# Example of an Educational Scenario

## 1. Identification of the educational scenario

### 1.1 Title of the scenario

*Nuclear Energy*

### 1.2 Creator

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School: 1st High School of Thermi

### 1.3 Subjects or subjects covered

e.g. Physics, Chemistry, Biology, Social and Civic Education, Language, History

### 1.4 Level of education

Primary education X 10-12 years old

Secondary education X 13-15 years old X 16-18 years old

Tertiary education

Adult education Second

Chance School Reception

class

Integration Department X 10-12 years old X 13-15 years old X 16-18 years old

## 1.5 Learning outcomes

By the completion of this course/educational scenario, students are expected to have acquired the knowledge and skills to: ...

- Explore contemporary examples of ethical and environmental dilemmas.

- To practice and develop both psychomotor and language and communication skills.

- Create and answer questions about the facts of science and the responsibility of both the scientist and the citizen.

- Apply active listening and communication rules

- To develop their creative thinking and, in particular, their imagination and originality, their flexibility and fluency of thought.
- Develop the ability to edit and compose a variety of text types.
- Listen to different opinions and perspectives.
- Work cooperatively.
- Develop their emotional and interpersonal intelligence - and in particular their empathy.
- Recognise and promote critical thinking

## 1.6 Time - Duration

In-class work: 8-10 hours

Out-of-classpreparation: 2-3 hours

# 2. Development of the Educational Scenario

## 2.1 General description

### 2.1.1. Loading

(where students react to one of the terms to be discussed and analysed and the teacher identifies their interest in the topic, their involvement and their prior knowledge.)

Questions to explore and define these terms:

> Have you heard the words/concepts 'radioactivity', 'nuclear energy', 'nuclear power plants'?

> What do they mean?

> In what context did you hear or read them?

> Can you find synonyms and/or important personalities associated with them?

> Can you 'connect' them (with various 'paths')?

> In which cases would you use these concepts?

> Do they have some other meaning?

> Do you know what needs are covered by nuclear power generation?

> Can you imagine what factors may influence the choice of nuclear fission power generation instead of a renewable energy source (e.g. wind, solar, geothermal energy, biomass);

> Could we operate a nuclear power plant in Greece safely?

### 2.1.2.Stimulus

One of the following is suggested, depending on the age of the students or the class

A. GENERAL

#### Introduction

> Radioactivity - Marie Curie (http://bit.ly/2XnEefn, TheatrePerformance)

> Nuclear energy - General (http://bit.ly/2NfMA55)

> Nuclear power plants - IEA (https://www.iea.org/geco/data), technology (Zohuri & McDaniel, 2018)

> Energy needs - global energy demand (https://www.iea.org/geco/emissions)

> Renewable energy sources -

> Safety - nuclear accidents (http://bit.ly/2Zzuf3X), Chernobyl radioactive fallout (UNSCEAR (2008)), Maps of geotectonic zones & faults of Greece (http://bit.ly/2WQGZS8 & http://bit.ly/2WUooEE & http://bit.ly/2L5t48v)

#### Video

> How do nuclear power plants work? (TED Ed) https://youtu.be/R7WPEYGr1Vs

> Inside a nuclear reactor core (BBC) https://youtu.be/MGj_aJz7cTs

> Nuclear power worldwide - An error or the future? (DW) https://www.dw.com/en/nuclear-power-worldwide-an-error-or-the-future/av-19281067

> Russia's 'floating Chernobyl' nuclear power plant heads out to sea (DW) https://www.dw.com/en/russias-floating-chernobyl-nuclear-power-plant-heads-out-to-sea/a-43579556

> French nuclear power plants pose a grave security risk - lawmakers (DW) https://www.dw.com/en/french-nuclear-power-plants-pose-a-grave-security-risk-lawmakers/a-44546734

> Nuclear Power Plant Safety (DW) https://www.dw.com/en/nuclear-power-plant-safety/av-6477091

B. FOR THE DOCUMENTARY THEATRE (SUBJECT: CHERNOBYL)

Introduction

Animation "How I survived Chernobyl" https://youtu.be/BQcuMUu8KvE

Animation "Chernobyl Suicide Squad - 3 Men Who Prevented Even Worse Nuclear Disaster" https://youtu.be/vntKopJeeuo

