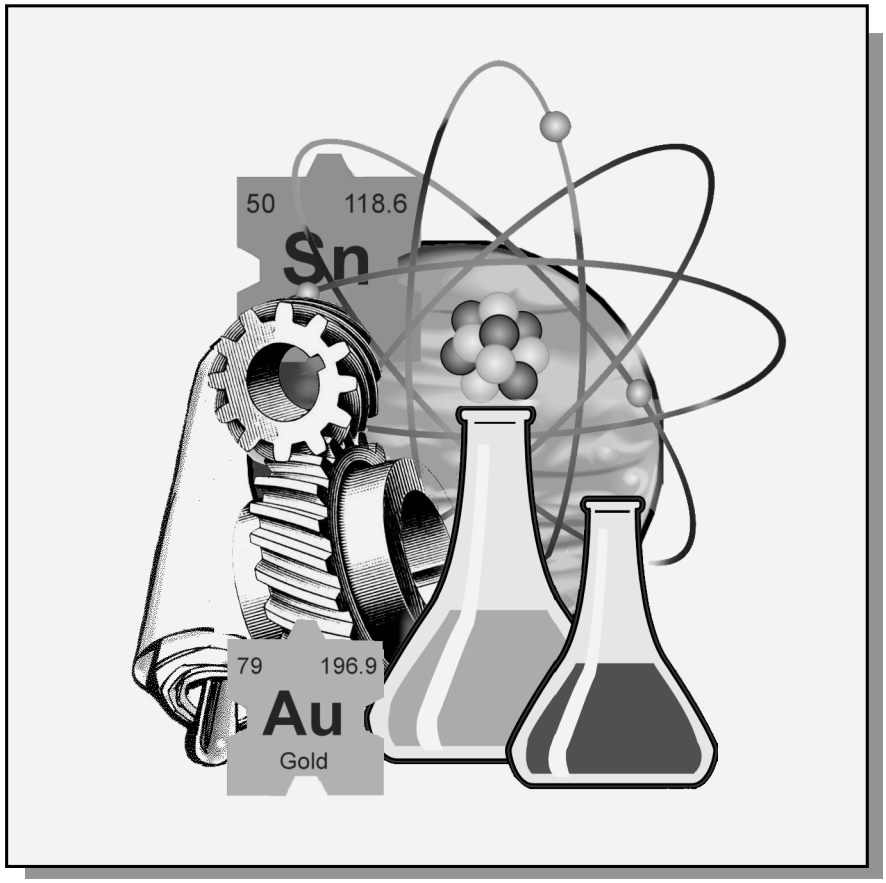
Integrated Physics & Chemistry

ACTIVITIES



Chapter 10

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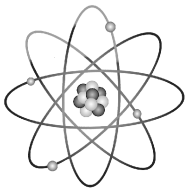
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ACTIVITIES
Lesson 1:
Energy

X-Rays

You are making progress! ***Answer the following questions. Circle the correct answers or fill in the blanks with words, letters or numbers as each question indicates. Check your answers from the Answer Key. Correct all errors, then complete your next goal.***

1. The ***First Scientific Revolution*** took place during the time: _____.
   (a) from Copernicus to Galileo (c) of Fermi and Sagan
   (b) of Einstein and Rutherford (d) of the 18th century
2. During the First Scientific Revolution, _____ proposed the sun-centered planetary system.
3. During the First Scientific Revolution, the Belgium anatomist, Andreas Vesalius, accurately described the structure of the _____ _____.
4. During the First Scientific Revolution, the German astronomer, Johannes Kepler, developed Three Basic Laws of _____ Motion.
5. The English physician, William Harvey, showed that _____ circulates through the body and proved that the heart is a _____ pump.
6. _____ _____ developed the important concept of a chemical element and demonstrated that gases followed laws the same as solid objects in the atmosphere.
7. The ***Second Scientific Revolution*** began in _____.
8. During the Second Scientific Revolution, French physicist, Henri Becquerel, discovered _____.
9. During the Second Scientific Revolution, _____ _____ proposed the Theory of Relativity and developed the equation for finding energy.
10. During the Second Scientific Revolution, one of the discoveries was: _____.
    (a) interstellar travel (c) Newton's Law of Gravity
    (b) Kepler's Laws of Planetary Motion (d) the discovery of X-rays
11. Wilhelm Roentgen made most of his important discoveries before he was _____ years old.

*12. Cathode rays are actually streams of: _____.
    (a) electrons (b) positrons (c) neutrons (d) protons

*13. Because of the ray's mysterious nature, the mathematical symbol for the unknown (X) was used to designate the rays as _____.

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*14. The substance that stopped ***X–rays*** was: _____.
(a) heavy metal and bone (c) rock and glass
(b) flesh and blood (d) wood and light metals

15. After Roentgen demonstrated his discovery, several years passed before scientists were willing to experiment with X–rays.
(a) True or (b) False

*16. The first use of X–rays was in: _____.
(a) airport security (b) medicine (c) plant biology (d) shoe sales

17. In 1901, Roentgen received the first _____ _____ for his discovery of the X-ray.

*18. X–rays are produced when: _____.
(a) electromagnetic rays cross each other
(b) moonlight shines on ice
(c) electrons traveling at high speed are stopped by a metal target
(d) radioactive atoms come apart

*19. The one with a higher frequency, shorter wavelength, more energy and greater penetrating power is: _____.
(a) infrared light (b) sound waves (c) ultraviolet light (d) X–rays

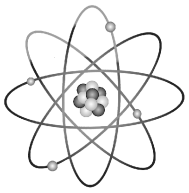
20. Since Roentgen's time, other scientists have discovered some drawbacks to X-rays: they _____ in the body and are _____ to human and animal _____.

