

RADIOACTIVE DECAY

Cornell Doodle Notes TEACHER NOTES

These scaffolded Cornell Doodle Notes combine two effective note-taking strategies and can be used to introduce the concepts of radioactivity and half-life, and the three types of radioactive decay (alpha, beta, and gamma). These notes support NGSS HS-PS1-8 (Develop 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.)

Cornell Notes are a note-taking strategy in which topic questions are written in a narrow left-hand column and definitions, explanations, and diagrams are filled in in the right-hand column. At the bottom of Cornell Notes, there is typically a section included for reflection on the lesson's main points. See the example to the right.

The top image shows a template for Cornell Doodle Notes. It has three main sections: 'CUES' (left), 'NOTES' (right), and a bottom section for reflection. The 'CUES' section includes boxes for 'WRITTEN SOON AFTER CLASS', 'ANTICIPATED EXAM QUESTIONS', 'MAIN IDEAS OR PEOPLE', 'VOCABULARY WORDS', and 'USED FOR REVIEW & STUDY'. The 'NOTES' section includes a box for 'TAKEN DURING CLASS' with bullet points: 'MAIN POINTS', 'BULLET POINTS', 'DIAGRAMS/CHARTS', 'ABBREVIATE/CHARTS', 'PARAPHRASE', 'OUTLINES', and 'LEAVE SPACE BETWEEN TOPICS'. The bottom section is labeled 'CORNELL NOTE-TAKING METHOD'.

The bottom image shows a completed Cornell Doodle Note page titled 'Radioactive Decay'. It includes an 'ESSENTIAL QUESTION' box, 'TOPIC QUESTIONS' numbered 1 and 2, and a 'VOCAB' section with illustrations of atoms and particles. The page is filled with handwritten text and drawings related to radioactive decay.

Doodle Notes (or Sketch Notes) are another note-taking strategy for which pictures and graphics activate the visual pathways of the brain, which helps with retention of information when compared to standard note-taking. Your visual learners will really benefit from seeing and coloring in the pictures aside the main points of the notes!

Doodle Notes is a registered trademark used with permission. See DoodleNotes.org for more details.

This is a sample of Radioactive Decay Cornell Doodle Notes. It features an 'ESSENTIAL QUESTION' box asking 'How do unstable atoms behave?'. Below it is a large drawing area containing a stylized atomic symbol.

I created a Powerpoint that goes with these notes. The Powerpoint walks the students through the lesson from the Essential Question and through all of the Topic Questions. There is a "Sum It Up" page at the end of the notes, for which students practice applying the concepts. On that page there is also a great 'Quick Watch' TED Ed video on radioactive decay that students will view. They will answer questions about the video to help sum up the new learning.



SEE THE PRINTING TIPS ON NEXT PAGE

On the following pages, you will find 4 versions of the Cornell Doodle Notes:

KEY

The KEY : pages 4-8 : All notes and "answers" are included on this version



Green Circle : pages 9-13 : Use this version for your lower-level students who need more support, take more time, or who are learning English as a second language...they will have to fill in missing words



Blue Square : pages 14-18 : Use this version for your mainstream students...they will have to write each of the topic questions and fill in more of the words and sentences throughout



Black Diamond: pages 19 -23 : Use this version for your high-level students who work more quickly or who like to write in their own handwriting...they will have to fill in almost all of the text throughout the notes

Note: the "Sum It Up" page is the same for all student versions.

On the next page are the directions for accessing the Powerpoint for this product via Google Drive (Google Slides). This is obviously option depending on how you choose to use this in your classroom.

Here are some ways that I suggest using this resource:

- 1) Whole-Group lesson with differentiation : decide which students should receive which level of the notes. Hand out the notes to the students. Use the Powerpoint as a presentation and talk aloud through the lesson while the students take notes. Allow them to color/doodle further during and at the end of the lesson.
- 2) Differentiated Small-Group lesson : separate your students into groups by learning level. Give each student group sets of the appropriate notes for their level. Make sure each group has a device to view the presentation. Post the Powerpoint or Google Slides to your Google Classroom or other online learning platform, or email the Powerpoint version to one 'student leader' in each group. The students would view the Powerpoint/Slides together on one device and fill in the notes. Encourage them to add color/further notes.
- 3) Individual Note-Taking or Flipped Classroom : Post the Powerpoint or Google Slides presentation to your Google Classroom or other online learning platform. Hand out the appropriate-level notes to each student. Students can work at their own pace to view the presentation and complete their notes. Encourage them to add color/further notes.

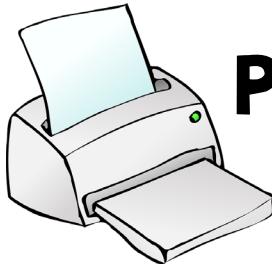
Thank you very much for your purchase! If this product has met your needs, please consider leaving feedback at TeachersPayTeachers.com. I read each and every feedback and I appreciate your time. Also please feel free to email me at SunriseScienceTPT@gmail.com with any questions or concerns! © Sunrise Science 2018

You may also be interested in my other Cornell Doodle Notes products! Click on the picture to the right!



Thank you to these amazing artists!





PRINTING TIPS!

It depends how you'd like your students to use these notes. They can be printed one-sided and folded up into an interactive notebook, or you can print them double-sided and have students keep them in binders/folders.

If you print them double-sided, this is what I suggest doing:

- In the print settings on Adobe/Reader, keep the "Auto Orientation" button selected
- Click "FLIP ON LONG EDGE"
- Type in the page numbers that you'd like to print and the number of copies
- You can also print the pages one-sided and run them double-sided through your school's copy machine!

Printing the notes this way will avoid your students having to rotate their paper when they go to the next side. Instead, they will flip and the left and right columns will be in the same place!

EXAMPLE COLORED NOTES

GOOGLE DRIVE DIRECTIONS

Below are some instructions for how to download this product and share it with your students via Google Drive. Just a note- although this is a digital resource, please know that it is for personal classroom use for only you and your students to share via email, Google Drive, or Google Classroom. Please do not upload this resource online where it can be accessed by the general public.

CLICK ON THIS LINK TO ACCESS YOUR PURCHASE IN GOOGLE!:
<https://tinyurl.com/ybttx3ock>

When you click the link above, you'll be taken to a screen that says "Copy Document". Click the blue button that says "Make a Copy". This will transfer the file to your own Google Drive account.

Preferably, share this resource with your students through your Google Classroom, OR once all of your students have their own Google Drive account (drive.google.com), share the above link with them and have them make their own copy of the assignments into their own Google Drive.

Name: _____

Class: _____

Date: _____

KEY

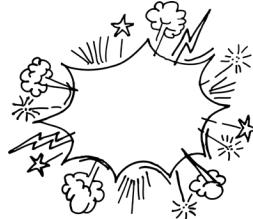
Radioactive Decay

**ESSENTIAL
QUESTION:**

How do unstable atoms behave?

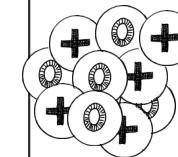
VOCAB

spontaneous

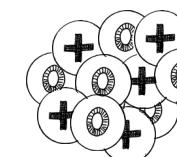


Happens by itself and releases energy.

isotope



Boron-10



Boron-11

Atoms of the same element with different numbers of neutrons.

frequency



Rate per second of vibration of a wave. Radio waves vibrate at certain frequencies.

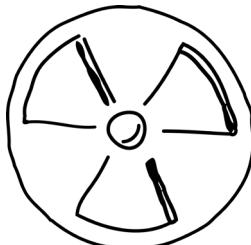
TOPIC QUESTIONS:

1

What is radioactivity?



It was discovered and named by Marie Curie, who won the Nobel Prize in Physics in 1903.

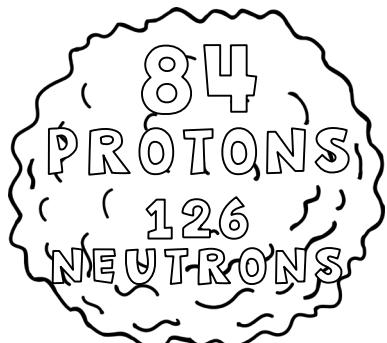


The universal symbol for a radioactive substance.

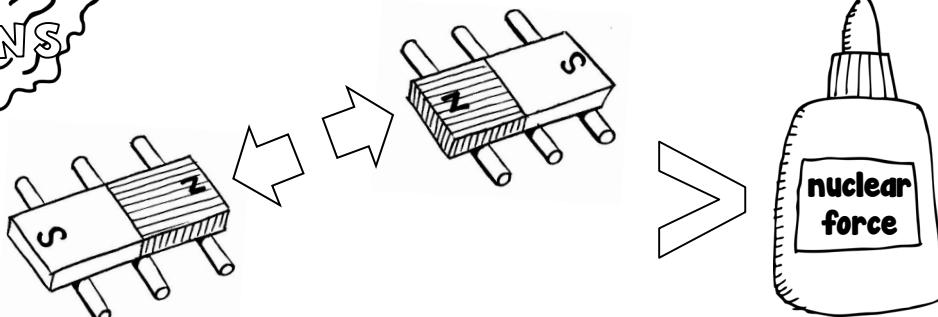
2

Why are some atoms unstable?

POLONIUM-210



In BIG atoms with a lot of protons, this repulsion causes instability!



TOPIC QUESTIONS:

3

Which elements have radioactive isotopes?



All isotopes of Technetium (#43), promethium (#61), and all elements with atomic number greater than 83 (bismuth) are radioactive. These are called radioisotopes.

Many other elements have at least one radioisotope, including carbon, sodium, and iodine.

On the periodic table, circle or highlight the elements whose isotopes are all radioactive.

