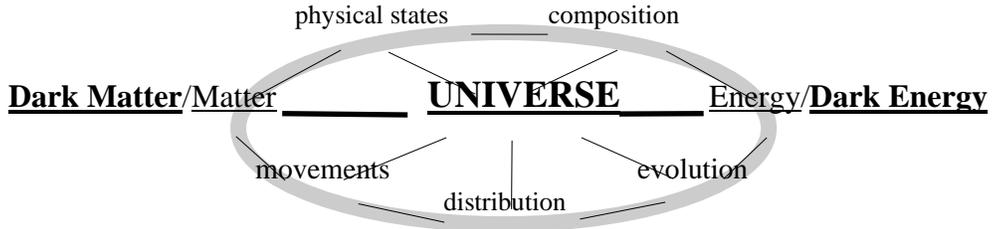


**SESSION ONE: INTRODUCING ASTRONOMY  
DEFINE ASTRONOMY!**

Write all of the words that you believe to be directly or indirectly related to astronomy. Be sure to consider the consequences of each word that you write. As an example, the word "planet" is certainly an appropriate choice, but this word can also lead to a variety of other choices such as "Mercury," "Jupiter," "canals," "Great Red Spot," as examples. You'll have five minutes to complete this task. The record is 80 words held by Moravian student Missy Salvadeo in 2019. Much Success!!



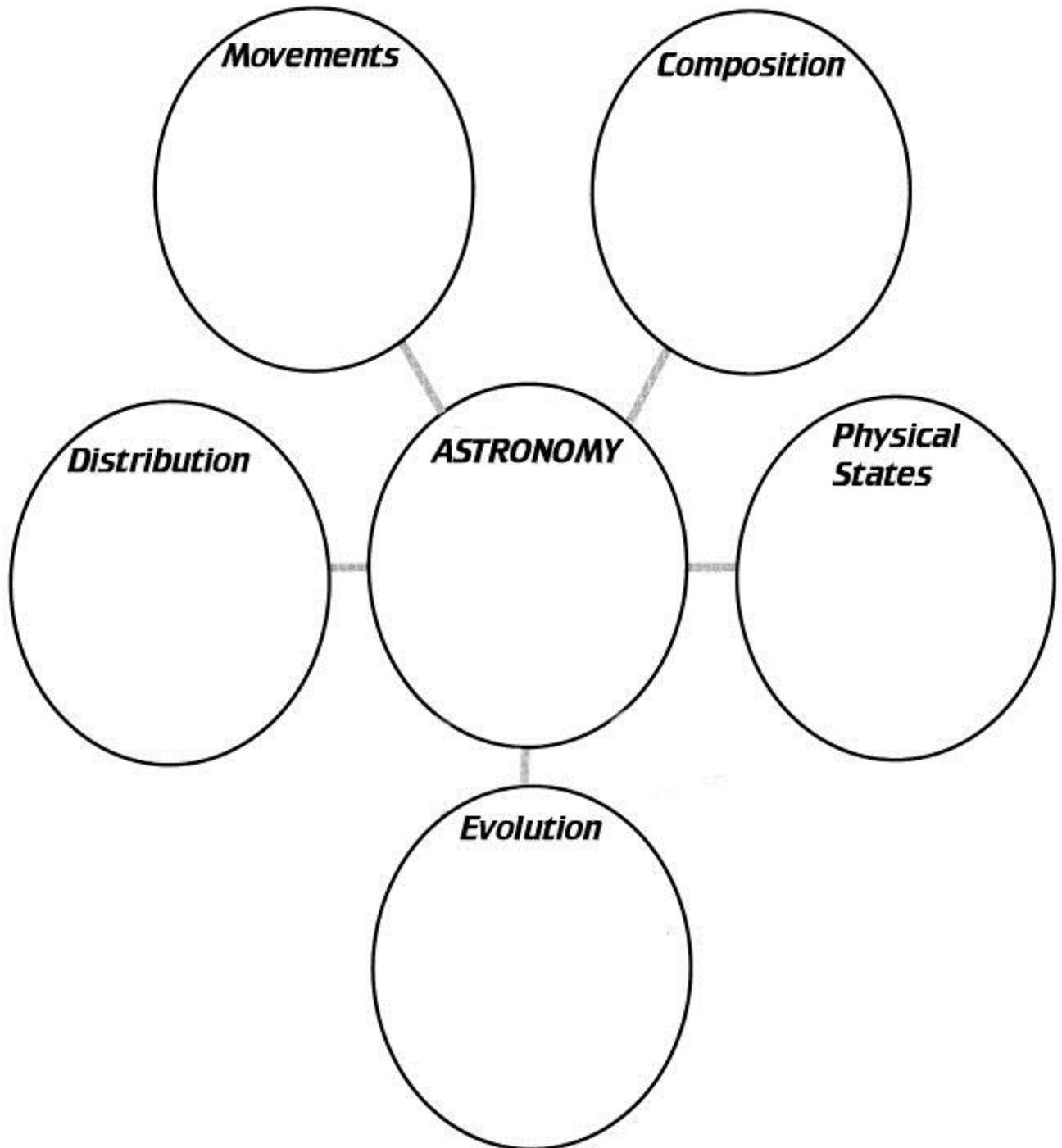
Name \_\_\_\_\_ Date \_\_\_\_\_ Moravian University

