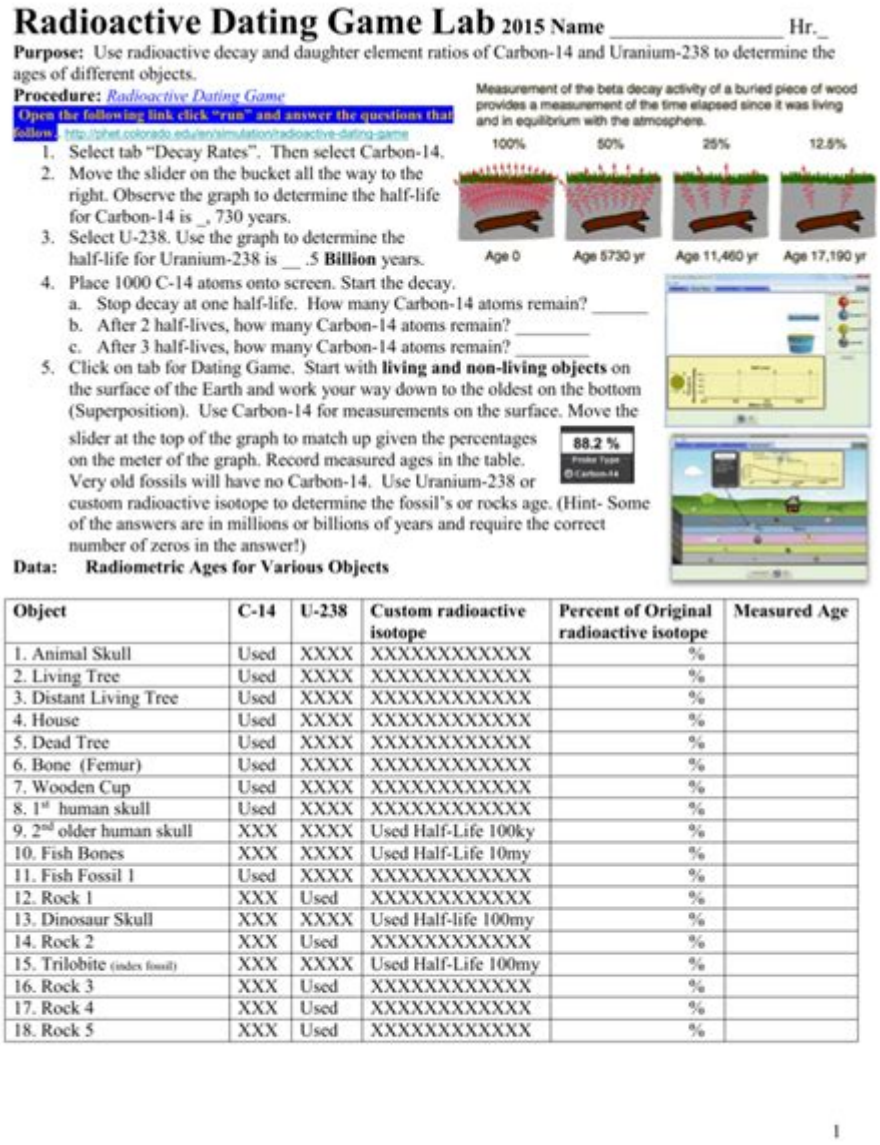
Phet Radioactive Dating Game Lab Answer Key



Radioactive Dating Game Lab 2015 Name _____ Hr._

Purpose: Use radioactive decay and daughter element ratios of Carbon-14 and Uranium-238 to determine the ages of different objects.

Procedure: *Radioactive Dating Game*

Open the following link click "run" and answer the questions that follow: http://phet.colorado.edu/en/simulation/radioactive-dating-game

1. Select tab "Decay Rates". Then select Carbon-14.
2. Move the slider on the bucket all the way to the right. Observe the graph to determine the half-life for Carbon-14 is _, 730 years.
3. Select U-238. Use the graph to determine the half-life for Uranium-238 is __ .5 **Billion** years.
4. Place 1000 C-14 atoms onto screen. Start the decay.
   a. Stop decay at one half-life. How many Carbon-14 atoms remain? _____
   b. After 2 half-lives, how many Carbon-14 atoms remain? _____
   c. After 3 half-lives, how many Carbon-14 atoms remain? _____
5. Click on tab for Dating Game. Start with **living and non-living objects** on the surface of the Earth and work your way down to the oldest on the bottom (Superposition). Use Carbon-14 for measurements on the surface. Move the slider at the top of the graph to match up given the percentages on the meter of the graph. Record measured ages in the table. Very old fossils will have no Carbon-14. Use Uranium-238 or custom radioactive isotope to determine the fossil's or rocks age. (Hint- Some of the answers are in millions or billions of years and require the correct number of zeros in the answer!)

