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| **Nuclear Chemistry Web Quest Inquiry** |

**Introduction:**

**ABC's of Nuclear Science** <http://www.lbl.gov/abc/Basic.html>

“Nuclear chemistry is the most powerful and misunderstood topic in chemistry. The mention of the word nuclear puts most people in fear and their first and sometimes only picture is that of a nuclear explosion.  What comes first to your mind when the term nuclear chemistry is brought up?  Are the bomb, nuclear power and radiation poisoning the only things nuclear chemistry has to offer?”

Completing this quest will allow you to understand many aspects of nuclear chemistry while also working with your classmates to determine your stance on a specific use of nuclear chemistry in our world.

There are many applications (uses) of nuclear chemistry today. Here is a list of a portion of them:

* Medicine:
  + - Treatment
    - Diagnosis
* Warfare:
* Reactors: Energy
* Scientific analysis:
  + - Radioactive Dating
    - Tracing
    - NMR (Nuclear magnetic resonance spectroscopy)
* Food and Agriculture:
  + - Insect Control
    - Food Preservation and Treatment
* Industrial Uses

**Goal:**  The end result of your quest will be an informed perspective from which to form an opinion **for** or **against** the use of nuclear chemistry in our world.

***Albert Einstein said:  "Concern for man and his fate must always form the chief interest of all technical endeavors.”***

**Resources:**

The following resources are additional good resources for your research:

[Nuclear Chemistry: An Introduction](http://www.visionlearning.com/library/module_viewer.php?mid=59)

[ABC’s of nuclear science](http://www2.lbl.gov/abc/Basic.html#Nuclearstructure)

[Nuclear disasters](http://content.time.com/time/photogallery/0,29307,1887705,00.html) in pictures

[Chernobyl disaster](http://www.world-nuclear.org/info/Safety-and-Security/Safety-of-Plants/Chernobyl-Accident/)

[Bombing of Hiroshima and Nagasaki videos](http://www.history.com/topics/world-war-ii/bombing-of-hiroshima-and-nagasaki/videos) (graphic images!!!)

[Bombing of Hiroshima and Nagasaki articles](http://www.history.com/topics/world-war-ii/bombing-of-hiroshima-and-nagasaki/videos)

[Nuclear medicine](http://content.time.com/time/photogallery/0,29307,1887705,00.html)

[Radiometric dating](http://paleobiology.si.edu/geotime/main/foundation_dating3.html)

[Food and agriculture](http://www.nei.org/Knowledge-Center/Other-Nuclear-Energy-Applications/Food-Agriculture)

[Nuclear power in the USA](http://www.world-nuclear.org/info/Country-Profiles/Countries-T-Z/USA--Nuclear-Power/)

[Nuclear power reactors](http://www.world-nuclear.org/info/Nuclear-Fuel-Cycle/Power-Reactors/Nuclear-Power-Reactors/)

[Atomic archive](http://www.atomicarchive.com/index.shtml)

[Alpha, beta and gamma decay](http://www.studyphysics.ca/2007/30/08_atomic/43_decay.pdf)

**Procedure:  This project has 5 sections.**

Your group has to complete all 5 five sections. Divide sections 1-3 among your group members to complete the research. For sections 4 and 5, work together. Use the individual research to complete the Nuclear power comparison worksheet (section 4). After your group formed an opinion about the usefulness of nuclear power, complete section 5.

**What are you going to turn in?**

* Sections 1-3 turn in a Word document. Follow the same numbering of questions. Due \_\_\_\_\_\_\_\_\_
* Sections 4 and 5. Turn in a Word document with section 5 on top and section 4 under. Due \_\_\_\_\_\_\_\_\_\_

Word document specifications: font size 12; 1.5 spacing, margins Normal. Do not copy the questions or include the hyperlinks, however answer all questions in complete sentences. DO NOT cut and paste from the Inernet!! Print the report and staple pages together. Heading must have names of all group members and a period number.

**Sections 1-5:**

**Section 1**:  Research about the **history** of nuclear chemistry. This must include:

1. The scientists involved in the advancement of nuclear chemistry
2. Stable vs. unstable nuclei (compare and contrast)
3. Types of radiation emitted during nuclear reactions (explain each type and write an example reaction)
4. Nuclear fission vs. nuclear fusion (Compare and contrast these two processes)

**Section 2:** Research about the **specific use** of nuclear chemistry. Pick one topic listed in **the Introduction**. You should research the following about your topic:

1. What are the nuclear reactions involved in this use of nuclear chemistry?
2. What is the purpose of this use of nuclear chemistry in our world?
3. What are the benefits of this use of nuclear chemistry in our world?
4. What are the detriments of this use of nuclear chemistry in our world?

**Section 3: Answer questions in Parts 3a – 3h**

**View the short video at**[**http://www.teachersdomain.org/resource/phy03.sci.phys.matter.everyday/**](http://www.teachersdomain.org/resource/phy03.sci.phys.matter.everyday/)

**Part 3a – Go to** <http://www.atomicarchive.com/Effects/index.shtml> or use another reliable source.

Answer the following questions:

1. What are the commonly used units to measure radiation dosage?
2. What is considered a lethal dose of radiation?
3. What are some of the common effects of radiation exposure?
4. What specifically happened to people in Hiroshima and Nagasaki?
5. What happened to the people of Chernobyl?