**Astronomy** is the science that investigates all \_\_\_\_\_.

- |            |            |            |
|------------|------------|------------|
| 1. _____,  | 24. _____, | 47. _____, |
| 2. _____,  | 25. _____, | 48. _____, |
| 3. _____,  | 26. _____, | 49. _____, |
| 4. _____,  | 27. _____, | 50. _____, |
| 5. _____,  | 28. _____, | 51. _____, |
| 6. _____,  | 29. _____, | 52. _____, |
| 7. _____,  | 30. _____, | 53. _____, |
| 8. _____,  | 31. _____, | 54. _____, |
| 9. _____,  | 32. _____, | 55. _____, |
| 10. _____, | 33. _____, | 56. _____, |
| 11. _____, | 34. _____, | 57. _____, |
| 12. _____, | 35. _____, | 58. _____, |
| 13. _____, | 36. _____, | 59. _____, |
| 14. _____, | 37. _____, | 60. _____, |
| 15. _____, | 38. _____, | 61. _____, |
| 16. _____, | 39. _____, | 62. _____, |
| 17. _____, | 40. _____, | 63. _____, |
| 18. _____, | 41. _____, | 64. _____, |
| 19. _____, | 42. _____, | 65. _____, |
| 20. _____, | 43. _____, | 66. _____, |
| 21. _____, | 44. _____, | 67. _____, |
| 22. _____, | 45. _____, | 68. _____, |
| 23. _____, | 46. _____, | 69. _____, |

Name \_\_\_\_\_ Date \_\_\_\_\_ Moravian University

**WHAT IS ASTRONOMY?**  
(graphic organizer)



- I. **Definition of Astronomy:** The science which investigates all of the matter-energy in the universe: its distribution, composition, physical states, movements, and evolution.
- A. **Distribution:** The position, arrangement or frequency of matter/energy over an area or throughout a space.
1. The universe looks like a sponge or better yet Halloween spiderwebbing with clusters of galaxies composing the spongy or webbing material.
  2. Most of the solar system's mass is contained within the sun (99.98%).
  3. The bulk of the mass in the Earth-moon system is found in the Earth (98.8%).
- B. **Movements:** Any condition related to the change of position of matter in space or on a coordinate grid. Objects in space change their position because they are in motion and the observation platform from which those observations are being made, Earth, is also in motion.
1. **Rotation:** Period of time a body takes to complete one spin about its axis.
  2. **Revolution:** Period of time a less massive body takes to complete one orbit around a more massive object.
  3. **Precession:** The conical wobbling of Earth's axis. One cycle takes about 26,000 years and causes the pivot position of Earth's axis to point to different stars along its path.
- C. **Physical States:** The conditions that permit matter to be found as a solid, a liquid, a gas, or a plasma.
1. **Solid:** Matter has a shape/volume caused by strong atomic or molecular bonds.
  2. **Liquid:** Matter cannot retain a definite shape because bonds between atoms and molecules are too weak, but it does retain a definite volume.
  3. **Gas:** A fluid that has neither independent shape nor volume, but tends to expand indefinitely.
  4. **Plasma:** A hot gas that is not electrically neutral. Plasma is composed of ions and electrons in free association. The ions that compose the substance have either an excess or a deficiency of electrons in comparison to the number of protons that they contain.
- D. **Composition:** The qualitative and quantitative chemical makeup of matter.
1. **Qualitative example:** Components are identified in a descriptive way without being quantified. The sun is composed of hydrogen and helium.
  2. **Quantitative example:** Components are identified in a numerical fashion. The sun by volume is composed of 95% hydrogen and 5% helium, but by mass it is composed of 78% hydrogen, 20% helium and 2% heavier atoms all called metals.
  3. **Composition of Universe:** 68% dark energy, 27% dark matter, 5% baryonic matter. Baryonic matter contains the protons, neutrons and electrons which we are familiar with in every day matter. Dark matter/energy does not react with the matter that is baryonic, that we can see. Dark matter does possess gravity, so we can see its effects on baryonic masses.

- E. **Evolution**: The process of change from a beginning to an end.
1. **Big Bang**: The universe started with a Big Bang (pop) and will expand forever.
  2. **Oscillating Universe**: The universe started with the Big Bang, but possesses enough mass (gravity) to halt the expansion so that it will one day collapse upon itself creating the **Big Crunch**. With proof of the accelerating universe, the oscillating universe theory has become obsolete. By observing galaxies at different distances, it is possible to see the rate of expansion of the universe at different times in the past. The expansion was slower in the early universe.
  3. **Big Chill**: Dark energy causes the universe to accelerate forever or effects of dark energy decrease with time slowing but never stopping the universe's expansion.
  4. **Superclusters of galaxies will collapse into black holes** that over several hundred billion years will evaporate their mass back into space.

### NOTES

Name \_\_\_\_\_ Date \_\_\_\_\_ Moravian University

**DISTILL THE DEFINITION TO ITS BASIC MEANING**

**Instructions:** Take the word on the left and find the most important information, words, or numbers associated with it to complete a shortened definition on the right. The full definitions of these words can be found elsewhere in this chapter. **You may not use more than six words for your core definition.** **Abbreviations will count as words,** such as mi./sec., equals miles/second, equals two words. Numbers, symbols, and punctuation will not count as words unless used incorrectly. Here is an example of an incorrect usage. “2 b or not 2 b” will mean “To be or not to be,” and will have six words, not four. The grammar police will also be arresting you! The word or a similar word may **NOT** be used in the definition unless there is an asterisk with the word underlined. The asterisk is only good for the word directly next to it. In Electromagnetic Force\*, only “Force” applies to this situation.

