

Unit title	Nuclear Waste
Topic	Atomic and Nuclear
Name and email address of person submitting unit	M J O'Neill Mike.O'Neill@church-schools.com
Aims of Unit	Students are required to read a short digest on the classification of Nuclear waste, and then answer associated questions.
Indicative content	Radioactive waste, activity, half-life, chemical properties.
Resources needed	None
Teachers notes	<p>A very interesting presentation with embedded questions for pupils to work through. Suitable for 15 + pupils.</p> <p>Time about 45 minutes.</p> <p>Learning outcomes for this activity</p> <p>All pupils should be able to discuss the need for the correct type of storage for nuclear waste products and identify the main characteristics of storage.</p> <p>Most will be able to identify the various types of radiation by its properties and also use the concept of half-life to discuss storage.</p> <p>Some pupils will be able to evaluate the concept of safety in terms on Nuclear radiation.</p>

Date:	Topic: Nuclear Waste	Time:	Class: Key stage 4
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SEN pupils

Gifted and Talented

Class Room Support

Equipment needed for this activity:

There are no specific equipment requirements for this activity.

Health and Safety:

There are no health and safety implications for this activity.

Learning outcomes for this activity

All pupils should be able to discuss the need for the correct type of storage for nuclear waste products and identify the main characteristics of storage.

Most will be able to identify the various types of radiation by its properties and also use the concept of half-life to discuss storage.

Some pupils will be able to evaluate the concept of safety in terms on Nuclear radiation.

Starter Activity

Main Activity

Pupils require viewing the accompanying sheet which recaps information from previous lessons. Pupils are then required to answer the 10 questions provided on the sheet.

This activity should take about 20 to 25 minutes and can be used to test pupils comprehension of the questions and understanding of the concepts.

Plenary Activity

Reflections on the lesson

## Nuclear Waste

The nuclear industry produces a large amount of nuclear waste, and until recently this has been stored rather than disposed of. When deciding how best to dispose of nuclear waste you need to consider several factors such as the activity of the sources in the waste, the half-life of the materials and the chemical properties of the materials.

For example, plutonium-239 is an alpha emitter, and it is fairly easy to provide protection against  $\alpha$ -radiation as it is so short range in air and will not penetrate even small thicknesses of materials. However, plutonium-239 has a very long half-life of 24000 years and it is very corrosive and toxic. When plutonium-239 is stored it must be made secure for thousands of years.

There are three main categories of nuclear waste which are described in the following table:

<b>Waste Category</b>	<b>Examples</b>	<b>Methods of Disposal</b>
Low-level	Discarded protective clothing. Used wrapping materials	Buried on land or at sea
Intermediate-level	Irradiated nuclear fuel cladding Nuclear reactor components Chemical waste	Concrete stores Deep trenches
High-level	Fission fragments from reprocessed fuel	Liquified and stored in steel-lined, water cooled tanks

### **QUESTIONS:**

1. Which three factors need to be considered when deciding the best way to dispose of nuclear waste?
2. Plutonium-239 is a waste product that is an alpha-emitter. Why does this mean it is easy to store?
3. Why does plutonium-239 have to be stored for thousands of years?
4. What do the words corrosive and toxic mean, and what extra implications do these properties have for the storage of plutonium-239.
5. Where might low-level, intermediate-level and high-level nuclear waste come from?
6. Why might either concrete stores or deep trenches be used for storage of intermediate-level waste?

7. Describe how waste products from nuclear power stations may be stored.
8. Apart from nuclear power stations, where else do large volumes of nuclear waste come from? What categories are likely from these sources?
9. Why do the container tanks for high-level waste have to be water-cooled?
10. Is any level of radiation from nuclear waste ever completely safe? Explain your answer.