Measurement of the beta decay activity of a buried piece of wood provides a measurement of the time elapsed since it was living and in equilibrium with the atmosphere.

100% 50% 25% 12.5%

Age 0 Age 5730 yr Age 11,460 yr Age 17,190 yr

88.2 %

Data: Radiometric Ages for Various Objects

Object	C-14	U-238	Custom radioactive isotope	Percent of Original radioactive isotope	Measured Age
1. Animal Skull	Used	XXXX	XXXXXXXXXXX	%	
2. Living Tree	Used	XXXX	XXXXXXXXXXX	%	
3. Distant Living Tree	Used	XXXX	XXXXXXXXXXX	%	
4. House	Used	XXXX	XXXXXXXXXXX	%	
5. Dead Tree	Used	XXXX	XXXXXXXXXXX	%	
6. Bone (Femur)	Used	XXXX	XXXXXXXXXXX	%	
7. Wooden Cup	Used	XXXX	XXXXXXXXXXX	%	
8. 1st human skull	Used	XXXX	XXXXXXXXXXX	%	
9. 2nd older human skull	XXX	XXXX	Used Half-Life 100ky	%	
10. Fish Bones	XXX	XXXX	Used Half-Life 10my	%	
11. Fish Fossil 1	Used	XXXX	XXXXXXXXXXX	%	
12. Rock 1	XXX	Used	XXXXXXXXXXX	%	
13. Dinosaur Skull	XXX	XXXX	Used Half-life 100my	%	
14. Rock 2	XXX	Used	XXXXXXXXXXX	%	
15. Trilobite (index fossil)	XXX	XXXX	Used Half-Life 100my	%	
16. Rock 3	XXX	Used	XXXXXXXXXXX	%	
17. Rock 4	XXX	Used	XXXXXXXXXXX	%	
18. Rock 5	XXX	Used	XXXXXXXXXXX	%	

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Radioactive dating is a fascinating process used by scientists to determine the age of materials such as rocks and fossils. The PHET Radioactive Dating Game is an interactive simulation that allows students and enthusiasts to explore the principles of radioactive decay and half-lives in an engaging and educational way. This article delves into the mechanics of the game, the scientific principles behind radioactive dating, and provides a comprehensive answer key to enhance learning and understanding.

Understanding Radioactive Dating

Radioactive dating is a method used to date materials by determining the decay of radioactive isotopes present within them. This technique is crucial for understanding geological time scales and the age of archaeological

artifacts.

Key Concepts in Radioactive Dating

1. Radioactive Isotopes: These are unstable isotopes that decay over time into stable forms. Common isotopes used in dating include Carbon-14, Uranium-238, and Potassium-40.

2. Half-Life: This is the time required for half of the radioactive substance to decay into its stable form. Different isotopes have different half-lives, making them suitable for dating different types of materials.

3. Parent and Daughter Isotopes: The original radioactive isotope is referred to as the parent isotope, while the product of its decay is called the daughter isotope.

The PHET Radioactive Dating Game

The PHET Radioactive Dating Game is an educational simulation designed to help students understand the concepts of radioactive decay and the calculations involved in dating materials. The game allows players to engage in a virtual environment where they can manipulate variables and observe outcomes.

Game Objectives

- Learn about radioactive isotopes and their decay processes.
- Understand how half-lives work and how they are calculated.
- Apply knowledge of radioactive dating to determine the ages of different samples.

Game Mechanics

- Selection of Isotope: Players choose which radioactive isotope to study, such as Carbon-14 or Uranium-238.

- Decay Process: Players observe the decay of the isotope over time, tracking the amount of parent and daughter isotopes.

- Graphical Representation: The game provides visual graphs that depict the decay process, making it easier to understand the concept of half-lives.

