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| **Title** | **Module** |
| **Aims** | 1. To develop a more accurate and complete understanding of nuclear energy resource. 2. To identify the advantages and challenges of nuclear energy. 3. To be able to list possible sources of radiation. |
| **Key competences.** | **With this module students will develop the following competences:**   1. **Linguistic competence**: being able to express and interpret concepts, facts and opinions; interacting linguistically in an appropriate and creative way. 2. **Mathematical competence**, applying mathematics to count the amount of the radiation. 3. **Competence in knowledge and interaction with the physical world**, recognizing processes and describing them, representing data in the form of a graph or a scheme. 4. **Competence in the treatment of information and digital competence**, using Internet, PC, smartphones, etc. in the search of and the treatment of information. 5. **Social and civic competence**, participating in group work in an effective and constructive way, expressing active position towards the use of nuclear power. 6. **Cultural and artistic competence,** having necessary values and principles, and demonstrating appropriate attitudes and behaviour; creating films, preraring presentations, videos or other pieces of information on the topic ”Nuclear Power”. 7. **Competence in learning to learn**, building on prior learning and life experiences in order to use and apply knowledge and skills in a variety of contexts. 8. **Competence for autonomy and personal initiative,** empowering the critical approach in order to confront the topic of nuclear power and search for responsible solutions. |
| **Approx. time** | 6 sessions (Material Annex) |
| **Methods** | Different methods are used |
| **Age** | 12-19 |
| **Assessment** | SESSION 6  Answering the questions about the issues the students have learnt during sessions 1-5. |
| **Necessary material** | PC, projector, smartphone / tablet with access to the Internet, camera, board, pens, coloured pencils, etc. |
| **Remarks** | Background information for teachers (Annex 3) |
| **WEB LINKS** | * <http://www.nuclear-power.net/> * <https://whatisnuclear.com/> |

**Material Annex**

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| **ACTIVITIES** | **SUBJECT / AREA** | **LEVEL /AGE** |
| **1. “Warm-up”** | ANY LESSONS | 12-19 |
| * 1. Find where nuclear power plants are located in your country. |
| * 1. http://apzvalga.eu/images/pasaulis-susirupines-branduolines-energetikos-saugumu-259x250.jpgWhat 3 things come to your mind when you see this symbol? List them and discuss them in the group. |
| * 1. What do you know about impacts of nuclear energy on health? Answer the questions: * Health impacts from Fukushima. * Health impacts from Chernobyl. |
| * 1. Calculate the yearly dose of radiation you get. | MATHS, PHYSICS | 12-19 |

**CALCULATION OF THE YEARLY DOSE OF RADIATION**

Radiation is all around us, all the time. We're exposed to radiation when we fly and when we get medical treatment - and whenever we leave the house. There are different kinds of radiation. The problems we're concerned about come from ionizing radiation.

Radiation dosages are measured in sieverts - but because these are so big we're talking about millisieverts mSv (a thousandth of a Sievert).

Answer the questions and find out what is YOUR yearly dose of radiation.

1. Have you had an X-ray, CT (computed tomography) scan in the last 12 months?

YES NO (0 mSv)

***Select ALL your x-rays.***

* Skull (0,02mSv)
* Chest (0,1 mSv)
* Spine (1,5 mSv)
* Abdomen (0,6mSv)
* Pelvis or hips (0,75 mSv)
* Limbs and joints (0,06 mSv)
* Dental film (0,005 mSv)

*Select ALL your CT scans.*

* CT scan: head 2 mSV
* CT scan: heart 16mSV
* CT scan: full body 10mSv
* CT scan: addomen $pelvis 15mSv

1. Choose elevation (altitude) of your town.

Vilnius 97,5 meters (0,02mSv)

Cologne 54 meters (0,02mSv)

Vera 99 meters (0,02mSv)

Bari 5 meters (0,02mSv)

Ploiesti 160 meters (0,02mSv)

1. Cosmic radiation 0,26mSv
2. Internal radiation from food and water (e.g., potassium) (0,4mSv)
3. Do you have porcelain crowns or false teeth? YES (0,007mSv) NO (0 mSv)
4. How many kilometres have you traveled by jet this year?

(0,01mSv per every 1610 km)

………………………

1. How many times did you go through a screening machine at the airport over the last year?

(0,0003mSv each)

…………………………….