21. Write the **Life Principle:** *"*_____
_____
_____*."*

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Name: _____

Date: _____ Grade: _____



ACTIVITIES
Lesson 2:
Energy

Radioactivity

You are making progress! ***Answer the following questions. Circle the correct answers or fill in the blanks with words, letters or numbers as each question indicates. Check your answers from the Answer Key. Correct all errors, then complete your next goal.***

1. The country that Germany and Russia divided in 1863 was _____.

2. Henri Becquerel of Paris, France, was the first person to detect the radioactivity of: _____.
   (a) polonium (b) radium (c) uranium (d) plutonium

3. _____ is the emission of light when the substance absorbs energy.

4. Becquerel's source of crystals was as a gift from: _____.
   (a) his government (b) his father (c) Marie Curie (d) Roentgen

5. During the first part of his experiment, Becquerel tested whether crystals exposed to _____ sunlight gave off X–rays.

6. The rays that Becquerel discovered were given off by: _____.
   (a) sunlight (b) meteorites (c) film (d) crystals

7. The rays that Becquerel discovered were identical in every way to X–rays.
   (a) True or (b) False

*8. The term ***radioactivity*** was invented by: _____.
   (a) Albert Einstein (c) John Kepler
   (b) Henri Becquerel (d) Marie Curie

9. Becquerel shared the 1903 _____ with Pierre and Marie Curie.

*10. _____ is used in crystal microphones and in very accurate quartz watches.

11. Of the elements known in 1896, the only ones that were radioactive were uranium and: _____.
   (a) cesium (b) helium (c) ***thorium*** (d) ***pitchblende***

12. The element, ***polonium***, was found by Pierre and Marie Curie in pitchblende.
   (a) True or (b) False

13. Marie Curie named polonium after: _____.
   (a) Marco Polo (c) her mother
   (b) Pierre's father (d) her native country of Poland

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*14. The chemical symbol for polonium is _____.

*15. Polonium is: _____.
(a) radioactive (b) soft (c) nonradioactive (d) explosive

16. The density of polonium is near that of: _____.
(a) aluminum (b) lead (c) hydrogen (d) gold

17. Polonium-plated metal is used to carry off static _____.

*18. Polonium can be used to: _____.
(a) purify the air (c) conduct away accumulations of static electricity
(b) purify water (d) to make fossil fuel

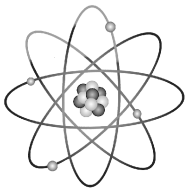
*19. Some high speed printers attached to computers use _____ brushes to prevent the paper from jamming because of static build up.

20. Write the **Life Principle:** *"*_____
_____
_____*."*

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Name: _____

Date: _____ Grade: _____



ACTIVITIES
Lesson 3:
Energy

The Electron and Proton

You are making progress! ***Answer the following questions. Circle the correct answers or fill in the blanks with words, letters or numbers as each question indicates. Check your answers from the Answer Key. Correct all errors, then complete your next goal.***

1. ***Cathode rays*** receive that name because they come from the cathode or _____ terminal of the cathode ray tube.
   (a) negative (b) positive (c) neutral (d) grid

2. Joseph John Thomson discovered the: _____.
   (a) cyclotron (b) nucleus (c) neutron (d) electron

*3. Of the following, the one that is the heaviest is the: _____.
   (a) electron (b) positron (c) hydrogen atom (d) neutron

4. To balance the negative electric charge of the electron, the atom must also carry a _____ charge.

5. The one who shot ***alpha particles*** into the gold atom was: _____.
   (a) Ernest Rutherford (c) Emilio Trent
   (b) J. J. Thomson (d) Marie Curie

*6. The nucleus of an atom contains a _____ charge.
   (a) negative (b) positive (c) neutral (d) triple positive

7. Without an electron, the hydrogen atom is a single particle with a positive charge.
   (a) True or (b) False

8. A hydrogen atom without its electron is a _____.

*9. A path of a _____ particle is bent in a magnetic field.

10. Provided they have the same charge, the one that is bent in a tighter arc in a magnetic field is a particle with _____ mass.
   (a) zero (b) more (c) less (d) equal

11. An alpha particle is a _____ atom without its electrons.
   (a) oxygen (b) carbon (c) hydrogen (d) helium

*12. Atoms of the same element have the same number of: _____.
   (a) alpha particles (b) ***electrons*** (c) neutrons (d) ***protons***

13. Helium has _____ protons.

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14. Uranium has _____ protons.

*15. The number of protons in the ***nucleus*** of an atom is the atomic: _____.
(a) charge (b) mass (c) number (d) theory

*16. The *atomic number* is always a: _____.
(a) large number (b) fraction (c) whole number (d) decimal

*17. The atomic number and the atomic mass are always equal.
(a) True or (b) False

18. The atomic number of oxygen is _____.

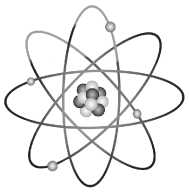
19. The atomic weight of oxygen is _____.

20. Write the **Life Principle:** *"*_____
_____
_____*."*

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Name: _____

Date: _____ Grade: _____



ACTIVITIES
Lesson 4:
Energy

The Neutron

You are making progress! ***Answer the following questions. Circle the correct answers or fill in the blanks with words, letters or numbers as each question indicates. Check your answers from the Answer Key. Correct all errors, then complete your next goal.***

1. Pilots would rather land: _____.
   (a) crossing the wind (c) with the wind at their back
   (b) facing into the wind (d) with no wind at all

2. A windsock is used to: _____.
   (a) wear with a windshoe (c) show the direction of the wind
   (b) clean an airplane windshield (d) guide airplanes in the right path

3. Charged particles pass through a special chamber, known as a _____ _____, causing droplets of fog to form along its path.

*4. An electron has a _____ electric charge.