<b>DEFINE THE WORD</b>	<b>DEFINITION: NO MORE THAN SIX WORDS MAXIMUM</b>
<b>Astronomical Unit</b>	
<b>Astronomy</b>	
<b><u>Baryonic Matter</u>*</b>	
<b>Big Bang</b>	
<b>Black Hole</b>	
<b>Composition</b>	
<b>Dark Energy</b>	
<b>Dark Matter</b>	
<b>Density</b>	
<b>Distribution</b>	
<b>Ecliptic</b>	
<b><u>Electromagnetic Force</u>*</b>	
<b>Electromagnetic Spectrum</b>	
<b>Evolution</b>	
<b>Galaxy</b>	
<b>Gravity</b>	
<b>Hydrogen</b>	
<b>Inverse Square Law</b>	

<b>DEFINE THE WORD</b>	<b>DEFINITION: NO MORE THAN SIX WORDS MAXIMUM</b>
<b>Ion</b>	
<b><u>Light</u>* <u>Year</u>*</b>	
<b>Mass</b>	
<b>Meridian</b>	
<b><u>Move</u>*<u>ments</u></b>	
<b><u>Oscillating</u> <u>Universe</u>*</b>	
<b>Physical States of Matter</b>	
<b>Planet</b>	
<b>Plasma</b>	
<b>Precession</b>	
<b>Qualitative</b>	
<b>Quantitative</b>	
<b>Quantum Mechanics</b>	
<b>Revolution</b>	
<b>Rotation</b>	
<b>Solar System</b>	
<b>Speed of <u>Light</u>*</b>	
<b>Stellar System</b>	
<b>Star</b>	
<b>String Theory</b>	
<b>Strong Nuclear <u>Force</u>*</b>	
<b>Universe</b>	
<b>Weak Nuclear <u>Force</u>*</b>	

**BASIC ASTRONOMY WORD LIST**

1. **Astronomical Unit**: The average distance from the Earth to the sun, approximately 93 million miles or 149 million kilometers.
2. **Astronomy**: The science which investigates all matter and energy in the universe.
3. **Baryonic Matter**: The protons, neutrons, and electrons which govern the chemical makeup of the universe which we can observe. It comprises about five percent of the known universe.
4. **Big Bang**: A theory for the beginning of the evolution of the universe. The hypothesis purports that the universe appeared or “popped” from a small primordial atom or from “nothingness” and will keep expanding/accelerating forever. The notion that an explosion occurred is no longer considered valid; but the big bang has been impossible to remove from the literature, and so the words remain.
5. **Black Hole**: The volume of space surrounding a collapsed star in which the escape velocity equals or exceeds the speed of light.
6. **Composition**: The (qualitative and quantitative) chemical make-up of matter.
7. **Dark Energy**: An unknown force that can be quantified and is responsible for the expansion and acceleration of the universe. The amount of dark energy in the universe remains constant with volume and represents about 68 percent of the known universe.
8. **Dark Matter**: An unseen mass of unknown substance which can be quantified and comprises about 27 percent of the known universe. Its only similarity to baryonic matter is that it possesses gravity.
9. **Density**: The mass of an object divided by its volume. Mass per unit volume.
10. **Distribution**: The position or arrangement of matter/energy through an area or a space.
11. **Ecliptic**: The reference plane of the solar system which is created by the Earth orbiting the sun. It can also be defined as the path of the sun in the sky created by the Earth’s orbital motion, or the plane of the Earth’s orbit projected into space.
12. **Electromagnetic Force**: It governs how electrons orbit the nucleus of atoms and how atoms interact with each other to form the chemical bonds of the matter which we see all around us.
13. **Electromagnetic Spectrum**: All of the forms of energy which travel at the speed of light in a vacuum and which are represented by an electrical as well as a magnetic component— (**most intense**) gamma rays, X-rays, ultraviolet, visible, infrared, microwaves, and radio energy (**least intense**).
14. **Evolution**: The process of change over time from a beginning to an end.
15. **Galaxy**: The basic manner in which matter clumps or congregates in the universe. Galaxies can be composed of millions to trillions of stars.
16. **Gravity**: The force of attraction acting between two bodies. That force is directly related to the mass of the bodies and inversely correlated to the square of their distances ( $1/d^2$ ).
17. **Hydrogen**: The most abundant element in the universe as well as the simplest element on the Periodic Table of Elements. It is composed of one proton and one electron.
18. **Inverse Square Law**: The intensity of a force varies as one over the distance multiplied by itself ( $1/d^2$ ). It governs how the strength of electromagnetic energy (light), magnetism, and gravity (even sound) varies with distance from the source.
19. **Ion**: An atom or molecule (radical) which is not electrically neutral because it has either gained or lost one or more electrons.
20. **Light Year**: The distance that light travels in one year, approximately 5.8 trillion miles.