1. Are x-ray luggage inspection machines used at your airport?

YES (0,0002mSv) NO (0 mSv)

1. Do you smoke? NO (0 mSv)

YES. How many packs of cigarettes do you [smoke](https://www3.epa.gov/radiation/calculator/calculator.html" \l "self) per day? (0,0049mSv per pack)

……………………..

1. Do you live in a stone, brick, or concrete building?

YES (0,07 mSv) NO (0 mSv)

1. Do you wear a luminous wristwatch?

YES (0,0006mSv) NO (0 mSv)

1. Do you have a [smoke detector](http://www3.epa.gov/radtown/docs/americium-smoke-detectors.pdf" \t "_blank) in your home?

YES (0,0008mSv)

NO (0 mSv)

1. Do you live within 80 kilometres of a [nuclear power plant](http://www3.epa.gov/radtown/docs/nuclear-power-plants.pdf" \t "_blank)?

YES (0,09 mSv) NO (0 mSv)

1. Do you live within 50 miles of a [coal fired power plant](http://www3.epa.gov/radtown/docs/coal-fired-power-plants.pdf" \t "_blank)?

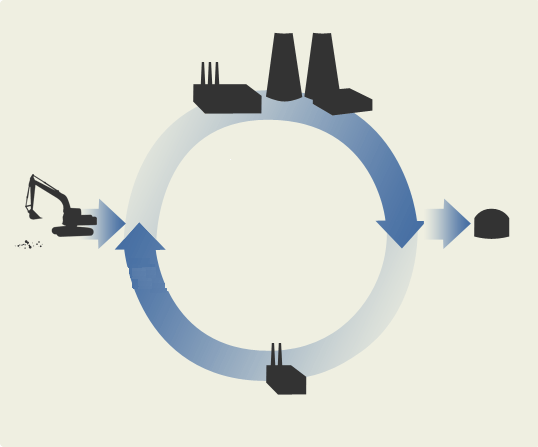
YES (0,0003mSv) NO (0 mSv)

TOTAL…………………..mSv

**The average person safely absorbs about 3,65 millisieverts of radiation annually.**

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| **ACTIVITIES** | **SUBJECT / AREA** | **LEVEL /AGE** |
| 1. **Group Work** (time for this work – up to 1-2 weeks). | IT, ART, CHEMISTRY, LANGUAGES, GEOGRAPHY, PCHYSICS | 15-19 |
| * 1. Students are divided into 5 groups. Each group gets a task from the list presented. |
| * 1. Each group chooses what to do: a poster, a presentation, a short film, a description, a leaflet, etc. |
| * 1. Each group searches for information. They can use <https://whatisnuclear.com/> |
| * 1. TOPICS (additional questions): * What is nuclear energy? * Problems with Nuclear Power   + - Nuclear Waste     - Dramatic accidents     - Cost * What is a nuclear reactor? * What is Nuclear Waste?   + - What do we currently do with our nuclear waste?     - What should be done with nuclear waste?     - Recycling nuclear waste.     - What is nuclear recycling? * What is radiation?   + - What is radioactivity?     - Health and Radiation?     - How much risk is acceptable? |
| * 1. Performs the chosen task on the given topic. |
| * 1. The tasks performed are presented and results are discussed. |

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| **ACTIVITIES** | **SUBJECT / AREA** | **LEVEL /AGE** |
| 1. **Analysis of the diagram (image).** | ANY LESSONS | 15-19 |
| * 1. The image depicts **“The nuclear fuel cycle”. Write in the names of every element of the diagram (as you think it might be called.)** |
| * 1. **Read the short text.** |
| * 1. Check if the names are indicated correctly. |