Do

1 H	2 He	13 B	14 C	15 N	16 O	17 F	10 Ne
Hydrogen 1.008	Helium 4.003	Boron 10.811	Carbon 12.011	Nitrogen 14.007	Oxygen 16.999	Fluorine 18.998	Neon 20.190
3 Li	4 Be	5 C	6 N	7 O	8 F	9 Ne	10 Ar
Lithium 6.941	Beryllium 9.012	Carbon 12.011	Nitrogen 14.007	Oxygen 16.999	Fluorine 18.998	Neon 20.190	Argon 39.948
11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
Sodium 22.990	Magnesium 24.305	Aluminum 26.982	Silicon 30.974	Phosphorus 30.974	Sulfur 32.066	Chlorine 35.453	Krypton 83.820
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe
Potassium 39.098	Calcium 40.078	Scandium 44.956	Titanium 47.88	Vanadium 50.942	Chromium 51.995	Manganese 54.938	Iron 55.933
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru
Rubidium 84.4468	Strontronium 87.52	Yttrium 89.0000	Zirconium 91.224	Niobium 92.906	Molybdenum 95.954	Technetium 95.907	Ruthenium 101.07
55 Cs	56 Ba	57 Lu	58 Hf	59 Ta	60 W	61 Re	62 Os
Cesium 132.905	Barium 137.327	Lutetium 174.967	Hafnium 178.49	Tantalum 180.948	Tungsten 183.85	Rhenium 185.207	Osmium 190.23
87 Fr	88 Ra	103 Lr	104 Rf	105 Db	106 Sg	107 Bh	108 Hs
Francium 223.020	Radium 226.025	Lawrencium 262	Rutherfordium 261	Dubnium 262	Seaborgium 265	Berkeleyium 264	Hassium 269
57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd
Lanthanum 138.906	Cerium 140.115	Praseodymium 141.908	Neuropium 144.24	Neptunium 144.918	Samarium 150.36	Euroopium 151.960	Gadolinium 157.925
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm
Actinium 227.028	Thorium 232.038	Protactinium 231.039	Uranium 238.029	Neptunium 237.049	Plutonium 244.064	Americium 243.061	Curium 247.070
97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Ts	104 Og
Berkelium 251.080	Cferrium 251.080	Einsteinium 254.054	Fermium 257.098	Mendeleevium 258.1	Nobelium 259.101	Tserrium 259.087	Oganesson 289.018

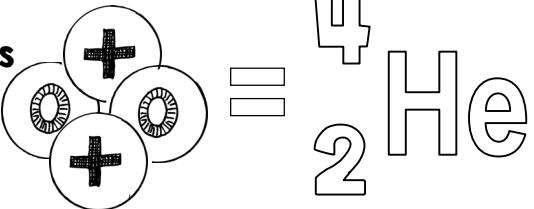
4

What are the types of radioactive decay?

Alpha Decay

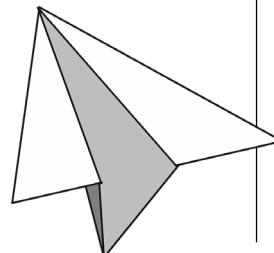
Symbolized by the Greek letter alpha

The unstable nucleus emits a helium nucleus (2 protons & 2 neutrons)!



The alpha particle is relatively large and slow.

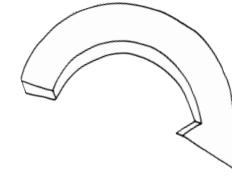
It can be shielded by a piece of paper.



The Most Genius Table

1 H	2 He	13 B	14 C	15 N	16 O	17 F	10 Ne
Hydrogen 1.008	Helium 4.003	Boron 10.811	Carbon 12.011	Nitrogen 14.007	Oxygen 16.999	Fluorine 18.998	Neon 20.190
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Potassium 39.098	Calcium 40.078	Scandium 44.956	Titanium 47.88	Vanadium 50.942	Chromium 51.995	Manganese 54.938	Iron 55.933
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru
Rubidium 84.4468	Strontronium 87.52	Yttrium 89.0000	Zirconium 91.224	Niobium 92.906	Molybdenum 95.954	Technetium 95.907	Ruthenium 101.07
55 Cs	56 Ba	57 Lu	58 Hf	59 Ta	60 W	61 Re	62 Os
Cesium 132.905	Barium 137.327	Lutetium 174.967	Hafnium 178.49	Tantalum 180.948	Tungsten 183.85	Rhenium 185.207	Osmium 190.23
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Francium 223.020	Radium 226.025	Lawrencium 262	Rutherfordium 261	Dubnium 262	Seaborgium 265	Berkeleyium 264	Hassium 269
57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd
Lanthanum 138.906	Cerium 140.115	Praseodymium 141.908	Neuropium 144.24	Neptunium 144.918	Samarium 150.36	Euroopium 151.960	Gadolinium 157.925
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm
Actinium 227.028	Thorium 232.038	Protactinium 231.039	Uranium 238.029	Neptunium 237.049	Plutonium 244.064	Americium 243.061	Curium 247.070
97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Ts	104 Og
Berkelium 251.080	Cferrium 251.080	Einsteinium 254.054	Fermium 257.098	Mendeleevium 258.1	Nobelium 259.101	Tserrium 259.087	Oganesson 289.018

Transmutations



Beta Decay

Symbolized by the Greek letter beta

B

A neutron becomes a proton and a fast electron gets emitted!

0 e -1

Remember, electrons have no mass and a charge of negative one.

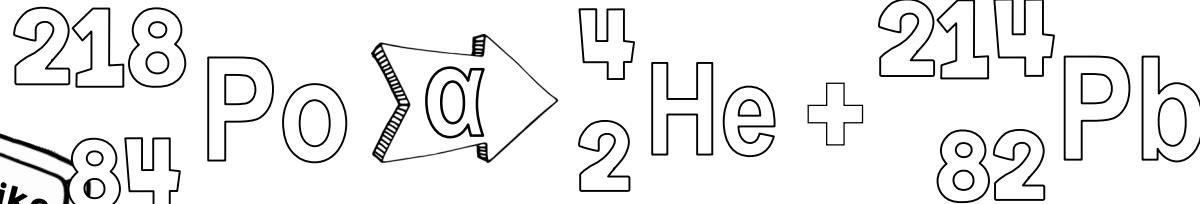


The beta particle can be shielded by aluminum foil.

TOPIC QUESTIONS:

5

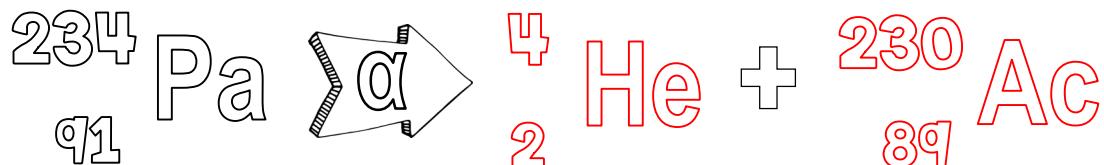
How does a radioactive atom change during an alpha decay?

Alpha Decay α 

**Polonium-218 lost 2 protons to become a lead nucleus.
It also lost 2 neutrons, so its mass was decreased by 4.**



Try finding the daughter isotope in the alpha decay below!

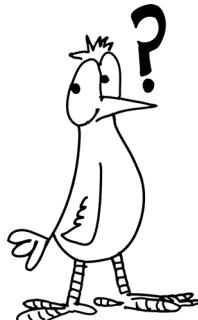
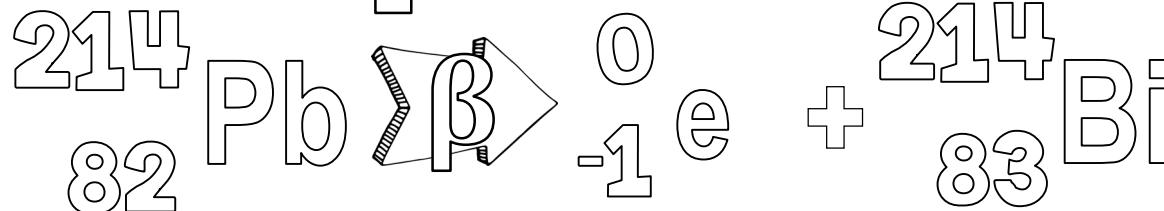


6

How does a radioactive atom change during a beta decay?

Beta Decay β

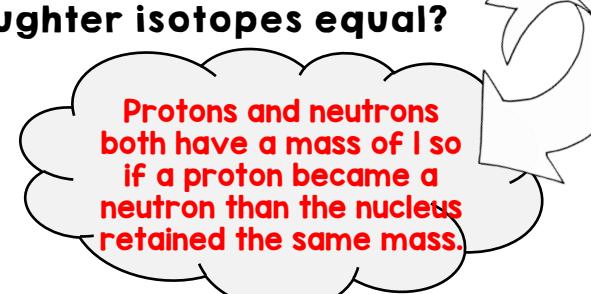
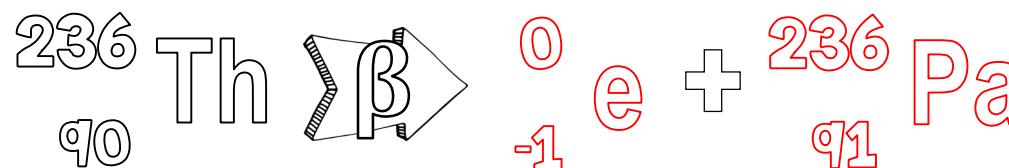
A neutron in the parent isotope becomes a proton and ejects an electron.



Lead-214 lost a neutron but gained a proton to become a bismuth nucleus. Why are the mass of the parent and daughter isotopes equal?

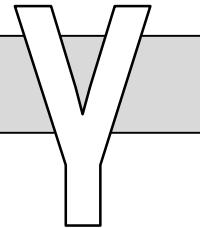


Try finding the daughter isotope in the beta decay below!