21. **Mass:** The quantity of matter which an object contains.
22. **Meridian:** An imaginary great circle that intersects the south point on the horizon, the point directly overhead (zenith), the North Celestial Pole (near to the North Star), and the north point on the horizon. The meridian divides the eastern sky (a.m.—antemeridian, before the meridian) from the western sky (p.m.—post meridian, after the meridian).
23. **Movements:** The change in the position of a celestial object due to a change in the position of the Earth or the object itself.
24. **Oscillating Universe:** An outdated theory which states that the universe started with a big bang, but has a sufficient amount of matter to collapse upon itself, regenerating into another big bang in an endless cycle. Astronomers now know that the universe is not only expanding, but it is also accelerating. There will be no future collapse only endless acceleration.
25. **Physical States of Matter:** solid (volume/shape remains constant), liquid (volume remains constant/shape changes), gas (volume/shape change), and plasma (see specific definition)...
26. **Planet:** A round object, which is not the satellite of another planet; it is in orbit around the sun, and it is massive enough to clear its orbital path from debris.
27. **Plasma:** A hot, ionized gas in which ions and electrons are in free association.
28. **Precession:** The conical wobbling of the Earth's axis created by the sun's unequal pull on the equatorial bulge of the Earth. One precession cycle takes about 25,800 years.
29. **Qualitative:** A description of something...
30. **Quantitative:** Putting a numeric value on something...
31. **Quantum Mechanics:** The physics of the very small which governs the interactions of the parts of an atom and the interactions of atoms and molecules with each other.
32. **Revolution:** The orbiting motion of one body around another body. The Earth completes one orbit around the sun in a period of 365.24 days.
33. **Rotation:** The spinning motion of a body around its axis. The Earth rotates in a period of 23 hours, 56 minutes, 4 seconds.
34. **Solar System:** Our family of planets, moons, dwarf planets, and smaller bodies that are in orbit around the sun.
35. **Speed of Light:** The distance covered by electromagnetic radiation in a unit time interval. In a vacuum it is equivalent to 186,000 miles per second or 300,000 kilometers per second. The symbol "c" which represents the speed of light comes from the Latin word *celeritas*, which means speed.
36. **Stellar System:** A star surrounded by other stars in orbit around it, or a family of planets, moons, and lesser bodies orbiting around a star other than our sun.
37. **Star:** A self-luminous body which maintains its energy output because of the conversion of matter into energy within its core.
38. **String Theory:** A hypothesis which proposes that the universe is ultimately composed of minuscule vibrating strands of energy which are found within subatomic particles known as quarks. The vibrations of the strings are governed by six additional tiny point dimensions which create the physical constants which allow us to describe the universe in which we live. According to String Theory the universe has a total of 11 dimensions.
39. **Strong Nuclear Force:** It is the "glue" which binds the nucleus of an atom together.
40. **Universe:** All matter and energy everywhere...
41. **Weak Nuclear Force:** It is the force which governs how radioactive isotopes decay.

# The periodic table

www.webelements.com

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18																																																																							
Hydrogen 1 <b>H</b> 1.008	Lithium 3 <b>Li</b> 6.94	Sodium 11 <b>Na</b> 22.990	Potassium 19 <b>K</b> 39.098	Rubidium 37 <b>Rb</b> 85.468	Cesium 55 <b>Cs</b> 132.91	Francium 87 <b>Fr</b> [223.02]	Beryllium 4 <b>Be</b> 9.0122	Magnesium 12 <b>Mg</b> 24.305	Calcium 20 <b>Ca</b> 40.078(4)	Strontium 38 <b>Sr</b> 87.62	Barium 56 <b>Ba</b> 137.33	Radium 88 <b>Ra</b> [226.03]	Scandium 21 <b>Sc</b> 44.956	Yttrium 39 <b>Y</b> 88.906	Lutetium 71 <b>Lu</b> 174.97	Lawrencium 103 <b>Lr</b> [262.11]	Titanium 22 <b>Ti</b> 47.867	Zirconium 40 <b>Zr</b> 91.224(2)	Hafnium 72 <b>Hf</b> 178.49(2)	Rutherfordium 104 <b>Rf</b> [261.10]	Vanadium 23 <b>V</b> 50.942	Niobium 41 <b>Nb</b> 92.906(2)	Tantalum 73 <b>Ta</b> 180.95	Dubnium 105 <b>Db</b> [268.13]	Chromium 24 <b>Cr</b> 51.996	Molybdenum 42 <b>Mo</b> 95.96(2)	Tungsten 74 <b>W</b> 183.84	Seaborgium 106 <b>Sg</b> [263.10]	Manganese 25 <b>Mn</b> 54.938	Technetium 43 <b>Tc</b> [98.9062]	Rhenium 75 <b>Re</b> 186.21	Bohrium 107 <b>Bh</b> [264.10]	Iron 26 <b>Fe</b> 55.845(2)	Ruthenium 44 <b>Ru</b> 101.07(2)	Osmium 76 <b>Os</b> 190.23(2)	Hassium 108 <b>Hs</b> [277.10]	Cobalt 27 <b>Co</b> 58.933	Rhodium 45 <b>Rh</b> 102.91	Iridium 77 <b>Ir</b> 192.22	Meltherium 109 <b>Mt</b> [276.10]	Nickel 28 <b>Ni</b> 58.693	Palladium 46 <b>Pd</b> 106.42	Platinum 78 <b>Pt</b> 195.08	Darmstadtium 110 <b>Ds</b> [281.16]	Copper 29 <b>Cu</b> 63.546(3)	Silver 47 <b>Ag</b> 107.87	Gold 79 <b>Au</b> 196.97	Roentgenium 111 <b>Rg</b> [280.16]	Zinc 30 <b>Zn</b> 65.38(2)	Cadmium 48 <b>Cd</b> 112.41	Mercury 80 <b>Hg</b> 200.59	Copernicium 112 <b>Cn</b> [285.17]	Aluminum 13 <b>Al</b> 26.982	Gallium 31 <b>Ga</b> 69.723	Indium 49 <b>In</b> 114.82	Thallium 81 <b>Tl</b> 204.38	Ununtrium 113 <b>Uut</b> [284.18]	Carbon 6 <b>C</b> 12.011	Silicon 14 <b>Si</b> 28.085	Germanium 32 <b>Ge</b> 72.63	Tin 50 <b>Sn</b> 118.71	Lead 82 <b>Pb</b> 207.2	Flerovium 114 <b>Fl</b> [289.19]	Nitrogen 7 <b>N</b> 14.007	Phosphorus 15 <b>P</b> 30.974	Arsenic 33 <b>As</b> 74.922	Antimony 51 <b>Sb</b> 121.76	Bismuth 83 <b>Bi</b> 208.98	Ununpentium 115 <b>Uup</b> [288.19]	Oxygen 8 <b>O</b> 15.999	Sulfur 16 <b>S</b> 32.06	Selenium 34 <b>Se</b> 78.96(3)	Tellurium 52 <b>Te</b> 127.60(3)	Polonium 84 <b>Po</b> [209]	Livermorium 116 <b>Lv</b> [293]	Fluorine 9 <b>F</b> 18.998	Chlorine 17 <b>Cl</b> 35.45	Bromine 35 <b>Br</b> 79.904	Iodine 53 <b>I</b> 126.90	Astatine 85 <b>At</b> [210]	Ununseptium 117 <b>Uus</b> [294]	Helium 2 <b>He</b> 4.0026	Neon 10 <b>Ne</b> 20.180	Argon 18 <b>Ar</b> 39.948	Krypton 36 <b>Kr</b> 83.798(2)	Xenon 54 <b>Xe</b> 131.29	Radon 86 <b>Rn</b> [222.02]	Ununoctium 118 <b>Uuo</b> [294]