Animation "Chernobyl Radiation" https://youtu.be/_USpAPkAd5A

Testimonials (Video)

#1 https://youtu.be/xACDtWlIntE

#2 https://youtu.be/v7DPtp16P3o

From the press

#1 https://www.bbc.com/news/world-europe-48580177

#2 https://www.bbc.com/future/article/20190725-will-we-ever-know-chernobyls-true-death-toll

#3 https://time.com/5255663/chernobyl-disaster-book-anniversary/

#4 https://www.theguardian.com/environment/2019/jun/16/chernobyl-was-even-worse-than-tv-series-kim-willsher

#5 https://www.theguardian.com/environment/2019/jun/07/chernobyl-now-i-was-not-afraid-of-radiation-a-photo-essay

#6 https://www.nationalgeographic.com/travel/destinations/europe/ukraine/exclusion-zone-chernobyl-ukraine/

#7 https://nsarchive.gwu.edu/briefing-book/nunn-lugar-russia-programs/2019-08-15/top-secret-chernobyl-nuclear-disaster-through-eyes-soviet-politburo-kgb-us-intelligence

#8 https://www.dianuke.org/secret-chernobyl-documents-expose-the-cover-up/

#9 https://www.deseret.com/1996/4/13/19236968/online-document-chernobyl-claiming-a-second-generation-of-victims

Living

#3 https://youtu.be/quYUNf7eCYg

#4 https://youtu.be/2mVgFAsvAyg

#5 https://youtu.be/_N8p-ujQXbQ

2.1.3. Discussion as a reaction to the stimulus

Students' first reactions to the material from 'A' are explored. General'.

Recorded thoughts, concerns, ideas, feelings, emotions

### 2.1.4. The basic concept(s)

Students further analyse and define the basic concept(s), based on questions, dictionary, etc., and try to find the real meaning of the concepts in a different context. The following material is used:

> PhET simulations Nuclear Fission & Radioactive Dating Game .

#### Thoughts

> The need for more electricity is growing worldwide (population growth, industrial, technological and urban use, etc.).

> Indeed, even countries that have not had a nuclear power programme intend to develop one in the future.

> New technology nuclear power plants are considered to be safer (for humans and the environment) than the 'older' ones - the ones that are now in operation.

> The more nuclear power we use to generate electricity, the less carbon and/or hydrocarbons we use, and that is definitely a plus.

> Even if 'minimal', there is always the risk of a nuclear accident (Note: The three worst nuclear accidents are considered to be those at Three Mile Island (USA) in 1997, Chernobyl (former USSR, now UKR) in 1986, and Fukushima Daiichi (JPN) in 2011), which can be magnified by a natural disaster event (such as earthquake, tsunami - see Fukushima Daiichi in 2011)

> And what about the radioactive waste? (e.g. sending them to the Sun is not a 'solution')

### 2.1.5. Theatrical techniques

In this phase, students explore and experience the topic through experiential theatre exercises of various genres/forms of theatre. In this teaching proposal, Documentary Theatre is proposed. By way of introduction, the following two activities are proposed:

#### A. Introductory Activities

* '*Energy Theater*' (Scherr et al., 2013).

This activity aims to consolidate the concept of energy through physical activity in the body.

The 'rules': 1. Each student is a unit of energy, 2. Each student has one form of energy at a time, 3. There are designated areas on the floor which correspond to objects, 4. Each student indicates the form of energy in some way (e.g. a gesture - our suggestion: using sign language), 5. Students move from one area to another as the energy is transferred and change the gesture (=form of energy) if it changes or make it more pronounced if the amount of a particular energy in a particular object or form increases (or decreases).

* *Radioactive Ping-Pong Balls* (link)

This activity aims to highlight teamwork to solve a problem.

The 'task' is to transfer... 'radioactive' ping pong balls from one place to another - e.g. from a box, a bag or a table - using only the 'right tools' (e.g. paper clips, straws, rubber bands, plastic spoons, pieces of tape). We suggest using (large) work gloves and protection (e.g. mask) for the eyes, mouth or whole face. Another suggestion is to work in the dark using 'black light' and suitable paint for ping pong balls.