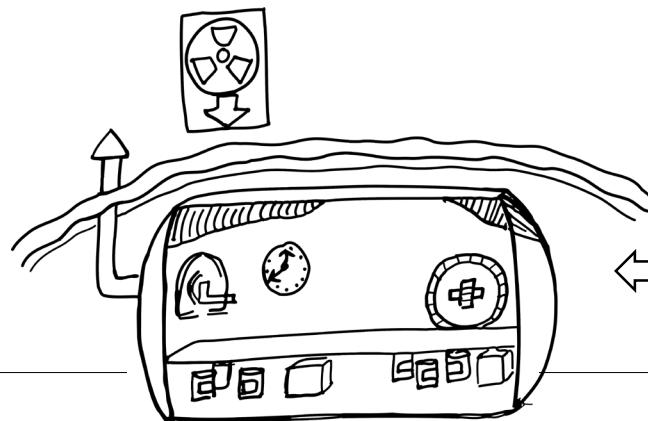
TOPIC QUESTIONS:**7**

What is the third type of radiation associated with radioactive decay?

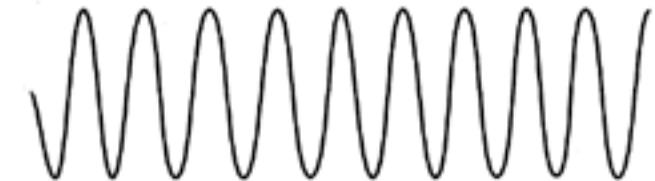
Gamma Rays

Symbolized by the Greek letter gamma

Accompanies both alpha and beta decay.



High frequency electromagnetic radiation which travel at the speed of light.

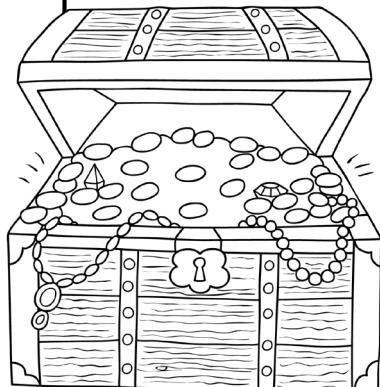


Can only be shielded by lead 1.5 feet thick or by concrete 6.5 feet thick!

Nuclear fallout shelters were meant to protect people from the threat of gamma radiation after a nuclear explosion.

8

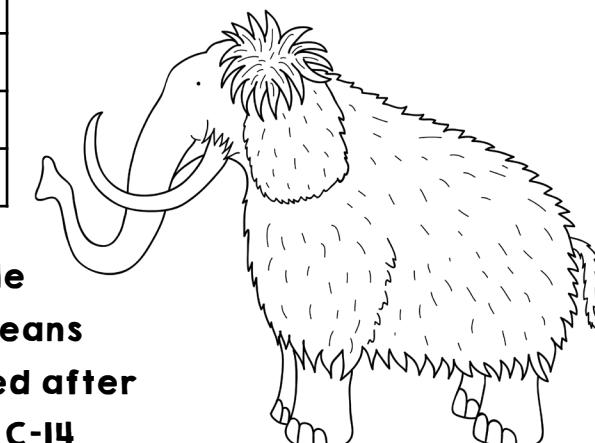
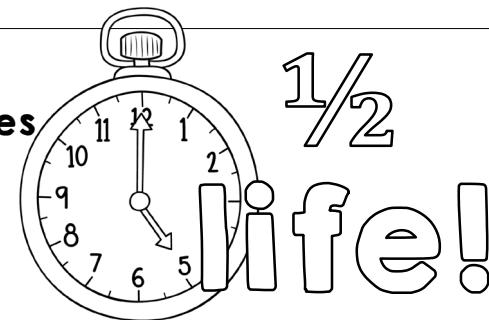
How quickly do radioactive isotopes decay?



It's like if you had to give up half of your treasure every 2 days until you had just one coin left.

Half Life of Some Radioisotopes	
Polonium-218	3 minutes
Radon-222	3.8 days
Polonium-210	140 days
Lead-210	22 years
Plutonium-239	24000 years

Carbon-14 is a radioisotope. Most carbon on Earth is stable carbon-12. Carbon-14 has a half-life of 5700 years. This means that if there are 100 C-14 atoms, 50 of them will be decayed after 5700 years passes. Scientists can measure the amount of C-14 still left in buried remains of living things to figure out how old something is. This is called radiocarbon dating.



An unearthed woolly mammoth may be found to be 10,000 years old!

Name: _____

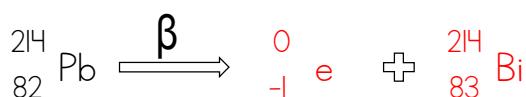
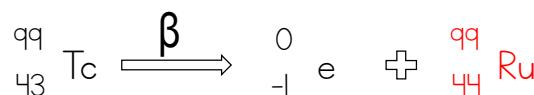
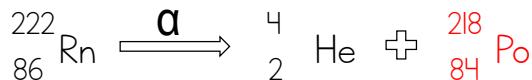
Class: _____ Date: _____

SUM IT UP!

Write the type of radiation {alpha, beta, or gamma} associated with each of the following:

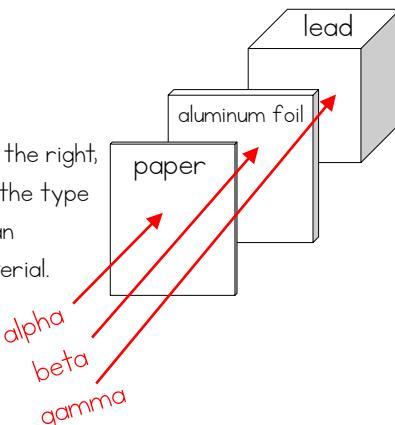
1. beta high speed electron
2. alpha a helium nucleus
3. beta a neutron becomes a proton
4. gamma high frequency waves
5. gamma does not cause transmutation

7. Complete the following decay equations. You will need a periodic table!



8. You have a substance with a half-life of 9 days. How much of it will be left after 36 days?

You will have one sixteenth ($1/16$) of it left. This is because after 9 days you will have $\frac{1}{2}$. After 18 days you will have $\frac{1}{4}$. After 27 days you will have $\frac{1}{8}$. After 36 days you will have $\frac{1}{16}$.

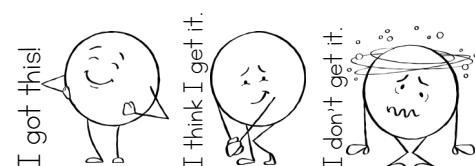


6. On the picture to the right, draw and/or write the type of radiation that can penetrate each material.

Watch this video clip and answer the questions:

QUICK WATCH: TED Ed Expect the Unexpected <https://tinyurl.com/y77rfrlr>

1. A radioactive nucleus:
 - a) Spontaneously emits a particle then changes to another element
 - b) Spontaneously emits a particle but remains the same element
 - c) Never emits a particle
 - d) Never changes element
2. Alpha particles are used in ___ and beta particles are used in ___.
 - a) airplanes, microwaves
 - b) smoke detectors, medical tracers
 - c) light bulbs, antimicrobial soap
3. Gamma radiation:
 - a) Causes you to turn green when angry
 - b) Is easily stopped by paper
 - c) Is a particle
 - d) An electromagnetic wave
4. Which type of radiation causes the most ionization:
 - a) Alpha
 - b) Beta
 - c) Gamma
5. The most serious effect of radiation on humans is:
 - a) It causes us to melt
 - b) The damage it can cause to our DNA
 - c) There are no serious effects of radiation on humans
 - d) The damage it can cause to our skin



How are you feeling about the basics of Radioactive Decay? Circle one:

Name: _____

Class: _____

Date: _____

Radioactive Decay

ESSENTIAL QUESTION:

TOPIC QUESTIONS:

1

What is _____?



It was discovered and named by _____, who won the Nobel Prize in _____ in _____.

2

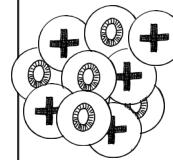
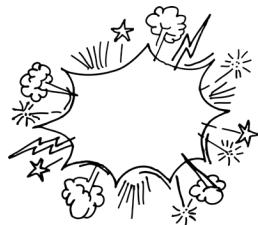
Why are some atoms _____?

In all atoms, the positively-charged _____ in the nucleus repel each other due to _____ repulsion.

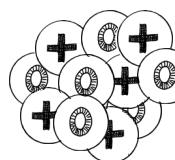


In _____ atoms with a lot of _____, this repulsion causes instability.

VOCAB



Boron-10

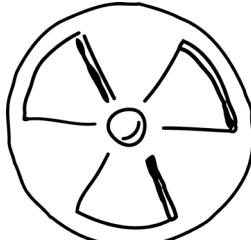


Boron-11



By the way, radioactivity is a misnomer. It has nothing to do with radio waves!

Radioactivity is the spontaneous _____ of particles or energy from an atom caused by the atom's _____.

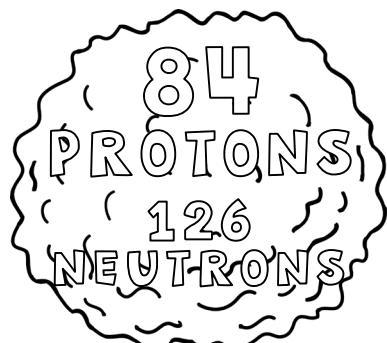


The symbol for a substance.

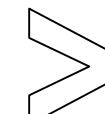
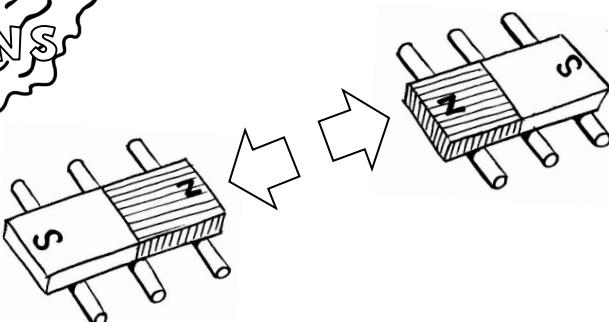
Achoo!