Key:  
Element Name  
Atomic number  
Symbol  
Atomic weight (mean relative mass)

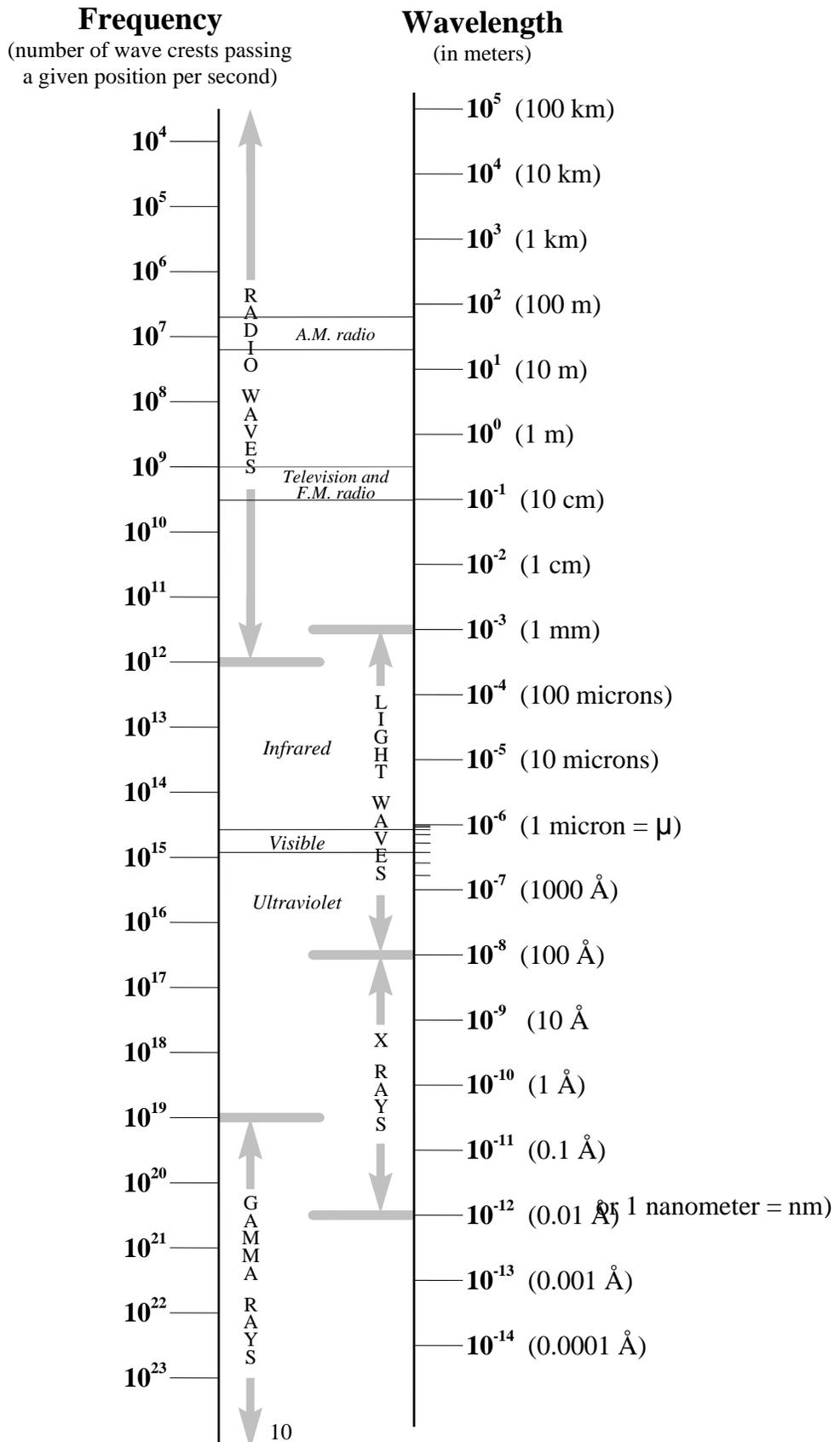
Lanthanum 57 <b>La</b> 138.91	Cerium 58 <b>Ce</b> 140.12	Praseodymium 59 <b>Pr</b> 140.91	Neodymium 60 <b>Nd</b> 144.24	Promethium 61 <b>Pm</b> [144.91]	Samarium 62 <b>Sm</b> 150.36(2)	Europium 63 <b>Eu</b> 151.96	Gadolinium 64 <b>Gd</b> 157.25(3)	Terbium 65 <b>Tb</b> 158.93	Dysprosium 66 <b>Dy</b> 162.50	Erbium 67 <b>Er</b> 167.26	Thulium 69 <b>Tm</b> 168.93	Ytterbium 70 <b>Yb</b> 173.05	Actinium 89 <b>Ac</b> [227.03]	Thorium 90 <b>Th</b> 232.04	Protactinium 91 <b>Pa</b> 231.04	Uranium 92 <b>U</b> 238.03	Plutonium 94 <b>Pu</b> [244.06]	Americium 95 <b>Am</b> [243.06]	Curium 96 <b>Cm</b> [247.07]	Berkelium 97 <b>Bk</b> [247.07]	Californium 98 <b>Cf</b> [251.08]	Fermium 100 <b>Fm</b> [257.10]	Mendelevium 101 <b>Md</b> [258.10]	Nobelium 102 <b>No</b> [259.10]
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\*lanthanoids