*5. A proton has a _____ electric charge.

6. The nucleus contained a proton and another particle that is electrically: _____.
   (a) active (b) positive (c) negative (d) neutral

7. The particle James Chadwick discovered was the: _____.
   (a) electron (b) gamma ray (c) beta ray (d) neutron

*8. *Atomic number* is the number of _____.

*9. *Atomic mass* is the number of electrons.
   (a) True or (b) False

10. Except for _____, all other elements have an atomic number and atomic mass that are different.

*11. Chemists place elements in the periodic table in order of their atomic: _____.
   (a) mass (b) number (c) volatility (d) mass defect

*12. The subatomic particle that is involved in chemical reactions is the: _____.
   (a) synchrotron (b) electron (c) ***neutron*** (d) proton

13. In an electrically neutral atom, the number of electrons is the same as the number of _____.

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*14. Atoms of the same element always have the same number of _____.

*15. Changing the number of neutrons or protons is an example of a _____ ***reaction***.
(a) ***chemical*** (b) violent (c) ***nuclear*** (d) physical

16. Uranium-238 and uranium-235 differ in mass because they have a different number of: _____.
(a) electrons (b) neutrons (c) positrons (d) protons

*17. The loss of neutrons causes the _____ of an atom to change.
(a) atomic mass (c) chemical properties
(b) atomic number (d) attitude

18. Danish physicist, Niels Bohr, modified the model that showed the electrons were confined to orbits with specific energy levels.
(a) True or (b) False

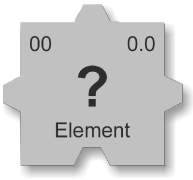
19. The diameter of the nucleus is about _____ the diameter of the whole atom.
(a) 100 times (b) ¼ (c) ½ (d) 1/10,000

20. Write the **Life Principle:** *"*_____
_____
_____*."*

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Name: _____

Date: _____ Grade: _____



ACTIVITIES
Lesson 5:
Elements

Isotopes

You are making progress! ***Answer the following questions. Circle the correct answers or fill in the blanks with words, letters or numbers as each question indicates. Check your answers from the Answer Key. Correct all errors, then complete your next goal.***

1. The atomic number of 95 for ***americium*** shows that it has 95: _____.
   (a) protons (c) protons and neutrons combined
   (b) neutrons (d) electrons

*2. The atomic mass of 241 for americium shows that it has 241: _____.
   (a) electrons (c) neutrons
   (b) protons (d) protons and neutrons combined

3. The chemical symbol for americium is _____.

*4. Atoms of the same element whose nuclei have the same number of protons but different number of neutrons is called _____.

5. Uranium-235 and uranium-238 have the same number of _____.

*6. The _____ of an element are not always equally abundant.

*7. Neon-20 has 10 protons and _____ neutrons.

*8. Neon-22 has _____ protons and 12 neutrons.

9. The atomic weight for neon of 20.183 shows that the more abundant isotope is: _____.
   (a) neon-20 (b) neon-21 (c) neon-18 (d) neon-22

10. Element number 80 is mercury, and one of its isotopes is mercury-200. The number 80 refers to the number of: _____.
   (a) protons (b) neutrons (c) electrons (d) atoms

*11. Americium has its atomic mass in brackets, [243], because: _____.
   (a) it cannot be weighed (c) it is especially rare
   (b) it is radioactive and 243 is its most stable isotope (d) it is extra heavy

12. Uranium is named after: _____.
   (a) a mine in Bohemia (c) the planet Uranus
   (b) the scientist who discovered it (d) a month in the German calendar

13. _____was discovered not by its spectrum but by its *radioactivity*.

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14. Only one of polonium's isotopes is ***stable***.
(a) True or (b) False

15. *Pitchblende* contains the radioactive elements of uranium, polonium and _____.

16. A _____ is a measure of heat energy equal to the heat required to raise one pound of water one degree Celsius.

*17. Pierre Curie calculated the energy given off by radium in: _____.
(a) ***calories*** (b) newtons (c) curies (d) ***isotopes***

*18. In _____ hours, an ounce of radium releases enough energy to heat a glass of water from room temperature to its boiling point.

19. A total of 1,620 years must pass before _____ loses half of its radioactive energy.

20. Write the **Life Principle:** *"*_____
_____
_____*."*

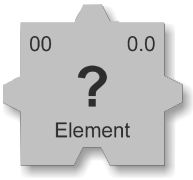
Note: Ask your teacher for the quiz over topics 1-5 before proceeding to the next section. Reminder: If you score 85% or higher on the three section quizzes, you may be exempt from the chapter test!



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Name: _____

Date: _____ Grade: _____



ACTIVITIES
Lesson 6:
Elements

Subatomic Particles

You are making progress! ***Answer the following questions. Circle the correct answers or fill in the blanks with words, letters or numbers as each question indicates. Check your answers from the Answer Key. Correct all errors, then complete your next goal.***

1. "We didn't know it couldn't be done" refers to: _____.
   (a) Moon landing (c) trans-Atlantic telegraph cable
   (b) trans-Alaska pipeline (d) Hoover dam

*2. The weld holding two steel pipes together can be checked by: _____.
   (a) circumlocution (b) echolocation (c) gamma rays (d) radar

3. Particles that carry an electric charge will bend when sent through a magnetic field.
   (a) True or (b) False

4. In Rutherford's experiment, the magnetic field split the radiation into _____ different streams.

*5. The names Rutherford gave to the radiation were alpha, beta and _____.