**Part 3b – Go to:** [**http://www.nrc.gov/about-nrc/radiation/rad-around-us.html**](http://www.nrc.gov/about-nrc/radiation/rad-around-us.html)

1. What are the natural and manmade sources of radiation? And what is the percentage for each?
2. What is the general dose of radiation per year?
3. Look at the Doses from Medical Procedures chart (under Doses in Our Daily Lives). Compare the doses a patient receives from X-rays and from a CT scan to the yearly radiation dose.
4. Calculate the Personal Annual Radiation Dose for 2 of your group members.  List the name and the dose: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
5. How much does the NRC (Nuclear Regulatory Commission) allow you to be exposed to each year?

**Part 3c – Go to:** [**http://www.nei.org/CorporateSite/media/filefolder/California-State-Fact-Sheet-2014.pdf?ext=.pdf**](http://www.nei.org/CorporateSite/media/filefolder/California-State-Fact-Sheet-2014.pdf?ext=.pdf) **and** [**http://www.world-nuclear.org/info/Country-Profiles/Countries-T-Z/USA--Nuclear-Power/**](http://www.world-nuclear.org/info/Country-Profiles/Countries-T-Z/USA--Nuclear-Power/)

1. What are the sources of energy in California?
2. Why is nuclear energy “clean air energy”?
3. CO2 emissions contribute to global warming. Compare and contrast CO2 emissions produces by burning fossil fuels (goal and natural gas) to nuclear energy.
4. What is the USA global position in producing nuclear energy?
5. How much nuclear energy is now produced in the USA?
6. What is the projections on building new nuclear power plants?

**Part 3d – Go to:** [**http://www.radiologyinfo.org/en/info.cfm?pg=gennuclear**](http://www.radiologyinfo.org/en/info.cfm?pg=gennuclear)

1. How is nuclear medicine useful in diagnosing illnesses?
2. How is nuclear medicine useful in treating illnesses?

**Part 3e - Go to** [**http://www.howstuffworks.com/nuclear-power.htm**](http://www.howstuffworks.com/nuclear-power.htm) **and**

**View the short video at  <http://www.teachersdomain.org/resource/phy03.sci.phys.energy.fission/>**

1. What is the major source of energy in a nuclear reactor?
2. Describe what happens in nuclear fission.
3. How does a nuclear plant work?
4. List 3 hazards of nuclear power.

**Part 3f -  Go to** [**https://en.wikipedia.org/wiki/Thermonuclear\_weapon**](https://en.wikipedia.org/wiki/Thermonuclear_weapon)

**View the short video at** [**http://www.teachersdomain.org/resource/phy03.sci.phys.matter.fusionbomb/**](http://www.teachersdomain.org/resource/phy03.sci.phys.matter.fusionbomb/)

1. What nuclei are fused in the nuclear reaction of a hydrogen bomb?
2. What function does Styrofoam perform in a hydrogen bomb?
3. Describe the reaction in a fusion bomb?

**Part 3g – Go to** [**Nuclear chemistry and radiation**](http://edtech2.boisestate.edu/lindabennett1/502/Nuclear%20Chemistry/types%20of%20decay.html)[**Alpha and beta decay**](http://www.chemteam.info/Radioactivity/Writing-Alpha-Beta.html) **or another site, complete the following chart**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Alpha particles | Beta particles | Gamma radiation |
| Definition |  |  |  |
| Charge |  |  |  |
| Symbol |  |  |  |
| Penetrating power |  |  |  |
| Stopped by |  |  |  |
| Radioactive decay (explain the process, what is the end product) |  |  |  |
| Equation for radioactive decay (example): |  |  |  |

**Part 3h - Define following terms (do not just copy and paste, rewrite the definitions, so they are easy to understand):**

Radioactivity:

Radiation:

Radioisotopes:

Nuclear Force:

Natural Radioactive Decay:

Artificial Transmutation:

Alpha Particle:

Beta Particle:

Gamma Radiation:

Fusion:

Fission:

Half time:

Fuel rods:

Uranium-235:

Enriched uranium:

Control rods:

Neutron:

**Section 4:** Use the Nuclear power comparison worksheet (Next page below) to write down facts **for and against** the use of nuclear power (always list the source next to the fact). As a group discuss your findings and decide where does your group stand: **for or against nuclear power**.

**Section 5:** As a group, write a persuasive argument explaining your stand. You have to use facts from the Nuclear power comparison worksheet (section 4) to support your argument. It can be in any written form. For example, your group may choose to do a pamphlet, a newspaper article, an essay, speech or any other written form of communication you choose.

**Section 4:**

**Nuclear power comparison worksheet**

|  |  |
| --- | --- |
| **Facts FOR using nuclear power** | **Facts AGAINST using nuclear power** |
|  |  |

Based on the data above, our group agrees that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

­­­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.