\*\*actinoids

Symbols and names: the symbols and names of the elements, and their spellings are those recommended by the International Union of Pure and Applied Chemistry (IUPAC - <http://www.iupac.org>). Names have yet to be proposed for elements 113, 115, 117, and 118 and so those used here are IUPAC's temporary systematic names. In some countries, the spellings **aluminium**, **caesium**, and **sulphur** are usual.  
Group labels: the numeric system (1-18) used here is the current IUPAC convention.  
Atomic weights (mean relative masses): these are the IUPAC 2009 values and given to 5 significant figures. The last significant figure of each value is considered reliable to ±1 except where a larger uncertainty is given in parentheses. Representative values for those elements having an atomic weight interval are given (H, Li, B, C, N, O, Si, Cl, Ti). Elements for which the atomic weight is given within brackets have no stable nuclides and are represented by the element's longest lived isotope reported in the IUPAC 2009 values.  
©2012 Dr. Mark J. Winter (WebElements Ltd and University of Sheffield). All rights reserved. For updates to this table see [http://www.webelements.com/nexus/Printable\\_Periodic\\_Table](http://www.webelements.com/nexus/Printable_Periodic_Table) (Version date: 7 June 2012).

# ELECTROMAGNETIC SPECTRUM



## MATH RULES

### RULE FOR ROUNDING UP OR DOWN

Five and above, give it a shove; four and below leave it alone. Leo Andreoli (2021)

### RULES FOR SIGNIFICANT NUMBERS

1. **Any nonzero digit is significant.** ...8.45 cm has three significant figures; 1.234 m has four significant figures.
2. **Zeros between nonzero digits are significant.** ...606 meters has three significant figures while 40,501 has five significant figures...
3. **Zeros to the left of the first nonzero digit are NOT significant.** Their purpose is to indicate the placement of a decimal point. ...0.08 liters has only one significant figure, while 0.0000349 has three significant figures...
4. **If a number is greater than one,** then all zeros written to the right of the decimal point are significant. Thus 2.0 has two significant figures, 2.00 would have three significant figures. ...40.062 has five significant figures and 3.040 has four significant figures...
5. **Trailing zeros in a number containing a decimal point are significant.** For example 0.090 kg has two significant figures, 0.3005 liter has four significant figures, and 0.00420 has three significant figures.
6. **For numbers that do not contain any decimal points,** the trailing zeros which are the zeros after the last nonzero digit may or may not be significant. Thus 400 cm may have one significant figure (4), two significant figures (40), or 3 significant figures (400). We cannot know which is correct without more information. In this particular case we can express the number 400 as  $4 \times 10^2$  for one significant figure,  $4.0 \times 10^2$  for two significant figures or  $4.00 \times 10^2$  for three significant figures.
7. **Assume that a single whole number digit** has as many significant figures to the right of the decimal as desired, unless otherwise stated.
8. **When numbers are multiplied or divided** to get the calculated quantity, the result may have no more significant figures than the measurement with the fewest significant numbers.
9. **When numbers are added or subtracted** to give a calculated quantity, it may have no column which represents a smaller quantity than the smallest numerical column common to both measurements. Thus the sum of 1.12 cm plus 21 cm is 22 cm, where the unit position represents the smallest numerical column common to both measurements. The addition or subtraction of numbers may have no decimal places greater than the measurement with the least number of decimal places.
10. **If a calculation has multiple steps, retain additional nonsignificant figures until the answer is achieved.** This helps to avoid any rounding errors (*California Institute of Technology*). The final answer must then be brought back into sync with the significant numbers of the original datum.