*6. The most penetrating radiation is: _____.
   (a) alpha particles (c) beta particles
   (b) omega particles (d) gamma rays

*7. An alpha particle can be thought of as a(n) _____ nucleus.
   (a) helium (b) hydrogen (c) uranium (d) iron

8. The loss of an alpha particle causes an atom's atomic number to: _____.
   (a) decrease by 2 (b) increase by 2 (c) stay the same (d) double

9. The loss of an alpha particle causes an atom's atomic mass to: _____.
   (a) double (b) decrease by 4 (c) increase by 4 (d) stay the same

*10. ***Beta particles*** are high-speed _____.

11. Beta particles are about _____ times more penetrating than alpha particles.

*12. Beta particles come from: _____
   (a) a proton (c) outer space
   (b) electrons (d) the nucleus of an atom

13. The one that does not curve in a magnetic field is a(n): _____.
   (a) ***gamma ray*** (c) charged particle
   (b) ***alpha particle*** (d) electron

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14. Gamma rays are: _____.
    (a) electromagnetic waves similar to light
    (b) particles with a positive charge
    (c) particles with a negative charge
    (d) all of the above

*15. _____ waves can penetrate through several feet of concrete.

*16. Gamma waves are emitted from the nucleus of an _____.

17. When an atom emits a gamma wave, the atomic number and atomic weight are _____.

*18. The emission of a gamma ray from the nucleus: _____.
    (a) splits the nucleus
    (b) carries away energy
    (c) changes the atomic number
    (d) changes the atomic weight

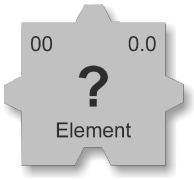
19. ***Half-life*** is a measure of the time for one-half of a sample of a radioactive substance to disintegrate.
    (a) True or (b) False

20. Write the **Life Principle:** *"*_____
    _____
    _____*."*

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Name: _____

Date: _____ Grade: _____



ACTIVITIES
Lesson 7:
Elements

Half-Life and Radiation Sickness

You are making progress! ***Answer the following questions. Circle the correct answers or fill in the blanks with words, letters or numbers as each question indicates. Check your answers from the Answer Key. Correct all errors, then complete your next goal.***

1. The ***archaeologist*** could find the age of the charcoal by _____ dating.

*2. The element in the air that changes into carbon-14 is: _____.
(a) carbon-12 (b) argon (c) nitrogen (d) oxygen

3. ***Carbon-14 dating*** is so exact, it can give the exact year a tree died.
(a) True or (b) False

4. The *half-life* of a radioactive element is the time required for _____ of the atoms in any given sample to disintegrate.

*5. Half-life is the same for all radioactive elements.
(a) True or (b) False

6. All isotopes of the same radioactive element have the same half-life.
(a) True or (b) False

7. Radium-226 has a half-life of about _____ years.

8. After 1,620 years, a one-kilogram sample of radium-226 becomes: _____.
(a) 1/2 gram (b) ungrams (c) 1/2 kilogram (d) 2 grams

9. The radioactivity of uranium is not affected by physical or _____ changes.

*10. The radioactivity of an element is measured in _____.

11. A radioactive sample with a radioactivity of one ***curie*** will have $3.7 * 10^{10}$ atoms disintegrate every: _____.
(a) day (b) minute (c) year (d) second

*12. The americium in smoke detectors has a half-life of _____ years.

*13. Alpha and beta particles produce a _____ on the skin that is slow to heal.

*14. The one that penetrates deeper into the body is a(n): _____.
(a) alpha particle (c) gamma ray
(b) beta particles (d) omega ray

*15. When ions attach themselves to nearby molecules and cause chemical changes, a person develops _____ _____.

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*16. Symptoms of _____ include nausea, vomiting, internal bleeding, lack of muscle control and possible cancers.

*17. Another effect of radiation poisoning includes a body's immune system becoming _____.

*18. Bone marrow transplants are given to radiation victims to help them generate: _____.

(a) gray matter in the brain
(b) more calcium
(c) white blood cells to fight infection
(d) red blood cells

*19. A *dosimeter* is used to measure: _____.

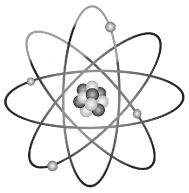
(a) doses of medicine
(b) exposure to radiation
(c) weather conditions
(d) blood pressure

20. Write the **Life Principle:** *"*_____
_____
_____*."*

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Name: _____

Date: _____ Grade: _____



ACTIVITIES
Lesson 8:
Energy

Artificial Radioactivity

You are making progress! ***Answer the following questions. Circle the correct answers or fill in the blanks with words, letters or numbers as each question indicates. Check your answers from the Answer Key. Correct all errors, then complete your next goal.***

1. Pierre and Marie did not attend the Nobel ceremony in Stockholm because of: _____.
   (a) illness from ***undiagnosed*** radiation poisoning
   (b) Marie's weakness due to ***leukemia***
   (c) they refused to accept it
   (d) they did not deserve it

2. _____ _____ caused Pierre Curie to have an unsteady walk, his hands to shake and muscle spasms.

3. The first woman professor at the Sorbonne in Paris was: _____.
   (a) Madame Becquerel (c) Ada, Countless of Lovelace
   (b) Amelia Earhart (d) Marie Curie

4. The first person to win two Nobel prizes was: _____.
   (a) Henri Becquerel (b) John Dalton (c) Marie Curie (d) Pierre Curie

5. A laboratory, the Radium Institute, had been built for Marie Curie in _____, but she did not occupy it until after the war.