POLONIUM-210



If the '_____' of the nucleus, the strong nuclear _____, is too _____, the nucleus will more likely _____.



TOPIC QUESTIONS:

3

Which elements have radioactive?



All isotopes of _____ (#43), promethium (#61), and all elements with atomic number _____ than _____ (bismuth) are radioactive. These are called _____.

Many other elements have at least one radioisotope, including _____, sodium, and _____.

Do

On the periodic table, circle or highlight the elements whose isotopes are all radioactive.

4

What are the types of radioactive?

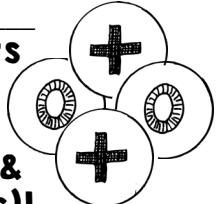
There are _____ types of radioactive decay in which the atom _____ from one type of _____ into another! This change is called a _____.

Transmutations

Decay α

Symbolized by the Greek letter _____

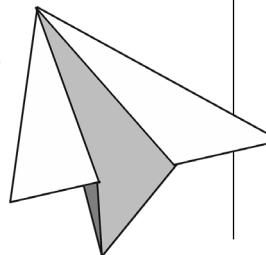
The _____ nucleus emits a _____ nucleus (protons & neutrons)!



$\begin{smallmatrix} 4 \\ 2 \end{smallmatrix}$ He

The alpha particle is relatively _____ and _____.

It can be _____ by a piece of _____.



The Most Genius Table

1 H Hydrogen [1.008]	2 He Helium [4.003]	13 Al Aluminum [26.982]	14 Si Silicon [28.074]	15 P Phosphorus [30.974]	16 S Sulfur [32.066]	17 Cl Chlorine [35.453]	10 Ne Neon [20.190]
3 Li Lithium [6.941]	4 Be Beryllium [9.012]	5 V Vanadium [50.942]	6 Cr Chromium [51.995]	7 Mn Manganese [54.938]	8 Fe Iron [55.933]	9 Co Cobalt [58.933]	10 Ni Nickel [58.693]
11 Na Sodium [22.990]	12 Mg Magnesium [24.305]	19 K Potassium [39.998]	20 Ca Calcium [40.078]	21 Sc Scandium [44.956]	22 Ti Titanium [47.88]	23 V Vanadium [50.942]	24 Cr Chromium [51.995]
37 Rb Rubidium [84.468]	38 Sr Strontium [87.62]	39 Y Yttrium [88.900]	40 Zr Zirconium [91.224]	41 Nb Niobium [92.906]	42 Mo Molybdenum [95.94]	43 Tc Technetium [95.907]	44 Ru Ruthenium [101.07]
55 Cs Cesium [132.905]	56 Ba Barium [137.327]	71 Lu Lutetium [174.967]	72 Hf Hafnium [178.49]	73 Ta Tantalum [180.948]	74 W Tungsten [183.85]	75 Re Rhenium [185.207]	76 Os Osmium [190.23]
87 Fr Francium [223.020]	88 Ra Radium [226.025]	103 Lr Lawrencium [262]	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [269]	107 Bh Bhabham [264]	108 Hs Hassium [269]
57 La Lanthanum [138.906]	58 Ce Cerium [140.115]	59 Pr Praseodymium [140.908]	60 Nd Neodymium [144.24]	61 Pm Promethium [144.915]	62 Sm Samarium [150.36]	63 Eu Europium [151.966]	64 Gd Gadolinium [157.925]
89 Ac Actinium [227.028]	90 Th Thorium [232.038]	91 Pa Protactinium [231.039]	92 U Uranium [238.029]	93 Np Neptunium [237.047]	94 Pu Plutonium [244.054]	95 Am Americium [243.061]	96 Cm Curium [247.078]
97 Bk Berkelium [247.078]	98 Cf Californium [251.080]	99 Es Einsteinium [254.078]	100 Fm Fermium [257.098]	101 Md Mendelevium [258.1]	102 No Nobelium [259.101]	103 Ts Terbium [263.04]	104 Og Oganesson [294]

13 Al Aluminum [26.982]	14 Si Silicon [28.074]	15 P Phosphorus [30.974]	16 S Sulfur [32.066]	17 Cl Chlorine [35.453]	18 Ar Argon [39.948]	19 Kr Krypton [83.804]	20 Rn Radon [222.018]
5 B Boron [10.811]	6 C Carbon [12.011]	7 N Nitrogen [14.007]	8 O Oxygen [16.999]	9 F Fluorine [18.998]	10 Ne Neon [20.190]	11 Ne Neon [20.190]	12 Ne Neon [20.190]
13 Al Aluminum [26.982]	14 Si Silicon [28.074]	15 P Phosphorus [30.974]	16 S Sulfur [32.066]	17 Cl Chlorine [35.453]	18 Ar Argon [39.948]	19 Kr Krypton [83.804]	20 Rn Radon [222.018]
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52 Te Tellurium [127.6]	53 I Iodine [126.904]	54 Xe Xenon [131.25]	55 At Atoms [209.987]	56 Rn Radon [222.018]
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Remember, electrons have _____ and a charge of negative _____.

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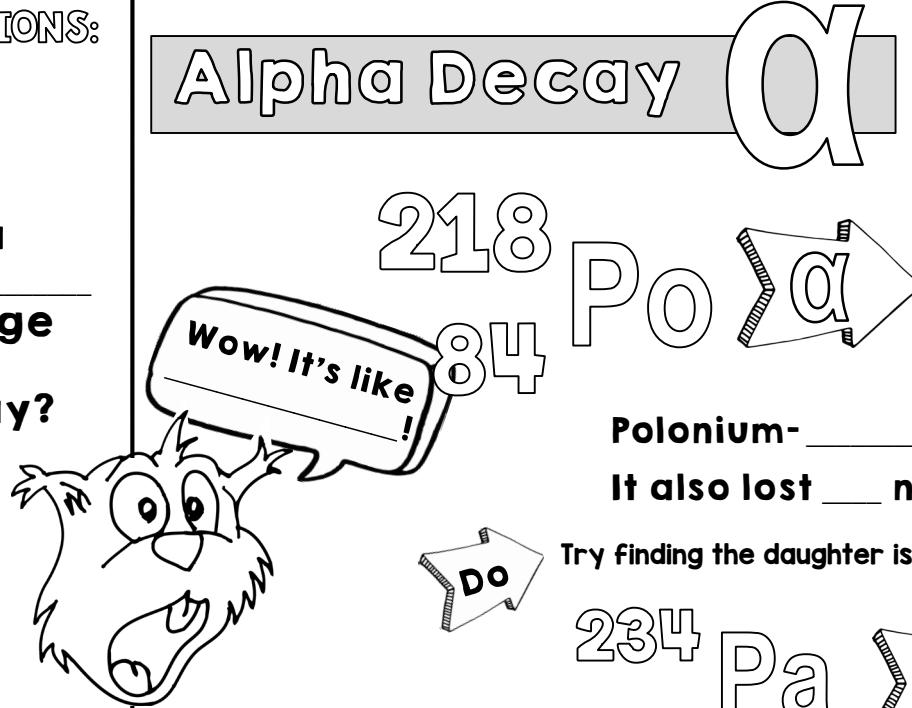
Remember, electrons have _____ and a charge of negative _____.

TOPIC QUESTIONS:

5

How does a

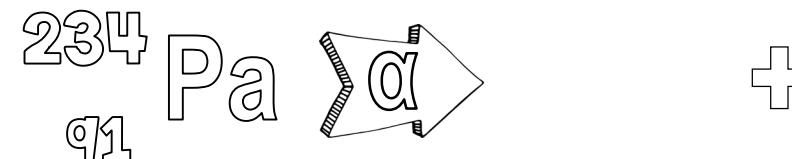
atom change
during an
alpha decay?



The _____ isotope splits out a helium nucleus and becomes a _____ isotope.

Polonium-_____ lost ____ protons to become a _____ nucleus.
It also lost ____ neutrons, so its mass was decreased by ____.

Try finding the daughter isotope in the alpha decay below!



6

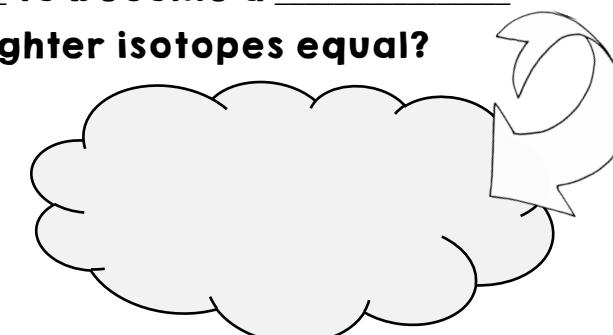
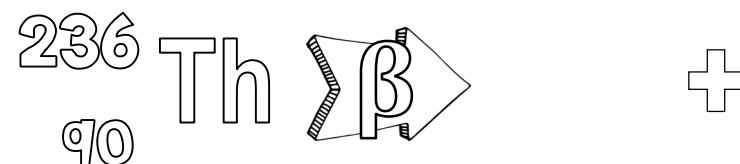
How does a radioactive atom _____
during a beta decay?



A _____ in the parent isotope becomes a proton and ejects an _____.

Lead-214 lost a _____ but gained a _____ to become a _____ nucleus. Why are the mass of the parent and daughter isotopes equal?

Do Try finding the daughter isotope in the beta decay below!



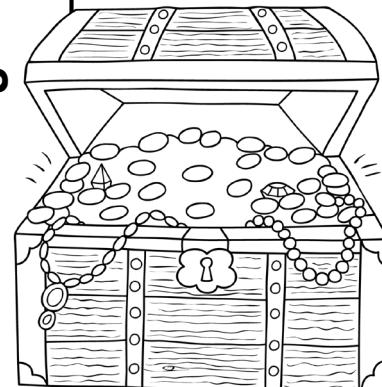
TOPIC QUESTIONS:

7

What is the third type of associated with radioactive decay?