## B. Document Theatre

Continuing in the implementation, it is good to mention that through the documentation performances we seek and aim at the most *direct* reference and engagement for the issues we are discussing in this teaching intervention as well as the promotion of *improvisation* and *imagination*. The material from the 'B. For Documentary Theatre'.

The 'steps'...

> It is noted that, although in this proposal there is ready/available documentation material (written material from the electronic press, audiovisual material from various sources, etc.), the teacher can ask the students to research and collect documents (e.g. oral histories of the past, passages of laws, conference proceedings).
Each group selects the documentation material it wishes to process and proceeds to analyse and edit it - looking for the points that will trigger actions and reactions. The aim is to create a theatrical text (one-person performance, representation for two or more characters). The 'first drawing' is produced

> The teams communicate the 'first drafts' to each other. Feedback - Suggestions - Reflections

> Each group discusses and comes up with the final text.

> Preparation (rehearsals)

> Presentation of projects.

>

### 2.1.6.Discharge

Students 'step out' of their roles as actors and first discuss how they felt and how they feel now.

A. How do you feel now?
How do you think person A/B ... feels now? How did it feel while in this dilemma?
How do you think each person in the project felt during their participation in it?
Was it easy to do? Why? Why not?
What did you notice about yourself doing this?
What would you do if you were person A or person B etc.?

B. Start with questions about emotions:
α) What was that for you?
b) How did you feel when you saw / heard / did this?

Γ. Now let the thoughts express themselves:
α) What came to your mind when you saw/heard/did this; b) What
connections do you see, if any?

D. Supporting questions
α) How do you know that?(Instead of "Why did you say that?" which could be seen
as an accusation rather than an actual question)
b) Can you elaborate or talk more about it? c) How does this affect our
lives, our relationships?
d) What would be the story behind it?

Throughout this activity, encourage people to be polite and considerate.

Q. Use paraphrasing of the words. For example, "I heard you say that....., did you mean ..... or ...".

F. Describe personal feelings instead of judging someone else's behaviour. For example, "I felt .... when you said/did ..." as opposed to "What you said was not OK

Z. Encourage people to observe their feelings as if they were observers. I often give an example: it's sort of an analogy of being like the sky and seeing the clouds (of thoughts) form different shapes. My role then shifts as if I were an observer of my feelings and thoughts.

H. Be aware of your feelings. Don't judge them. Notice what you notice.

### 2.1.7. Discussion for investigation

The teacher leads a discussion based on questions that develop critical thinking.

- Define the main issue (or disagreement): what do you think is ...?
- Where does this concept/phenomenon/term exist, in your opinion, at what level, (social) place, location and field? How widespread is it in the community and society?
- In what form / type do they exist?
- What are their consequences on a personal, local, national, social level?
- Is there an extreme form of this problem?
- What kind of solutions can you propose? Short-term, medium-term, long-term solutions?
- Are there many solutions? Are there permanent solutions?
- Do you think that making this problem public or sharing it with someone can help solve it or not? Why and how?
- What evidence can you present for / against ...?
- How ...as opposed to ...?
- How could you describe or map ...? Explain your answer with examples.
- Why is it ... important? Explain your reasoning.
- What are the advantages and disadvantages ...?
- How could you judge the accuracy ...?
- What are the differences between ... and ...?
- How is ... related to ...?
- Describe ... from the perspective of ....
- What do you think about .....? Explain your reasoning.
- When can..... be most useful and why?
- How could you create or design a new.....; Explain your thinking.
- What solutions could you propose to the problem..... ; What might be the most effective and why?
- What could happen if you combine ... and..... ;
- Do you agree that ; Why yes or why not?

> What information will you need to decide on ..... ;

> How you could prioritise .....;

> How it is ... an example .....;

> What are the most important parts or features of the .....;

> What details ..... are more important and why?

> What patterns do you observe in the ;

> How could you classify .....into a more/less general category?

> What does the important?

> What criteria could you use to assess..... ;

> How could they ... and..... work together? How do they work separately and together and with
different ways;

> Where is ... more / less..... ; Explain your reasoning.

### 2.1.8. Personalisation

The teacher invites the students to look at the whole issue from a personal point of view, in order to get more involved and mobilised.