6. Marie Curie died in 1934 of leukemia caused by exposure to: _____.
   (a) carbon-14 bombardment (c) cosmic radiation
   (b) X-ray machines (d) radioactivity of radioactive elements

*7. Rutherford caused an artificial nuclear reaction by bombarding _____ with alpha particles.
   (a) helium (b) nitrogen (c) radium (d) oxygen

*8. The symbol, $_{8}O^{17}$, shows that the number of protons in oxygen is: _____.
   (a) nine (b) eight (c) 17 (d) 25

9. Rutherford proved that it is impossible to artificially change one element into another.
   (a) True or (b) False

10. Like Sir Isaac Newton, Ernest Rutherford is often ranked as one of the ten greatest _____ of all time.

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*11. Most of the elements found in plants and animals are: _____.
(a) light like carbon (c) heavy like uranium
(b) oxygenated (d) equal with isotopes

12. The heaviest of elements found in the body is _____.

13. Radioactive _____ give information about whether an organ is functioning properly.

14. The first to generate radioactive isotopes of lighter elements was: _____.
(a) Pierre and Marie Curie (c) Mortimer Fellows
(b) Ernest Rutherford and R. B. Hayes (d) Irène and Frédéric Joliot

15. In _____, Irène and Frédéric Joliot bombarded aluminum with alpha particles that changed the aluminum into _____.

16. Phosphorus-30 is a naturally occurring radioactive isotope.
(a) True or (b) False

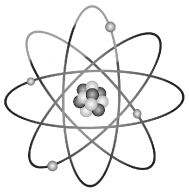
*17. The bullet that physicists used to fire into a nucleus to cause nuclear change was the: _____.
(a) alpha particle (b) beta particle (c) gamma ray (d) neutron ray

18. The repulsion of an alpha particle by the nucleus as the nucleus becomes heavier is: _____.
(a) doubled (b) weaker (c) stronger (d) equal

*19. Elements above phosphorus on the periodic chart exert repulsion so great that the alpha particle _____ hits the nucleus.
(a) sometimes (b) must (c) never (d) always

20. Write the **Life Principle:** *"_____
_____
_____."*

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ACTIVITIES
Lesson 9:
Energy

Fission

You are making progress! ***Answer the following questions. Circle the correct answers or fill in the blanks with words, letters or numbers as each question indicates. Check your answers from the Answer Key. Correct all errors, then complete your next goal.***

1. Compared to the other necessities of life, energy is not very important.
   (a) True or (b) False

2. The Sun is fueled by a nuclear reaction that changes hydrogen into: _____.
   (a) helium (b) iron (c) uranium (d) fission

*3. Atomic nuclei have a _____ electric charge.

4. The neutron has about the same mass as a(n): _____.
   (a) atom (b) alpha particle (c) electron (d) proton

5. Enrico Fermi was a brilliant student who graduated from the University of Pisa, Italy, with a Ph.D. in physics at the age of _____.

*6. A *thermal neutron* has a speed equal to the speed of molecules: _____.
   (a) at absolute zero (c) at room temperature
   (b) at rest (d) on the surface of the Sun

*7. Fermi showed that bombardment with _____ caused changes in almost every element.
   (a) high speed electrons (c) gammas
   (b) alpha particles (d) thermal neutrons

8. An atom will increase its atomic number by one when it releases _____ from the nucleus.
   (a) a beta particle (b) a neutron (c) an alpha particle (d) energy

*9. The naturally occurring element with the highest atomic number is _____.

10. Fermi was certain he had changed uranium into a new element beyond uranium.
    (a) True or (b) False

11. One thing _____ and _____ had in common was the persecutions of _____ and certain other ethnic groups.

12. Repressive practices of the ***fascist*** government in Italy allowed greater freedoms to people, especially ***ethnic*** groups.
    (a) True or (b) False

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13. After receiving the Noble Prize in Stockholm, Sweden, Fermi and his family: _____.
(a) escaped to America (c) returned to Italy
(b) escaped to Germany (d) stayed in Sweden

14. The one who insisted that students handle poisonous and radioactive chemicals properly was: _____.
(a) Marie Curie (b) Enrico Fermi (c) Lise Meitner (d) Otto Hahn

15. When uranium was bombarded with neutrons, tests by Hahn and Meitner indicated the product was _____ than uranium.
(a) lighter (b) less (c) heavier (d) greater

16. Meitner's nephew, Otto Frisch, worked at Bohr's laboratory and showed that her theory concerning radium, barium and krypton was _____.

17. The one who realized that uranium had split into two roughly equal pieces was: _____.
(a) Enrico Fermi (b) Lise Meitner (c) Pierre Curie (d) Otto Hahn

*18. ***Fission*** means to: _____.
(a) grow larger (b) melt together (c) split (d) expode

*19. A reaction in which the cause of the reaction is also one of the products is a _____ reaction.

20. Lise Meiter predicted that a fission reaction could become self-sustaining chain reaction by the _____ that the reaction released.

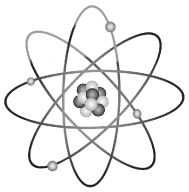
21. Lise Meitner's co-worker, Otto Hahn, was awarded the Nobel Prize for Chemistry in _____.

22. Lise Meitner died: _____.
(a) because of natural causes
(b) at the age of 56 because of radiation sickness
(c) celebrating her discovery
(d) short of her 90th birthday

23. The experiences of Enrico Fermi and Lise Meitner reveal that _____ is basic to encouraging and rewarding scientific discoveries.
(a) fascism (b) nazism (c) freedom (d) persecution

24. Write the **Life Principle:** *"*_____
_____
_____*."*

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ACTIVITIES
Lesson 10:
Energy

Nuclear Reactor

You are making progress! ***Answer the following questions. Circle the correct answers or fill in the blanks with words, letters or numbers as each question indicates. Check your answers from the Answer Key. Correct all errors, then complete your next goal.***

1. The products of fission are _____ stable than the original uranium atom.
   (a) more (b) less (c) equally (d) mono

*2. The extra energy that holds a nucleus together is the _____ energy.