8

How do radioactive isotopes decay?



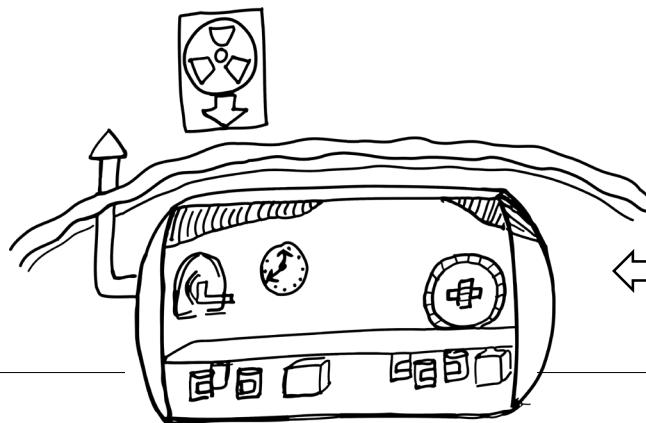
It's like if you had to give up _____ of your treasure every _____ days until you had just one coin left.

Carbon-_____ is a radioisotope. Most carbon on Earth is _____ carbon-_____. Carbon-14 has a half-life of _____ years. This means that if there are 100 C-14 atoms, _____ of them will be decayed after 5700 years passes. Scientists can _____ the amount of C-14 still left in buried _____ of living things to figure out how old something is. This is called _____ dating.

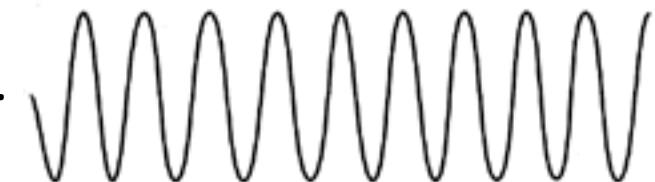
Rays

Symbolized by the Greek letter _____

Accompanies _____ alpha and beta decay.

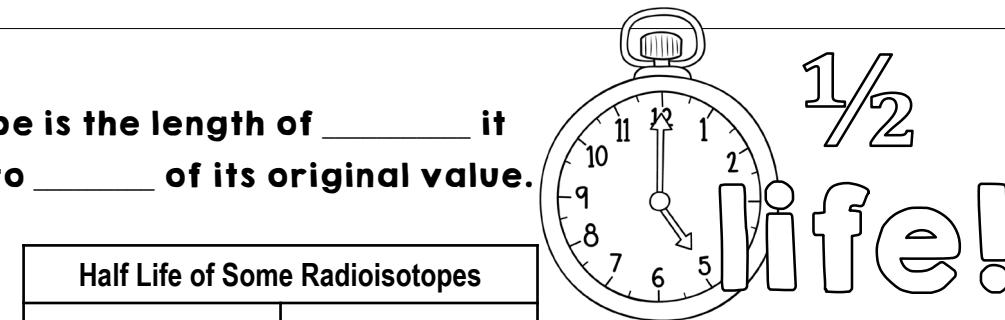


frequency _____ radiation which travel at the speed of _____.

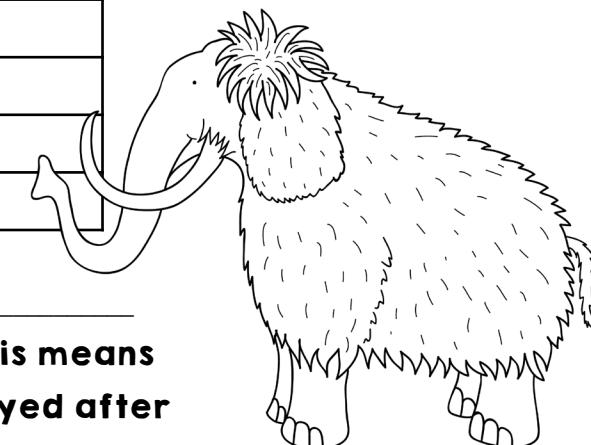


Can only be shielded by _____ 1.5 feet thick or by _____ 6.5 feet thick!

Nuclear _____ shelters were meant to protect people from the threat of _____ radiation after a _____ explosion.



Half Life of Some Radioisotopes	
Polonium-218	
Radon-222	
Polonium-210	
Lead-210	
Plutonium-239	



An unearthed woolly mammoth may be found to be _____ years old!

Name: _____

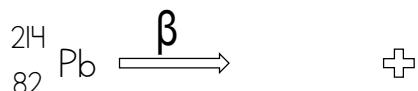
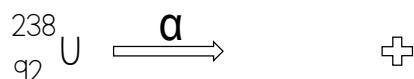
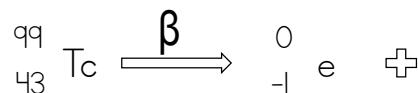
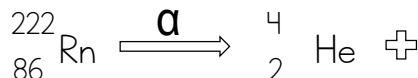
Class: _____ Date: _____

SUM IT UP!

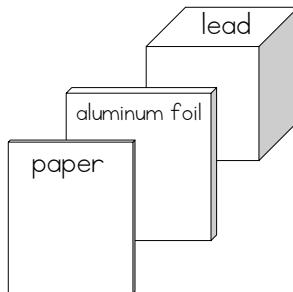
Write the type of radiation {alpha, beta, or gamma} associated with each of the following:

1. _____ high speed electron
2. _____ a helium nucleus
3. _____ a neutron becomes a proton
4. _____ high frequency waves
5. _____ does not cause transmutation

7. Complete the following decay equations. You will need a periodic table!



8. You have a substance with a half-life of 9 days. How much of it will be left after 36 days?



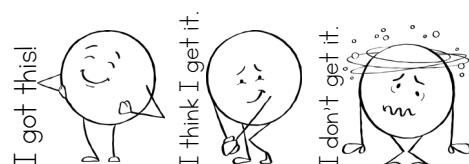
6. On the picture to the right, draw and/or write the type of radiation that can penetrate each material.

Watch this video clip and answer the questions:

QUICK WATCH: TED Ed Expect the Unexpected <https://tinyurl.com/y77rfrlr>

1. A radioactive nucleus:
 - a) Spontaneously emits a particle then changes to another element
 - b) Spontaneously emits a particle but remains the same element
 - c) Never emits a particle
 - d) Never changes element
2. Alpha particles are used in ___ and beta particles are used in ___.
 - a) airplanes, microwaves
 - b) smoke detectors, medical tracers
 - c) light bulbs, antimicrobial soap
3. Gamma radiation:
 - a) Causes you to turn green when angry
 - b) Is easily stopped by paper
 - c) Is a particle
 - d) An electromagnetic wave
4. Which type of radiation causes the most ionization:
 - a) Alpha
 - b) Beta
 - c) Gamma
5. The most serious effect of radiation on humans is:
 - a) It causes us to melt
 - b) The damage it can cause to our DNA
 - c) There are no serious effects of radiation on humans
 - d) The damage it can cause to our skin

How are you feeling about the basics
of Radioactive Decay? Circle one:



Name: _____

Class: _____

Date: _____

Radioactive Decay

**ESSENTIAL
QUESTION:**

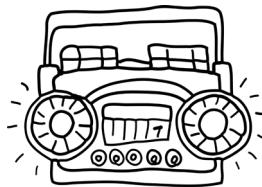
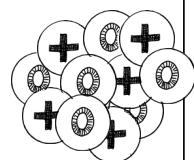
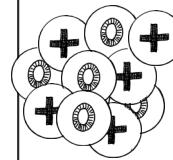
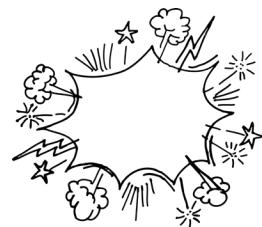
TOPIC QUESTIONS:

1



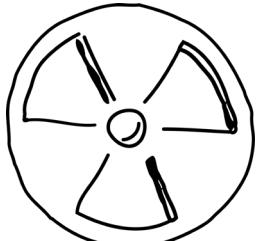
It was discovered and named by _____, who won the Nobel Prize in _____ in _____.

VOCAB



By the way, radioactivity is a misnomer. It has nothing to do with radio waves!

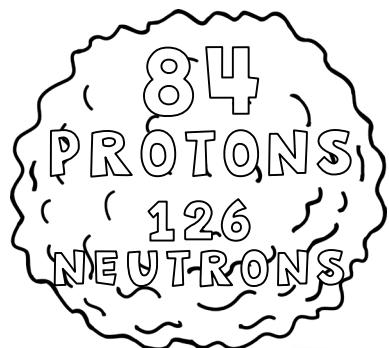
Radioactivity is . . .



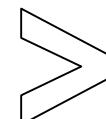
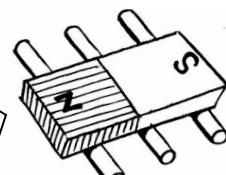
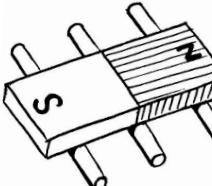
2

In all atoms, the positively-charged _____ in the nucleus repel each other due to _____ repulsion.

POLONIUM-210



In _____ atoms with a lot of _____, this repulsion causes instability



If the '_____' of the nucleus, the strong nuclear _____, is too _____, the nucleus will more likely _____.

TOPIC QUESTIONS:

3



All isotopes of _____ (#43), promethium (#61), and all elements with atomic number _____ than _____ (bismuth) are radioactive. These are called _____.

Many other elements have at least one radioisotope, including _____, sodium, and _____.

Do

On the periodic table, circle or highlight the elements whose isotopes are all radioactive.