Picture 1 ©http://www.vae.lt/lt/ziniu-centras/branduolinio-kuro-ciklas

**TEXT:**

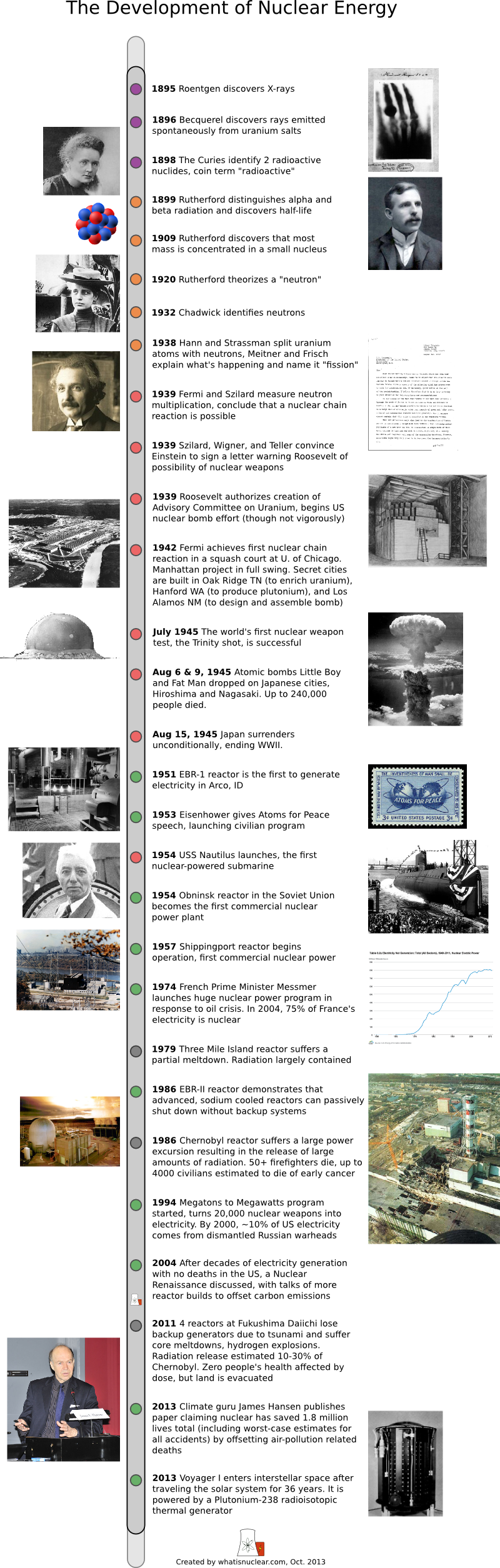
**The nuclear fuel cycle** is the entire process of producing nuclear fuel and energy, including scientific-research work. The cycle consists of 4 phases.

**Mining, production of nuclear fuel.** Uranium ore is mined and nuclear fuel is produced from it.

**Production of energy.** Nuclear fuel is used in a nuclear power plant – energy is produced. **Disposal.** If the fuel used in not recycled, it is transported to a storage facility − a geological disposal facility.

**Recycling.** The nuclear fuel set for recycling is transported to a recycling facility. Up to 95% of the recycled nuclear fuel can be reused for production of new fuel and production of energy in nuclear power plants.

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| **ACTIVITIES** | **SUBJECT / AREA** | **LEVEL /AGE** |
| 1. **A timeline of nuclear energy.** | PHYSICS | 15-19 |
| * 1. Discuss the timeline in the group. |
| * 1. Indicate 3 the most important elements. |



<https://whatisnuclear.com/articles/nuclear_history.html>

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| **ACTIVITIES** | **SUBJECT / AREA** | **LEVEL /AGE** |
| 1. **Debates** | LANGUAGES | 16-19 |
| * 1. Students are divided into 2 groups: “FOR” and “AGAINST”. Each group reads a sentence: “The first step to solving the problem of nuclear waste is to stop making it”.   Sentence from: Pandora’s+False+Promises\_Final\_May13\_2013) |
| * 1. A group fills in the table with 3-5 statements. |
| * 1. Each group presents its statements. |
| * 1. The most important statement of each group is selected. |
| * 1. Results are discussed. |

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| “The first step to solving the problem of nuclear waste is to stop making it”  (Sentence from: Pandora’s+False+Promises\_Final\_May13\_2013) | | |
|  | **ARGUMENTS “FOR”** | **ARGUMENTS “AGAINST”** |
| **1** |  |  |
| **2** |  |  |
| **3** |  |  |

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| **ACTIVITIES** | **SUBJECT / AREA** | **LEVEL /AGE** |
| 1. **Assessment** |  |  |
| Answer the questions/ complete the sentences:   * 1. I think nuclear energy is.............   2. **The nuclear fuel cycle** is**………..**   3. **What kind of** problems can occur with Nuclear Power sources?   4. What do you know about radiation?   5. When are we exposed to radiation?   6. What impact can nuclear energy have on your health? | ANY LESSONS | 12-19 |