3. Fermi saw that uranium fission could make a bomb with a destructive power never before imagined.
   (a) True or (b) False

4. The letter Albert Einstein signed and sent to President Franklin D. Roosevelt was written by: _____.
   (a) a friend of Einstein (c) Albert Einstein
   (b) a lab assistant (d) Enrico Fermi and a friend

*5. The isotope that splits and releases energy in (fuels) a ***nuclear reactor*** is: _____.
   (a) americium-241 (b) carbon-14 (c) uranium-235 (d) plutonium

6. The ***cryptic*** message, "The Italian navigator has entered the new world," refers to: _____.
   (a) Enrico Fermi's first controlled and sustained nuclear chain reaction
   (b) the bomb that exploded over Hiroshima
   (c) Marco Polo's early explorations
   (d) the invasion of North Korea by General Douglas MacArthur

*7. One reason uranium-235 is difficult to separate from uranium-238 is because they have the same chemical properties.
   (a) True or (b) False

8. Enriched uranium contains a higher proportion of _____ than is found in nature.
   (a) plutonium (b) potassium (c) uranium-235 (d) gold

*9. The amount of material to maintain a chain reaction is the _____ mass.

10. Fermi used pure _____ as a ***moderator***.

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*11. The purpose of a moderator is to: _____.
(a) contain an explosion (c) cool the reactor
(b) initiate fusion (d) slow neutrons

12. ***Control rods*** make a reaction proceed more slowly by absorbing: _____.
(a) alpha particles (b) neutrons (c) electrons (d) protons

13. The first nuclear reactor used _____ as control rods.

14. The ***coolant*** for most modern nuclear reactors is: _____.
(a) alcohol (b) air (c) water (d) oil

15. Fermi's first nuclear reactor was cooled by: _____.
(a) air (b) water (c) isotopes (d) antifreeze

*16. A nuclear reactor produces electricity: _____.
(a) when rods melt at 325ºC
(b) by freeing electrons
(c) when beta particles are changed into electricity
(d) by heating water to drive steam turbines

*17. A ***containment building*** is intended to: _____.
(a) prevent acid rain from affecting the nuclear reaction
(b) hold radioactive elements in a safe place so they cannot be stolen
(c) contain fission or fusion
(d) prevent the accidental release of radioactive materials

18. From 1978 to 2000, the number of new commercial nuclear power plants built in the United States was: _____.
(a) 0 (b) 20 (c) 100 (d) kept secret

19. The country that produces more of its electricity from nuclear energy is: _____.
(a) Sweden (b) France (c) United States (d) Germany

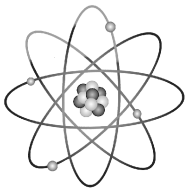
20. Nuclear reactors are limited to use in nuclear power plants and ***conventional*** submarines.
(a) True or (b) False

21. Write the **Life Principle:** *"*_____
_____
_____*."*

Note: Ask your teacher for the quiz over topics 6-10 before proceeding to the next section. Reminder: If you score 85% or higher on the three section quizzes, you may be exempt from the chapter test!



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ACTIVITIES
Lesson 11:
Energy

Albert Einstein and Nuclear Weapons

You are making progress! ***Answer the following questions. Circle the correct answers or fill in the blanks with words, letters or numbers as each question indicates. Check your answers from the Answer Key. Correct all errors, then complete your next goal.***

*1. _____ _____ is recognized as the greatest scientist of the 20th Century.

2. Browning motion is defined in terms of: _____.
   (a) electrostatic attraction
   (b) nuclear power
   (c) the ***Kinetic Theory of Heat***
   (d) the ***photoelectric effect***

3. Heat energy puts water molecules in _____ motion.

*4. In the photoelectric effect, the color that gives electrons the greatest speed is: _____
   (a) violet (b) blue (c) green (d) red

5. In the photoelectric effect, to release more electrons at the same speed the: _____
   _____.
   (a) brightness of the light has to be increased
   (b) the light is irrelevant
   (c) the color of the light has to be eliminated
   (d) the brightness of the light has to be decreased

6. The photoelectric effect is best explained by assuming that light has a _____ nature.
   (a) wave (b) particle (c) brilliant (d) particular

7. Einstein's third paper of 1905 was on the subject of the ***Special Theory of*** _____.

*8. The Michelson and Morley experiment proved that the speed of light: _____
   _____.
   (a) is a constant in a vacuum
   (b) is the same as the speed of sound
   (c) varies if the source of the light is in motion
   (d) was slower than previously thought

*9. When an electron is traveling near the speed of light its mass is: _____
   _____.
   (a) changed to a proton
   (b) greater than when it is at rest
   (c) less than when it is at rest
   (d) the same as when it is at rest

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*10. A _____ reaction takes larger nuclei and breaks them into smaller ones.

*11. A _____ reaction takes small nuclei and builds them into larger ones.

12. During a *fusion reaction*, the difference between the actual weight of nucleus and the total weight of its components is the _____ _____.

13. Einstein predicted that when starlight passed near a strong gravitational source such as the Sun, the light would: _____.
(a) change color (c) increase in speed
(b) come to a stop (d) have its path curved

14. During a total _____ of the Sun, stars near the line of sight of the Sun are visible.

15. Albert Einstein received the Nobel Prize in physics for his ***General Theory of Relativity***.
(a) True or (b) False

16. When Albert Einstein died in 1955, he: _____.
(a) was living in Spain and was bankrupt
(b) had become the best-known scientist in the world
(c) he was 100 years old and in ill health
(d) was forgotten and alone

17. The purpose of a ***breeder reactor*** is to produce: _____.
(a) electricity (c) uranium-235
(b) nuclear fuel, such as plutonium-239 (d) more reactors

*18. After exploding a test bomb at Alamogordo Air Force Base in New Mexico, the next two were exploded over industrial cities in: _____.
(a) Korea (b) France (c) Germany (d) Japan

19. The number of nuclear weapons used during war from 1945 to 2000 numbers in the hundreds. (a) True or (b) False

20. Write the **Life Principle:** *"*_____
_____
_____*."*

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ACTIVITIES
Lesson 12:
Inventions & Discoveries

Particle Accelerators and Detectors

You are making progress! ***Answer the following questions. Circle the correct answers or fill in the blanks with words, letters or numbers as each question indicates. Check your answers from the Answer Key. Correct all errors, then complete your next goal.***

*1. A particle _____ is a device that gives a high speed to a charged particle.