The Most Genius Table

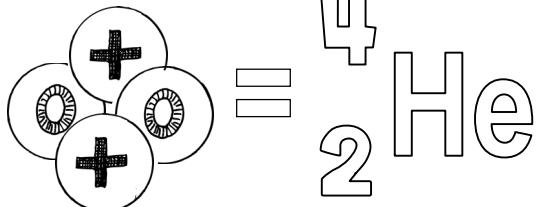
1	H Hydrogen 1.008	2		13	14	15	16	17																			
3	Li Lithium 6.941	4	Be Boron 9.012	5	6	7	8	9																			
11	Na Sodium 22.990	12	Mg Magnesium 24.305	21	Sc Scandium 44.956	22	Ti Titanium 47.88	23	V Vanadium 50.942																		
19	K Potassium 39.098	20	Ca Calcium 40.078	37	Rb Rubidium 84.468	38	Sr Strontium 87.62	39	Y Yttrium 88.900																		
41	Zr Zirconium 91.224	42	Nb Niobium 92.906	43	Tc Technetium 90.907	44	Ru Ruthenium 101.07	45	Rh Rhodium 102.906																		
55	Cs Cesium 132.905	56	Ba Barium 137.327	57	La Lanthanum 138.906	58	Ce Cerium 140.115	59	Pr Praseodymium 140.908																		
87	Fr Francium 223.020	88	Ra Radium 226.025	103	Lr Lawrencium 262	104	Rf Rutherfordium 261	105	Db Dubnium 262																		
106	Sg Seaborgium 266	107	Bh Bohrium 264	108	Hs Hassium 269	109	Mt Meitnerium 268	110	Ds Darmstadtium 272																		
111	Rg Roentgenium 277	112	Cn Copernicium 286	113	Nh Nhonium 289	114	Fl Flerovium 289	115	Mc Moscovium 289																		
116	Lv Livermorium 298	117	Ts Tennessine 294	118	Og Oganesson 294	13	He Helium 4.003	14	Ne Neon 20.190																		
15		16		17		18		19																			
25	Mn Manganese 54.938	26	Fe Iron 55.833	27	Co Cobalt 58.933	28	Ni Nickel 58.693	29	Cu Copper 63.54	30	Zn Zinc 65.39																
31	Ga Gallium 69.732	32	Ge Germanium 72.61	33	As Arsenic 74.922	34	Se Selenium 78.09	35	Br Bromine 79.904	36	Kr Krypton 84.848																
45	Rh Rhodium 102.906	46	Pd Palladium 104.418	47	Ag Silver 107.868	48	Cd Cadmium 112.411	49	In Indium 113.418	50	Sn Tin 118.71																
51	Sb Antimony 121.767	52	Te Tellurium 127.6	53	I Iodine 131.25	54	Xe Xenon 131.25	55	At Astatine 209.987	56	Rn Radium 222.018																
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89	Ac Actinium 227.028	90	Th Thorium 232.036	91	Pa Protactinium 231.036	92	U Uranium 238.029	93	Np Neptunium 237.046	94	Pu Plutonium 244.064	95	Am Americium 243.061	96	Cm Curium 247.076	97	Bk Berkelium 247.076	98	Cf Californium 251.080	99	Es Einsteinium 254.050	100	Fm Fermium 257.096	101	Md Mendelevium 258.1	102	No Nobelium 259.101

There are _____ types of radioactive decay in which . . .

4

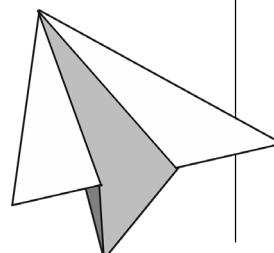
Transmutations

Decay α



Decay β

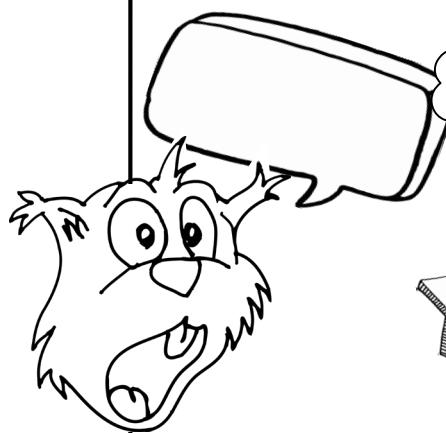
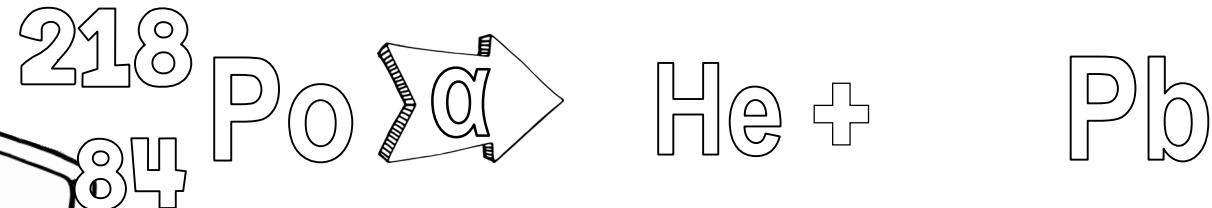
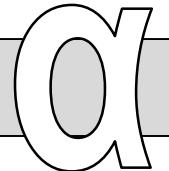
Remember,
electrons have
_____ and
a charge of
negative _____.
0 e -1



TOPIC QUESTIONS:

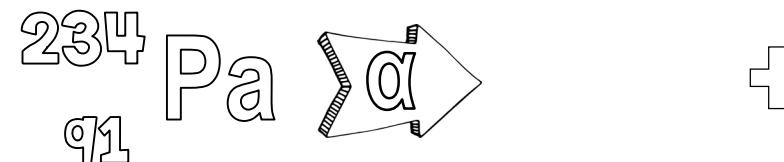
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Alpha Decay



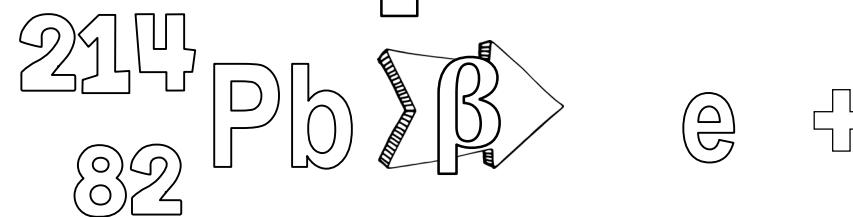
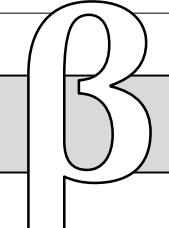
Polonium-_____ lost _____ protons to become a _____ nucleus.
It also lost _____ neutrons, so its mass was decreased by _____.

Try finding the daughter isotope in the alpha decay below!



6

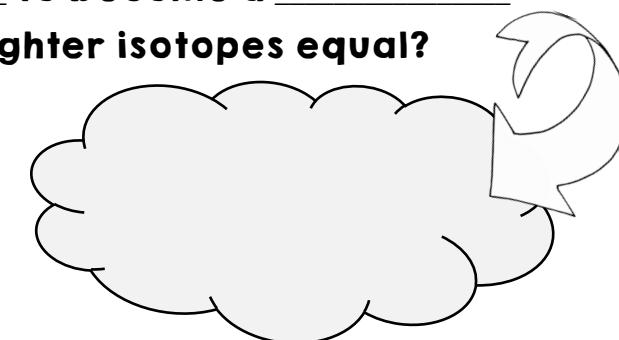
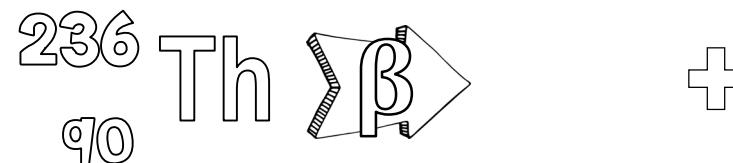
Beta Decay



Lead-214 lost a _____ but gained a _____ to become a _____ nucleus. Why are the mass of the parent and daughter isotopes equal?



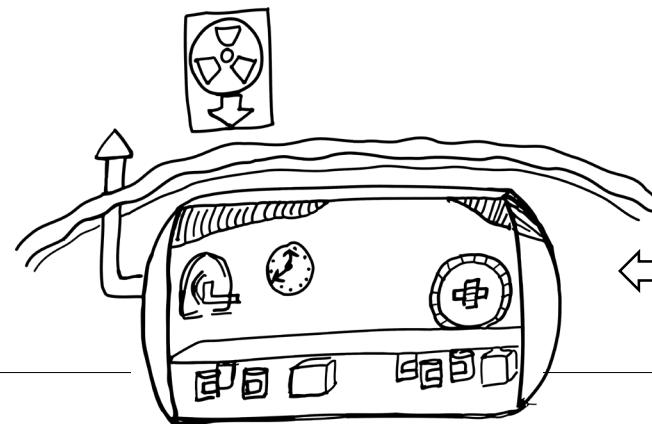
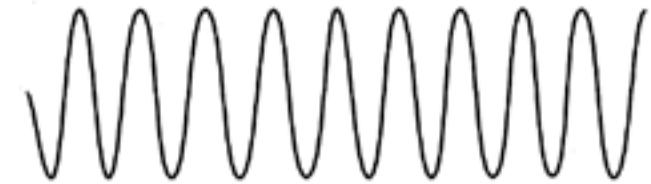
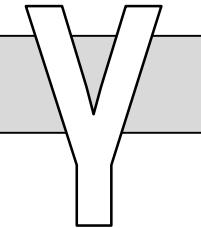
Try finding the daughter isotope in the beta decay below!