- Dating Samples: Players can apply their knowledge to date various samples and compare their results with known ages.

Answer Key to the PHET Radioactive Dating Game Lab

Understanding the answers related to the PHET Radioactive Dating Game can significantly enhance the learning experience. Below is a detailed answer key that reflects the various scenarios and questions that players may encounter.

Sample Questions and Answers

1. What is the half-life of Carbon-14?
- Answer: The half-life of Carbon-14 is approximately 5730 years. This means that after 5730 years, half of the original amount of Carbon-14 will have decayed into Nitrogen-14.

2. How do you determine the age of a sample?
- Answer: To determine the age of a sample, measure the ratio of parent to daughter isotopes. Use the known half-life of the parent isotope to calculate how many half-lives have passed, and multiply that number by the half-life duration.

3. If a sample contains 25% Carbon-14, how many half-lives have passed?
- Answer: If a sample contains 25% Carbon-14, two half-lives have passed. Starting with 100%, after the first half-life, it would contain 50%, and after the second half-life, it would contain 25%.

4. What materials can be dated using Carbon-14?
- Answer: Carbon-14 is effective for dating organic materials, such as bones, wood, and other carbon-containing substances, typically up to about 50,000 years old.

5. What is the significance of the decay constant?
- Answer: The decay constant (λ) is a value that represents the probability of decay of a radioactive isotope per unit time. It is crucial for calculating the age of a sample based on the ratio of parent to daughter isotopes.

Advanced Scenarios

As players progress through the PHET Radioactive Dating Game, they may encounter more complex scenarios. Here are some advanced questions and answers:

1. If a rock sample originally had 1000 atoms of Uranium-238 and currently has 125 atoms left, how long has it been since the rock formed? (Half-life of Uranium-238 is 4.5 billion years)
- Answer: The remaining 125 atoms represent 1/8 of the original 1000 atoms, indicating that three half-lives have passed (1000 -> 500 -> 250 -> 125). Thus, the age of the rock is 3 x 4.5 billion years = 13.5 billion years.

2. Explain how temperature affects the decay rate of radioactive isotopes.
- Answer: The decay rate of radioactive isotopes is not significantly affected by temperature, pressure, or chemical state. Radioactive decay is a nuclear process and occurs at a constant rate over time.

3. What are the limitations of Carbon-14 dating?
- Answer: Limitations include:
- Effective dating range is limited to about 50,000 years.
- Contamination can affect results.
- It can only be used on organic materials.

Conclusion

The PHET Radioactive Dating Game serves as an excellent educational tool, providing learners with a solid foundation in the principles of radioactive decay and dating techniques. By engaging with the simulation and studying the answer key provided, students can gain a deeper understanding of how scientists determine the age of materials and the significance of half-lives in this process. Mastery of these concepts not only reinforces scientific principles but also encourages curiosity about the natural world and its history.

Frequently Asked Questions

What is the purpose of the PhET Radioactive Dating Game lab?

The purpose of the PhET Radioactive Dating Game lab is to help students understand the principles of radioactive decay and how it is used to date fossils and rocks.

How does radioactive dating work in the PhET simulation?

In the PhET simulation, radioactive dating works by allowing users to observe the decay of radioactive isotopes over time and use the remaining amount to calculate the age of a sample.

What isotopes are commonly featured in the PhET Radioactive Dating Game?

Common isotopes featured in the PhET Radioactive Dating Game include Carbon-14, Uranium-238, and Potassium-40, each serving different dating purposes.

What key concept should students understand about half-life in the simulation?

Students should understand that half-life is the time required for half of the radioactive atoms in a sample to decay, which is a critical concept for dating materials.

Can the PhET Radioactive Dating Game be used for real-life applications?

Yes, the PhET Radioactive Dating Game can be used to illustrate real-life applications of radioactive dating in fields like archaeology, geology, and paleontology.

What skills can students develop by using the PhET Radioactive Dating Game?

Students can develop skills in critical thinking, data analysis, and an understanding of scientific methods through experimentation and observation in the simulation.

Is the PhET Radioactive Dating Game suitable for all age groups?

Yes, the PhET Radioactive Dating Game is designed for a wide range of educational levels, making it suitable for middle school students and up.

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