- Have I been in a similar position or in a situation like this?
- From which angle have we 'illuminated' the issue?
- Why did we decide on this particular issue?
- What did I do, how did I react?
- How did I feel and how do I feel about it now?
- How do I feel now, after this conversation?
- Are there people I could consult on this issue?
- What is my main concern about the issue I wanted to share with others?
- What would I want, what do I wish to change?
- Can I create a personal Action Plan for this issue? (*Learn, Act, Share*)
- Have I heard of a similar or related situation? Where does it happen? What are the commonalities and what are the differences?
- What can we do today about similar situations?

### 2.1.9. Action Plan

Draw on the following material on the environment and existing case law and propose a 'roadmap' for action.

> 'Environment & STEM Education' *http://wp.me/p3oRiZ-fo*

'Environment's Laws' *https://4myfiles.wordpress.com/sd/yliko_e/nomoi_e/*

## 2.2 Infrastructure and available materials

- Enough space to act, like in a schoolyard.
- The texts and the (multi-)media we need (photos, videos).
- Computer (projector, internet access).

Some accessories that can be used for the needs of the roles.

## 2.3 Variations

If we have groups of 'experienced' students, we can use other types of theatre such as 'verbatim theatre', 'reality based theatre', 'theatre of witness' and 'theatre of fact'.

## 2.4 Challenges and problems

> Many students find it difficult to 'perform', to expose themselves in front of an audience.

> Many students find it difficult to share their problem in front of an audience.

> If there are students with disabilities and/or special educational needs, you must ensure the accessibility of the material.

> It is not easy to find reliable evidence (narratives, archived material, reports, interviews, videos, films, photographs, objects, maps, scientific research, laws, etc.).

This educational approach is not well known to teachers, students and parents/guardians.There may be a 'reaction to change'.

## 2.5. Further reading

HBO Trailer (https://www.newsweek.com/chernobyl-disaster-first-responders-true-story-deaths-radiation-1415722)

Infographics

https://www.compoundchem.com/2016/04/26/nuclear-reactors/ **

https://www.earthlymission.com/radioactive-fallout-from-the-chernobyl-disaster/?cn-reloaded=1 **

https://www.livescience.com/13858-chernobyl-nuclear-disaster-25-years.html

https://visual.ly/community/Infographics/environment/aftermath-chernobyl-disaster

https://www.graphicnews.com/en/pages/05647/chernobyl

> GoLab ILS "Radioactivity: is it always harmful to people? (link)

## 3. Evaluation of the educational scenario

> Evaluation-Recognition

> What did I like about this research?

> What was difficult for me in this research?

> How did I work?

> Am I satisfied with my performance?

> Am I satisfied with the performance of my team?

- Conclusions

Record thoughts, ideas, questions, conclusions and reflections after the implementation of the intervention. PROPOSE the next steps you want the group to take: Go deeper into the same topic or some aspect of the topic (e.g., seek out testimonies to record) or work on another topic.

- Extended from

> Science Café /Cinema : "Chernobyl" The TV series vs. The book

> Entertainment: The Radioactive Orchestra
http://www.nuclear.kth.se/radioactiveorchestra/

> Annual Allowance Calculationhttp://www.ans.org/pi/resources/dosechart/
& http://nuclearconnect.org/in-the-classroom/for-teachers/using-the-radiation-dose-chart

> Explore the connection between action heroes and villains in comics (link). Is there a connection to scientific biological data (link, link)? In 1962, *Peter Parker* became *Spider- Man* when he was bitten by a radioactive spider. *Matt Murdock* became *Daredevil* when he was hit in the eyes with a radioactive isotope, blinded but gained a "radar sense" and his other senses were enhanced to fight crime (Kakalios 2009). There are fragments coming from planets far far away (like ... Kryptonite) and what about the *Hulk* or the *X- men*?

> Radioactivity & Astrophysics. "[...] measurements on unstable isotopes in different parts of the universe, and to relate other astronomical and nuclear-physics measurements of very different kinds and corresponding theories to the astrophysical studies on nuclear-physics aspects of cosmic objects and evolutionary processes." (Diehl 2018)

1960: Xe-129 trapped gas in meteorites, 1995: Al-26 in AGB stars comes, 2006: Fe-60 & AGB stars