TOPIC QUESTIONS:

7

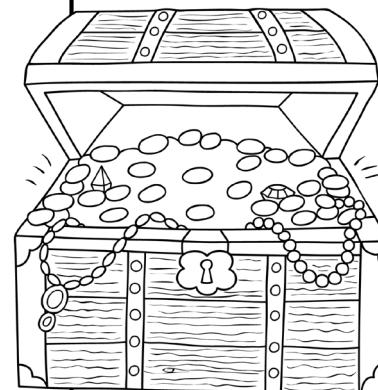
Rays



Nuclear _____ shelters were meant to protect people from the threat of radiation after a _____ explosion.

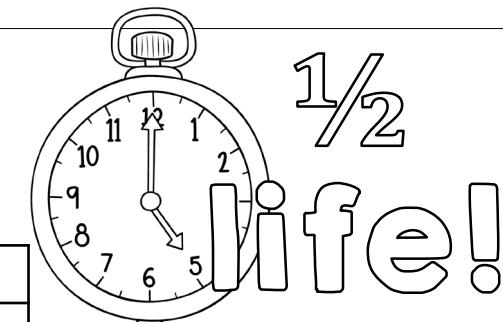
8

The _____ of a radioisotope is ...



It's like if you had to give up _____ of your treasure every _____ days until you had just one coin left.

Half Life of Some Radioisotopes	
Polonium-218	
Radon-222	
Polonium-210	
Lead-210	
Plutonium-239	



Carbon-_____ is a radioisotope. Most carbon on Earth is _____ carbon-_____. Carbon-14 has a half-life of _____ years. This means that if there are 100 C-14 atoms, _____ of them will be decayed after 5700 years passes. Scientists can _____ the amount of C-14 still left in buried _____ of living things to figure out how old something is. This is called _____ dating.

An unearthed woolly mammoth may be found to be _____ years old!

Name: _____

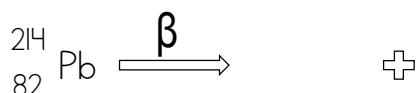
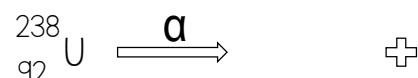
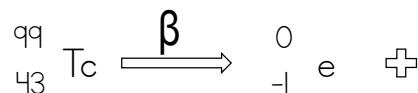
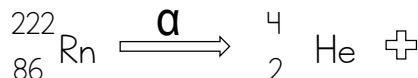
Class: _____ Date: _____

SUM IT UP!

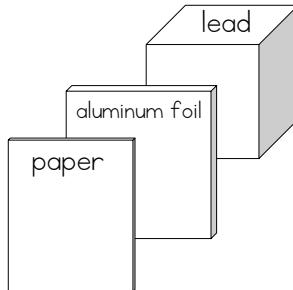
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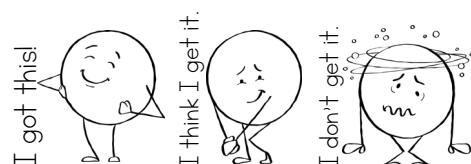
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How are you feeling about the basics
of Radioactive Decay? Circle one:



Name: _____

Class: _____

Date: _____

Radioactive Decay

ESSENTIAL
QUESTION:

TOPIC QUESTIONS:

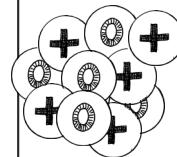
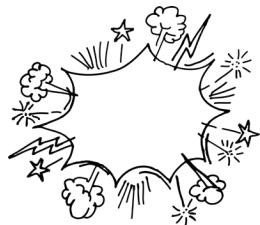
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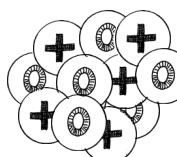
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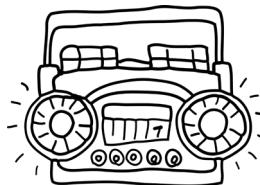
VOCAB



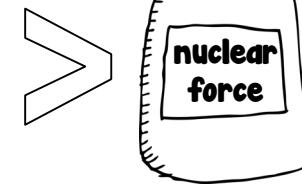
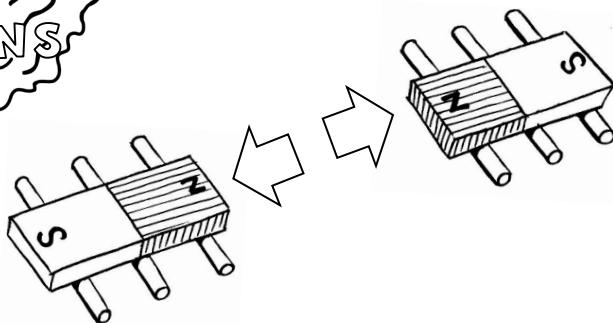
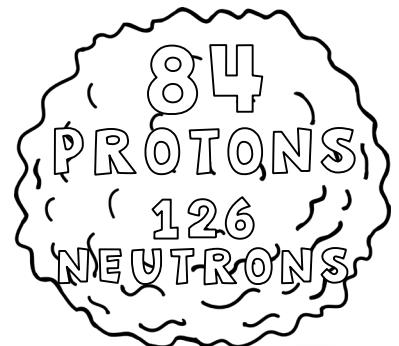
Boron-10



Boron-11



POLONIUM-210



Achoo!



TOPIC QUESTIONS:

3



The Most Genius Table

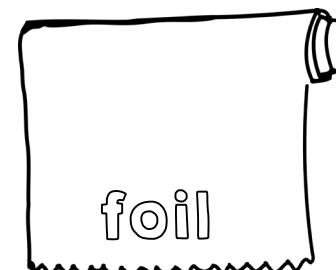
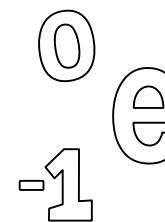
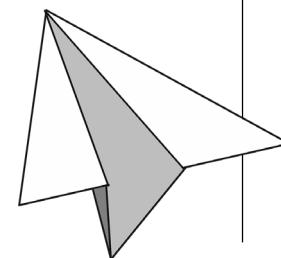
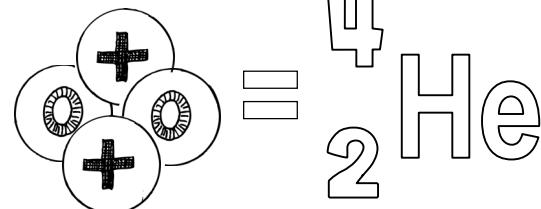
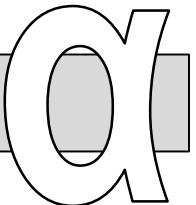
The Most Elements Table																			
1	H																		
Hydrogen 1.008		2																	
3	Li	4	Be	5	6	7	8	9	10	11	12	13	14	15	16	17	2		
Lithium 6.941	Beryllium 9.012											Boron 10.811	Carbon 12.011	Nitrogen 14.007	Oxygen 15.999	Fluorine 18.998	He Helium 4.003		
11	Na	12	Mg	13	14	15	16	17	18	19	20	21	22	23	24	25	26		
Sodium 22.990	Magnesium 24.305											Scandium 44.956	Titanium 47.88	Vanadium 50.942	Chromium 51.996	Manganese 54.938	Iron 55.933		
19	K	20	Ca	21	22	23	24	25	26	27	28	29	30	31	32	33	34		
Potassium 39.098	Calcium 40.078			Scandium 44.956	Titanium 47.88	Vanadium 50.942	Chromium 51.996	Manganese 54.938	Iron 55.933	Cobalt 58.933	Nickel 58.933	Copper 63.546	Zinc 65.39	Gallium 69.732	Germanium 72.664	Antimony 74.920	Bromine 79.904	Kr Krypton 83.80	
37	Rb	38	Sr	39	40	41	42	43	44	45	46	47	48	49	50	51	52		
Rubidium 84.468	Samarium 87.62	Strontium 88.906	Yttrium 91.224	Zirconium 91.224	Nickel 95.908	Nickel 95.908	Molybdenum 95.94	Techneium 98.907	Ruthenium 101.07	Rhodium 102.908	Palladium 106.42	Argentum 107.868	Cadmium 112.411	In Indium 114.818	Tin Tin 116.171	Sb Antimony 121.750	Te Tellurium 127.6	I Iodine 131.50	Xe Xenon 131.29
55	Cs	56	Ba	71	Lu	72	Hf	73	Ta	74	W	76	Os	77	Ir	78	Pt	80	
Cesium 132.905	Barium 137.327			Lutetium 174.967	Hafnium 178.49	Tantalum 180.948	Tungsten 183.85	Rhenium 186.207	Osmium 190.23	Ruthenium 192.22	Platinum 195.08	Auro Gold 196.967	Hg Mercury 200.50	Thallium 204.383	Pb Lead 207.2	Pb Bismuth 208.980	Bi Polonium 208.982	Po At 209.987	Rn Radium 222.018
87	Fr	88	Ra	103	Lr	104	Rf	105	Db	106	Sg	107	Hs	108	Mt	110	Rg	112	
Franconium 223.020	Radium 226.025			Lawrencium 262	Rutherfordium 261	Dubnium 262	Seaborgium 265	Bohrium 264	Hassium 265	Berthium 266	Darmstadtium 268	Roentgenium 272	Copernicium 277	Nihonium 280	Moscovium 286	Livermorium 290	Ts Tennessee 294	Og Oganesson 294	
57	La	58	Ce	59	Pr	60	Nd	61	Pm	62	Sm	63	Eu	64	Gd	65	Tb	66	
Lanthanum 138.906	Cerium 140.115	Praseodymium 140.908	Neodymium 144.24	Protactinium 144.913	Europium 150.36	Europium 151.966	Gadolinium 157.25	Terbium 158.925	Dysprosium 162.50	Holmium 164.930	Erbium 164.930	Thulium 168.934	Ytterbium 173.04						
89	Ac	90	Th	91	Pa	92	U	93	Np	94	Am	95	Cm	96	Cf	97	Dy	98	
Actinium 225.020	Thorium 232.025	Protactinium 231	Uranium 234	Neptunium 237	Plutonium 239	Uranium 238	Americium 243	Curium 244	Berkelium 247	Californium 247	Einsteinium 252	Minesite 253	Curium 254	Berkeleium 257	Californium 259	Einsteinium 260	Terbium 260	Dysprosium 260	
100	Fm	101	Md	102	No	103	Ts	104	Lu	105	Yb	106	Er	107	Pr	108	Ho	109	
Fermium 253.020	Mendeleyevium 254	No	Nobelium 255						Lutetium 260	Ytterbium 260		Erbium 260							

On the periodic table, circle or highlight the elements whose isotopes are all radioactive.