2. A Van de Graaff generator is one type of: _____.
   (a) metal detector (c) X–ray generator
   (b) particle accelerator (d) gamma device

3. An electron volt is the energy that is given to a(n) _____ as it crosses an electric potential of one volt.

4. The particle accelerator with hollow tubes arranged in a straight line is the: _____.
   (a) tube celetron (c) ***linear accelerator***
   (b) *cyclotron* (d) Van de Graaff generator

*5. In the cyclotron, the charged particles: _____.
   (a) are accelerated by gravitational attraction
   (b) circle around each other in cycles
   (c) are given a single huge shove at the beginning of their path
   (d) are bent in a circular path by magnets

*6. A positron has the same mass as a(n) _____ but with an opposite electrical charge.
   (a) hydrogen nucleus (b) proton (c) atom (d) electron

7. An improved version of the cyclotron built in the 1940s was known as the _____.

8. Tevatron at Fermilab is a particle accelerator made as a circle that has a diameter of: _____.
   (a) 8.0 inches (b) 1.25 miles (c) 20 miles (d) 50 miles

*9. Particle detectors identify _____ particles and reveal their properties.

*10. Most charged particles become visible because of the _____ they cause along their paths.

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11. The first particle detector was: _____.
    (a) a complete failure (c) a ***Geiger counter***
    (b) a cloud chamber (d) sheets of photographic film stacked together

12. Hans Geiger counted flashes of light produced as alpha particles struck a screen coated with _____.

*13. The Geiger counter produced ***audible*** clicks when radioactive particles caused ionization.
    (a) True or (b) False

14. Natural background radiation is produced by human activity.
    (a) True or (b) False

15. The natural background radiation serves as a guide to whether a source of _____ is sufficiently shielded.

16. The device that showed the path of the cloud chamber was invented by_____.

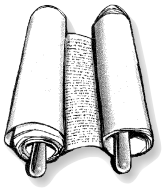
*17. When a charged nuclear particle passed through the Wilson cloud chamber, it caused: _____.
    (a) a condensation trail (c) a spark of light
    (b) fusion (d) an audible click

18. The one that produce thick tracks in the Wilson cloud chamber were: _____.
    (a) alpha particles (b) electrons (c) beta particles (d) gamma rays

19. Neutrons, gamma rays and other neutral particles leave no _____.

20. Write the **Life Principle:** *"*_____
    _____
    _____*."*

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Conservation Laws

ACTIVITIES
Lesson 13:
Scientific Laws

You are making progress! ***Answer the following questions. Circle the correct answers or fill in the blanks with words, letters or numbers as each question indicates. Check your answers from the Answer Key. Correct all errors, then complete your next goal.***

1. The total electric charge before a reaction must be the same as the total electric charge after a reaction.
   (a) True or (b) False

*2. In order to maintain the conservation of electric charge, when a neutron changes into a proton, the neutron must release a particle with a _____ charge.
   (a) negative (b) neutral (c) positive (d) determined

3. During nuclear reaction, mass is conserved.
   (a) True or (b) False

*4. When both mass and energy are taken together they _____ conserved.
   (a) could be (b) are (c) are not (d) are sometimes

5. During nuclear reactions the components at the start have _____ mass than the final products.
   (a) less (b) exerted more (c) more (d) same

6. A neutron is slightly more massive than a proton.
   (a) True or (b) False

7. The mass of two protons and two neutrons is _____ atomic mass units.

8. The mass of a helium nucleus is _____ atomic mass units.

*9. The difference between the combined masses of two protons and two neutrons and the mass of the helium nucleus is known as: _____.
   (a) fusion temperature (c) the critical mass
   (b) Roche's limit (d) the mass defect

10. A cloud chamber contained: _____.
   (a) moist air (c) liquid hydrogen
   (b) heavy water (d) a cumulus cloud

*11. A hydrogen ***bubble chamber*** detects radiation by the formation of _____ in liquid hydrogen.

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12. Luis Walter Alvarez was one of the best-known _____ physicists in the United States.

13. *Enola Gay* was: _____.
(a) the scientist-sweetheart of Hispanic physicist, Luis Alvarez
(b) a flightless Australian bird, genetically damaged by radiation
(c) a German physicist who worked with Einstein prior to World War II
(d) the B-29 bomber that carried the atom bomb to Hiroshima

14. To study the trails in the hydrogen bubble chamber, Alvarez: _____.
(a) used a camera to photograph them
(b) used a trailblazer
(c) employed assistants to sketch them
(d) hired his son-in-law

15. Luis Walter Alvarez received the 1968 Nobel Prize in _____.

16. According to the Meteorite Extinction Theory developed by Alvarez and his son, the dinosaurs died out because of: _____.
(a) a serious skin condition (c) the meteorite disease
(b) global warming (d) the impact of a giant meteorite

17. Marie Goeppert-Meyer spent most of her professional career as the highly paid director of the Institute of Advanced Studies in Princeton, New Jersey.
(a) True or (b) False

*18. After a nuclear reaction, protons and neutrons fall into a _____ stable pattern.
(a) more (b) less (c) equal (d) nearly

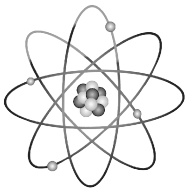
19. In 1963, Marie Goeppert-Meyer received the Nobel Prize in physics for her development of _____ shell structures.

