

Builder 1: History lesson over – come on, you two. A job is a job. Memories can't help us now. We have to work. [The others walk away.] What have I said? [shouts] You two! Here are the plans. Let's get started! Hey, where are you going? [they leave him quiet and alone]

Scene 6: Hospital waiting room

- Narrator:** Scene 6 takes us to the present day to see how Becquerel's discovery and Marie Curie's research have revolutionised modern medicine.
- Receptionist:** [on telephone] Good morning, Kings General hospital. Oh, Dr Stewart. Yes, your patients have arrived. Will do [puts down phone]. Mr Smith and Ms Hepworth, Dr Stewart will be running slightly late. Please make yourselves comfortable.
- Mr Smith:** [looks up from his newspaper] Thank you.
[Sighs and looks at his watch. Leans forward and picks up a leaflet 'Treating Your Cancer'. Looks round at the others in the waiting room, and starts reading.]
- Ms Hepworth:** This is the second time I have been kept waiting. I don't see why Dr Stewart can't get here on time.
- Mr Smith:** [looks at Ms Hepworth, smiles and continues reading]
- Ms Hepworth:** I mean.....I do have a life apart from coming here for treatment. Just because I have a few oddly behaving cells [Mr Smith looks confused at this remark]
Don't these doctor's realise I have better things to do.
- Mr Smith:** [interrupting] Me, too! I don't like to use the 'C' word either. It's all so frightening, isn't it? The doctors have only just discovered I've got oddly behaving cells. This is my first time, you know. But I am not worried [looking very worried].
- Ms Hepworth:** [looks at him oddly and then takes pity] They have very good radiation oncologists here .
- Mr Smith:** [looks at her confused]
- Ms Hepworth:** Doctors who use radiation to treat cancer. Where are your odd cells?
- Mr Smith:** [looking up very embarrassed] They're in my lower region.
- Ms Hepworth:** Oh, you mean prostate cancer [Mr Smith nods shyly]. Don't worry, my dad had that. Radiation is good for that. He was given small doses over a period of time. It killed the tumour but gave his body a chance to repair damaged healthy cells.
[At this point in the conversation another patient arrives at reception.]
- Mr James:** Hello, It's Mr James again. I have an appointment to see Dr Shaw.
- Receptionist:** Good morning. Please take a seat.
[Mr James sits near Ms Hepworth.]
- Ms Hepworth:** Hello, Howard, how are you?
- Mr James:** Nearly at the end of my five weeks treatment. Hi – a

newcomer, I'm Howard James. Is Dr Stewart is late again.

Mr Smith: Hello, I'm David Smith. I'm happy Dr Stewart's late – I have had a chance to talk to this kind lady here, which has helped.

Mr James: [talking to Mr Smith] Yes, no need to worry. They can kill all your cancerous cells these days.

Ms Hepworth: Tell him what happens, Howard.

Mr James: The actual radiation treatment only lasts a couple of minutes. You'll be alone in the room. The radiation therapist watches you from outside through closed circuit television.

Mr Smith: [looking very worried] On my own? Why is the therapist outside?

Mr James: Because radiation can kill healthy cells too. The therapists are exposed to it every day. The therapists minimise the damage to you too. They focus a narrow beam on the tumour. They also put lead around it to protect the rest of you.

Mr Smith: [In a very small voice – twisting his hands] And . . . the side-effects?

Ms Hepworth: Well.....[looking at Howard] There are some, really it depends on the exact type of tumour and the location of the radiation treatment.

Mr Smith: Like what.....

Ms Hepworth: Well, I get itchiness and dryness and redness [points to her breasts]. I've got some cream to help.

Mr Smith: [looks embarrassed and nods]

Ms Hepworth: It will disappear after the treatment is finished. Mind you – you don't have any of these to worry about to you! [points at her breasts again and smiles]

Mr Smith: [looks very embarrassed] No, I don't.

Mr James: You can get diarrhoea and vomiting. But you're given tablets to ease this.

Ms Hepworth: Howard and I have been receiving treatment here for weeks, we tend to think everyone knows as much as us, but I guess that's not true. Just ask if you want to talk about anything.

Receptionist: Mr Smith, Dr Shaw is in Room 4. Ms Hepworth, Dr Stewart is in Room 6.

[They leave. Mr James picks up the newspaper.]

Narrator: Radioactivity is one of the biggest scientific discoveries of the last hundred years. But as we have seen, it took a long time before we learned how to use it, and to understand its dangers.