Last Name, First Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Per: \_\_\_\_

**Types of Nuclear Change Notes**

**NGSS Standard:** HS-PS1-8. Develop [qualitative] models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.

**Essential Questions:** 1.What is binding energy and what is its significance to stability of an atom?

2. Who discovered radioactivity?

3. How can N/Z number help us to understand the stability of an isotope?

4. What is nuclear fission?

5. Why are nuclear fission reactions used in nuclear power plants and not nuclear fusion reactions?

**Thinking Side: Main Notes Side:**

**The discovery of radioactivity:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ was an important person in the discovery of radioactivity.

Born in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. She was the \_\_\_\_\_\_\_\_\_\_ female lecturer, professor, and lab head. She was awarded \_\_\_\_\_ Nobel prizes. She discovered \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_.

**Binding Energy:** When protons and neutrons that are far apart come together and form a nucleus, \_\_\_\_\_\_\_\_\_\_\_

This makes the nucleus at a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy state than the protons and neutrons were before they became the nucleus.

What does a lower energy state mean? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What does binding energy mean? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

What is a nucleon? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Radioativity: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 What does N/Z mean: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**3 Types of Beta Decay:**

1. **Electron emission:**

You draw it:

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1. **Electron capture:**

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1. **Positron Emission:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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What is a matter-antimatter

anhialiation?

**Alpha Decay:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Nuclear Fission:**

 Occurs when very \_\_\_\_\_\_\_\_ nuclei are \_\_\_\_\_\_

 into \_\_\_\_\_\_\_\_\_\_\_\_\_ nuclei, each \_\_\_\_\_\_\_ stable than the original \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

 Some nuclei undergo fission \_\_\_\_\_\_\_\_\_\_\_\_\_\_

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 ( \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)

What are chain reactions? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Why is it called Uranium-235? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Nuclear Power Plants:** use \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ as their radioactive isotopes.

Drawing of a Nuclear Power Plant: Nuclear power plants use nuclear \_\_\_\_\_\_\_\_\_

 reactions to produce electrical energy.

In a nuclear reactor, they have \_\_\_\_\_\_\_ \_\_\_\_ that are surrounded by a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The point of the moderator is to \_\_\_\_\_\_down \_\_\_\_\_\_\_\_\_\_\_\_\_\_. \_\_\_\_\_\_\_\_\_\_\_\_ rods are used to control the rate of the \_\_\_\_\_\_\_\_\_\_ reactions. The control rods absorb some \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that are emitted by fission reactions. By moving these rods in and out of the number of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ available for the chain reactions.

Water’s role in cooling nuclear Water is used to cool the nuclear reactors so they do not over-heat and explode. The

reactors: water is pumped around the reactor and it is heated up into steam. The steam goes through a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. It changes the steam from its \_\_\_\_\_\_\_\_\_\_\_\_ form into \_\_\_\_\_\_\_\_.

Lise Meitner: 1923: She discovered the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ effect. It’s not named after her.

 1939: She published the physical explanation for the observations with her nephew and they named the process \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

What is the Manhattan Project? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Nuclear Fusion:** When \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ nuclei \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. They combine to form a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ nucleus.

 The new nucleus has a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ binding energy per \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ than the \_\_\_\_\_\_\_ nuclei did. This means it’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ stable because it would take \_\_\_\_\_\_\_ energy to remove a nucleon (a nucleon is just a \_\_\_\_\_\_\_\_\_\_\_\_\_ or a \_\_\_\_\_\_\_\_\_\_\_\_\_ ).

 The sun runs on nuclear \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Problems of fusion reactions: It takes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of energy to start a nuclear fusion reaction. It takes just as much energy to \_\_\_\_\_\_\_\_\_\_\_\_\_\_ the reaction as is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by the reaction.

 Finding a suitable place to perform a nuclear fusion reaction is difficult.

 The reactants are in the form of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Plasma is a random mixture of \_\_\_\_\_\_\_\_\_\_\_ nuclei and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. No form of \_\_\_\_\_\_\_\_\_\_ matter can withstand the tremendous temperatures required for \_\_\_\_\_\_\_\_\_\_\_\_ to occur. This makes plasma hard to contain.

What are scientists currently using? Strong \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ fields to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the charged \_\_\_\_\_\_\_\_\_\_\_\_\_\_ particles.

This keeps the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the walls of its container. If it touches the walls of the container, it will destroy the container.

**Summary:**