### BASIC TRIGONOMETRIC FUNCTIONS—SOH, CAH, TOA

1. Sine function = SOH = Sine = Opposite Hypotenuse
2. Cosine function = CAH = Cosine = Adjacent Hypotenuse
3. Tangent function = TOA = Tangent = Opposite Adjacent

From Zack Egizio, Dieruff High School/East Stroudsburg University

## TEMPERATURE CONVERSIONS

1. Centigrade to Fahrenheit:  $F^{\circ} = \frac{9}{5} \times C^{\circ} + 32$
2. Fahrenheit to Centigrade:  $C^{\circ} = \frac{5}{9} \times (F^{\circ} - 32)$
3. Kelvin (no degrees used because it is an absolute):  $K = C^{\circ} + 273$

## THE BASICS OF SCIENTIFIC NOTATION

Scientific Notation is a shorthand way of expressing large numbers based on the number 10.

$10^9$	= 10 x 10	= 1,000,000,000.
$10^8$	= 10 x 10	= 100,000,000.
$10^7$	= 10 x 10 x 10 x 10 x 10 x 10 x 10	= 10,000,000.
$10^6$	= 10 x 10 x 10 x 10 x 10 x 10	= 1,000,000.
$10^5$	= 10 x 10 x 10 x 10 x 10	= 100,000.
$10^4$	= 10 x 10 x 10 x 10	= 10,000.
$10^3$	= 10 x 10 x 10	= 1,000.
$10^2$	= 10 x 10	= 100.
$10^1$	= 10	= 10.
$10^0$	= 1	= 1.
$10^{-1}$	= 1/10	= 0.1
$10^{-2}$	= 1/10 x 1/10	= 0.01
$10^{-3}$	= 1/10 x 1/10 x 1/10	= 0.001
$10^{-4}$	= 1/10 x 1/10 x 1/10 x 1/10	= 0.0001
$10^{-5}$	= 1/10 x 1/10 x 1/10 x 1/10 x 1/10	= 0.00001
$10^{-6}$	= 1/10 x 1/10 x 1/10 x 1/10 x 1/10 x 1/10	= 0.000001
$10^{-7}$	= 1/10 x 1/10 x 1/10 x 1/10 x 1/10 x 1/10 x 1/10	= 0.0000001
$10^{-8}$	= 1/10 x 1/10	= 0.00000001
$10^{-9}$	= 1/10 x 1/10	= 0.000000001

## RULES FOR GRAPHING

1. Title the graph.
2. Label the horizontal (x) and vertical (y) axes with the independent variable and include units of measurement.
3. Create a scale, also known as an interval, for each axis based upon the range of the data.
4. Try to utilize as much of the graphing space available.
5. Plot the points in the dataset accurately.
6. In a bar graph include the numeric values above the bars.
7. Where applicable, sketch a line of best fit. Don't simply connect points.
8. Neatness always counts in graphing.

Adapted from graphing instructions by Matthew Rach, Wm. Allen H. S., Allentown, PA...

**RULES FOR PASSING THE CRAAP TEST (2010)**

(Identifies six criteria readers should use to evaluate the credibility of information)

1. **Currency** (timeliness) of the information (date of posting or publication).
2. **Relevance** of the information for your needs (consider the intended audience for the material).
3. **Authority** of the source (qualifications, potential for bias or conflict of interest).
4. **Accuracy** of content (supported by evidence, peer-reviewed).
5. **Purpose** of the message (intended to inform, teach, entertain, persuade, or sell a product?).

**GUIDELINES FOR EVALUATING THE CREDIBILITY OF NEW STORIES/BLOGS**

(FactCheck.org)

1. Consider the source.
2. Read beyond headlines for details that might contradict or modify the meaning of the headline.
3. Evaluate supporting evidence (if any).
4. Check the date of publication.
5. Consider whether the “news” is intended as satire.
6. Consider your own biases (we tend to be less critical of sources that support our existing beliefs).
7. Consult expert authorities to corroborate assertions in the story.

**NOTES**

Name \_\_\_\_\_ Date \_\_\_\_\_ Moravian University

Name \_\_\_\_\_ Name \_\_\_\_\_

**TEST YOUR VISUAL KNOWLEDGE OF ASTRONOMY**

- 1. a. \_\_\_\_\_ Above is the (A),  
     b. \_\_\_\_\_ and to the left is the (B)
- 2. \_\_\_\_\_ The curved streaks are...  
     \_\_\_\_\_ What is causing them to streak in curves?
- 3. \_\_\_\_\_ Hit me with your best shot! What is the name of this planet?
- 4. \_\_\_\_\_ These are...
- 5. \_\_\_\_\_ What is it? These are two pictures of M51, a...
- 6. \_\_\_\_\_ Arching across the sky is the...
- 7. a. \_\_\_\_\_ What is it?  
     b. \_\_\_\_\_ The dim area is called...  
     c. \_\_\_\_\_ Does it have gravity?
- 8. a. \_\_\_\_\_ This nebula of glowing hydrogen was named after a state in the US.  
     b. \_\_\_\_\_ In what state of matter is the hydrogen?
- 9. a. \_\_\_\_\_ This is the...  
     b. \_\_\_\_\_ The black areas are called...  
     c. \_\_\_\_\_ Are they hotter or cooler?
- 10. \_\_\_\_\_ Inside the big dome (top) and the sphere (bottom) are...
- 11. a. \_\_\_\_\_ It is the most famous... in the heavens.  
     b. \_\_\_\_\_ In which constellation is it located?
- 12. \_\_\_\_\_ The straight streaks are...
- 13. \_\_\_\_\_ Most observers believe that this is the most spectacular object...
- 14. \_\_\_\_\_ What kind of eclipse is this?