20. Write the **Life Principle:** *"*_____
_____
_____*."*

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Name: _____

Date: _____ Grade: _____



ACTIVITIES
Lesson 14:
Energy

The Risks and Benefits of Nuclear Energy

You are making progress! ***Answer the following questions. Circle the correct answers or fill in the blanks with words, letters or numbers as each question indicates. Check your answers from the Answer Key. Correct all errors, then complete your next goal.***

1. Most people think of the period from 1950 to 2000 as "the _____ age."

*2. The reaction that requires a temperature of millions of degrees and incredible pressure is atomic: _____.
(a) fission (b) fusion (c) friction (d) fraction

3. The trigger that starts a fusion reaction is a(n): _____.
(a) hair trigger (c) critical mass of uranium
(b) explosion of TNT (d) fission reaction

*4. A ***thermonuclear*** bomb refers to a: _____.
(a) bomb made of TNT (c) fission bomb
(b) red hot smoke (d) fusion bomb

5. Unlike a fission bomb, the destruction of a thermonuclear explosion comes only from the blast.
(a) True or (b) False

6. The number of thermonuclear bombs used during wartime is: _____.
(a) 0 (b) 2 (c) kept secret (d) 100

7. The first commercial electric generating fission nuclear reactor was built in _____ in 1956.

8. By 2010, _____ voted to phase out all nuclear reactors in their country.

9. A typical atomic power generation plant costs about five _____ dollars.

10. A nuclear power plant has a ***useful lifetime*** of about: _____.
(a) 2 years (b) 35 to 45 years (c) 1,000 years (d) 10 years

*11. The single most difficult problem facing nuclear power production is: _____ _____.
(a) finding enough plutonium (c) disposal of radioactive material
(b) it only produces direct current wastes (d) possibility of an explosion

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*12. The most destructive nuclear accident/***meltdown*** took place at: _____ _____.
(a) the Chernobyl reactor in the Soviet Union (c) Hanford, Washington
(b) Three Mile Island, Pennsylvania (d) Oak Ridge, Tennessee

13. The Chernobyl explosion came: _____.
(a) during a safety test (c) during a time of peak energy demand
(b) during a break for lunch (d) after terrorist took over the building

*14. The Chernobyl reactor had no _____ building.

15. During the Chernobyl accident, the moderator of _____ caught fire.

*16. No country has succeeded in building a fusion reactor for electricity production.
(a) True or (b) False

17. In 1989, two scientists from the University of Utah claimed to have produced: _____.
(a) a fission reactor (b) *cold fusion* (c) diffusion of fission (d) a ***sarcophagus***

18. Fleischmann and Pons believed that hydrogen ions on the palladium electrode changed into _____.

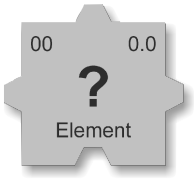
19. At the start of the year 2000, cold _____ had not been produced.

20. Write the **Life Principle:** *"*_____ _____ _____.*"*

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Name: _____

Date: _____ Grade: _____



ACTIVITIES
Lesson 15:
Elements

Benefits of Radioactivity and Completion of the Periodic Table

You are making progress! ***Answer the following questions. Circle the correct answers or fill in the blanks with words, letters or numbers as each question indicates. Check your answers from the Answer Key. Correct all errors, then complete your next goal.***

1. The benefits of nuclear power were _____ than most scientists anticipated.

2. _____ energy has many uses on Earth and in space.

3. Rosalyn Sussman Yalow began working at the Bronx Veterans Administration Hospital: _____.
   (a) as a physician on the staff
   (b) as a volunteer
   (c) because that is the only place she could find a job
   (d) as a janitor

4. Yalow and Berson developed a way to measure the amount of regular _____ in the blood.

5. Yalow received the Nobel Prize in 1977 for her development of radioimmunoassay or better known as _____.

*6. A ***stable element*** has at least one stable _____.

*7. Radium, polonium and radon are three examples of a(n): _____.
   (a) inert element
   (b) naturally occurring radioactive elements
   (c) stable radioactive element
   (d) radioactive element with at least one stable isotope

8. After the six naturally occurring ***radioactive elements*** were placed in the Periodic Table of the Elements, the chart was finally complete.
   (a) True or (b) False

9. Because all of its isotopes were very short lived, the Italian scientists gave element number 85 the name astatine from a Greek word meaning _____.

10. Element number 87 was discovered by a Marguerite Perey who worked at: _____.
    (a) Cavendish Laboratory
    (b) Stanford Laboratory
    (c) Curie Institute in Paris, France
    (d) University of California at Berkeley

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11. Element number 87 was named francium after: _____.
(a) America (b) Canada (c) Francis (d) France

12. In Greek mythology, the one who gave fire to human beings was: _____.
(a) Pluto (b) Prometheus (c) Uranius (d) Mars

*13. The transuranium elements: _____.
(a) are found in Transurania
(b) have an atomic number less than 92
(c) are naturally occurring
(d) are ***synthetic***

14. The first transuranium element, number 93, was produced by bombarding one of the isotopes of uranium with _____.

15. The element beyond neptunium is _____.

16. The planet beyond Neptune is _____.

17. None of the transuranium elements are named in honor of a person.
(a) True or (b) False

*18. The last transuranium element synthesized at the end of the 1900s was element number _____, ununoctium.

19. Ununoctium has an atomic weight of 293 and has a three letter symbol of _____.

20. Write the **Life Principle:** *"*_____
_____
_____*."*

Note: Ask your teacher for the quiz over topics 11-15 before proceeding to the next section. Reminder: If you score 85% or higher on the three section quizzes, you may be exempt from the chapter test!



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