Do

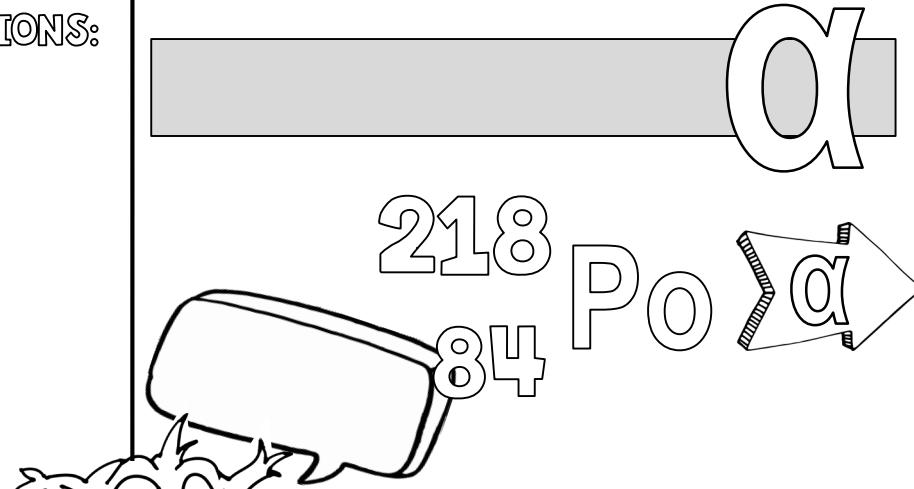
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Transmutations

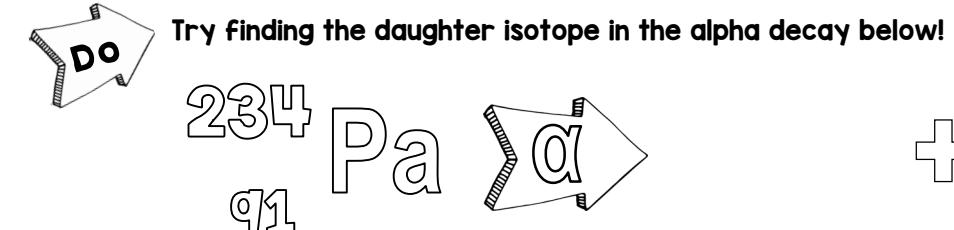


TOPIC QUESTIONS:

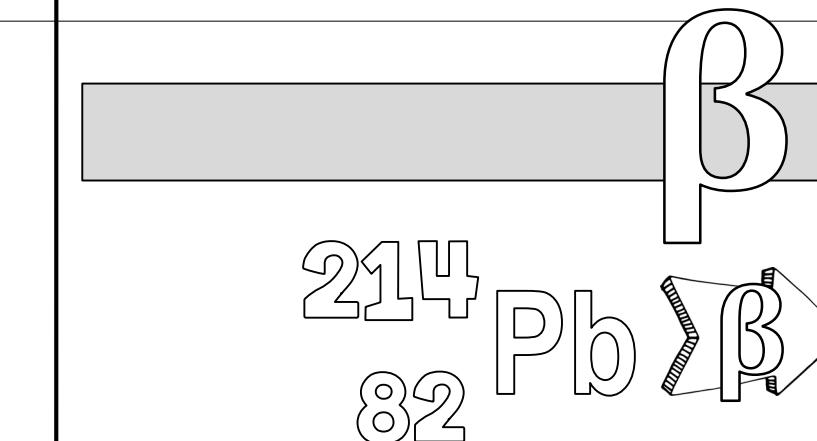
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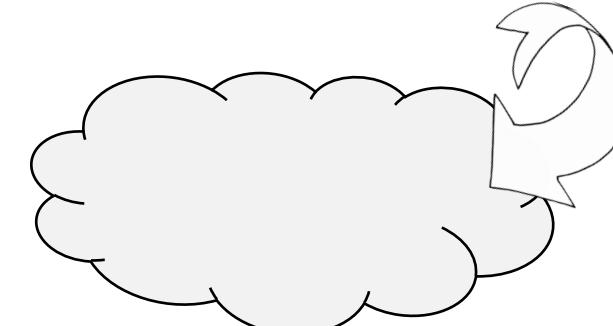
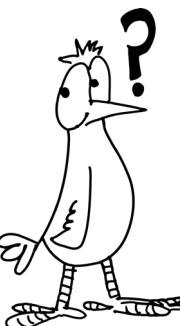
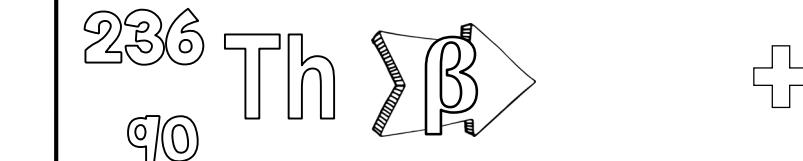
Try finding the daughter isotope in the alpha decay below!



6

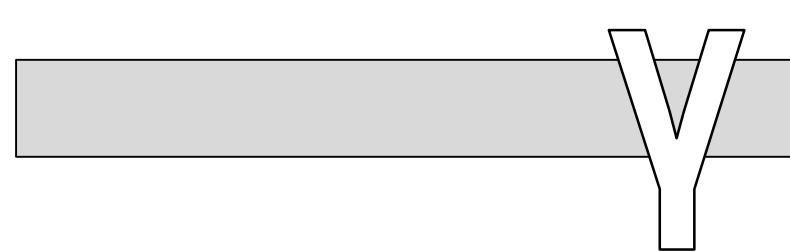


Try finding the daughter isotope in the beta decay below!

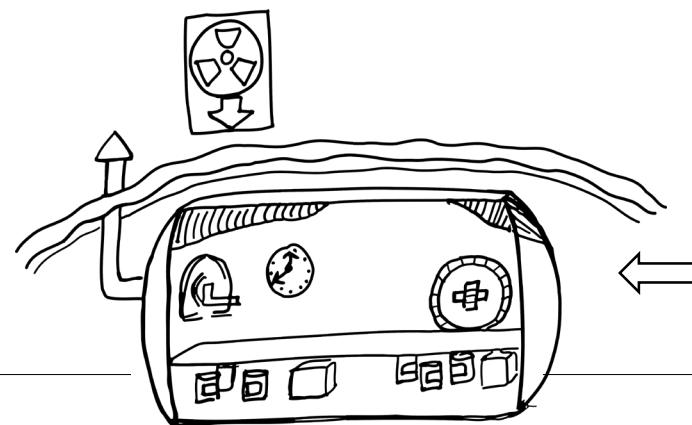
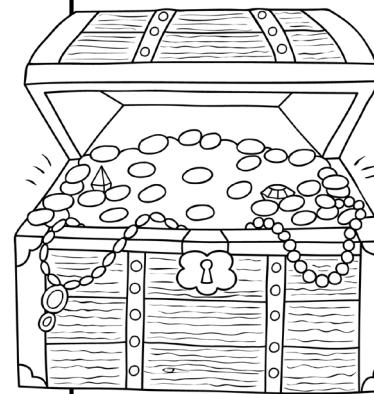


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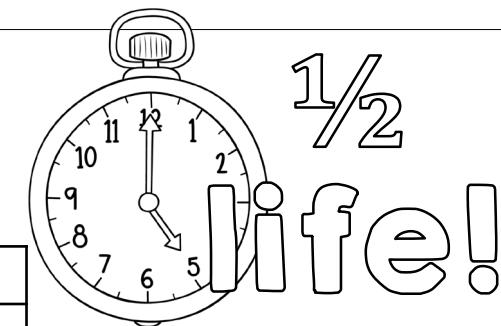
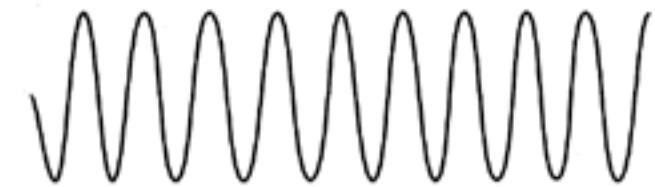
7



8



Half Life of Some Radioisotopes	
Polonium-218	
Radon-222	
Polonium-210	
Lead-210	
Plutonium-239	



Name: _____

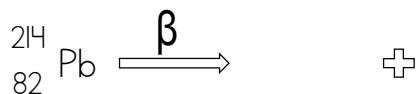
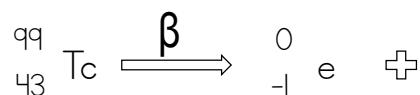
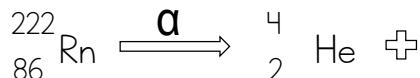
Class: _____ Date: _____

SUM IT UP!

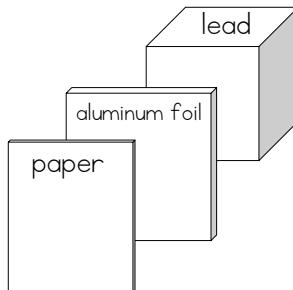
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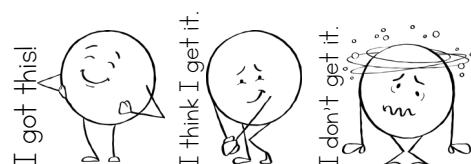
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