- 15. a. \_\_\_\_\_ Constellation
- b. \_\_\_\_\_ Constellation
- c. \_\_\_\_\_ Star
- 16. a. \_\_\_\_\_ Are these solar or lunar eclipses?
- b. \_\_\_\_\_ The type of eclipse that is most frequently shown in the photos.
- 17. \_\_\_\_\_ Your first telescope should really be two.
- 18. \_\_\_\_\_ The mushroom-shaped instruments near the bottom of the photo are...
- 19. a. \_\_\_\_\_ Optical feature
- b. \_\_\_\_\_ Optical feature
- c. \_\_\_\_\_ Optical feature
- 20. a. \_\_\_\_\_ Optical feature
- b. \_\_\_\_\_ Optical feature
- 21. \_\_\_\_\_ Identify this planet.
- 22. \_\_\_\_\_ It is the most famous of its kind in the heavens.
- 23. \_\_\_\_\_ Telescopes are kept in them.
- 24. \_\_\_\_\_ Found in galaxies, they are the specific locations where stars are born.
- 25. \_\_\_\_\_ They fall to Earth and are called...
- 26. \_\_\_\_\_ Red
- 27. \_\_\_\_\_ Alaska, Iceland, northern Canada...
- 28. \_\_\_\_\_ A general term for this type of object is...
- 29. \_\_\_\_\_ These are examples of...
- 30. a. \_\_\_\_\_ This is the planet...
- b. \_\_\_\_\_ This is...

Packet No. \_\_\_\_\_

Name \_\_\_\_\_ Date \_\_\_\_\_

Name \_\_\_\_\_ Name \_\_\_\_\_

Name \_\_\_\_\_ Name \_\_\_\_\_

**INTRODUCTORY ASTRONOMY WORD SCRAMBLE QUIZ**

(10 points)

**Instructions for the Scramble Quiz:** You will receive a packet of papers. One color will have the definitions, while the other colored paper will contain the vocabulary words. Complete the quiz by matching the vocabulary word with the correct definition.

**Grading:** Since students are working in groups, and since this is more of a matching exercise where students need to recognize the correct definition rather than stating it in writing, each mistake will count as a point deduction. As an example, a team that misses two words will receive a score of 8/10.

**Consider the Following Suggestions:**

1. **Mandatory:** Write the first and last name of each team member and note the date. Failure to do so will result in the loss of one point for each team member. Each team member will receive the same grade.
2. **Note the Packet Number** on this paper. Without a packet number I will not know which group of words to correct.
3. **Don't panic! Work as a team.** Keep focused on the problem at hand, not on what the other teams are doing.
4. **First separate** the colors into two packs.
5. **Arrange the vocabulary words in alphabetical order on the left.** Students studied the words in alphabetical order and this will help with remembering the definitions, and particularly words with definitions that are similar. The **vocabulary words are centered** on the page. The **definitions are left justified**. Assemble the packet so that I see the word to be defined first, followed by the definition.
6. **Keep all words and definitions visible on the table** so that all answer possibilities remain viable. Words which are related have definitions which may sound similar. If an incorrect word/definition association is made, and that word/definition is pulled from the table, there will probably be another incorrect word/definition association chosen for the other similar word.
7. **Teams will have about 15 minutes** to complete this exercise. Although this a timed exercise, extra time (one or two minutes) will be given if needed.

**NOTES**

**CAN YOU ANSWER THE FOLLOWING QUESTIONS/STATEMENTS?**

1. State a concise definition for the subject of astronomy. Astronomy is the science which...
  
2. The quantity of matter per unit volume (density) throughout the universe gives astronomers a feeling about how that material is d\_\_\_\_\_.
  
3. Precession, rotation, and revolution of the Earth define three different \_\_\_\_\_ that affect the Earth and the positions of other objects in the sky.
  
4. The spinning of a body about its axis is called \_\_\_\_\_. Its duration for Earth is equivalent to \_\_\_\_\_.
  
5. The motion of one body around another is called \_\_\_\_\_. Its duration for Earth is equivalent to \_\_\_\_\_.
  
6. The four physical states in which matter can exist are called a \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and a \_\_\_\_\_.
  
7. Ions and electrons in free association define a \_\_\_\_\_.
  
8. \_\_\_\_\_ consist of atoms or molecules which have lost or gained one or more electrons.
  
9. The big bang and nebular theories are models that detail the \_\_\_\_\_ of the universe and the solar system. The big bang is associated with the origin of the \_\_\_\_\_, while the nebular hypothesis details the beginning of the \_\_\_\_\_.
  
10. Knowing what elements comprise an astronomical body tells one about that object's \_\_\_\_\_.
  
11. The primary elements that compose the Earth are oxygen, silicon, and iron. This description is \_\_\_\_\_ in nature since it does not detail numerical amounts.
  
12. The Earth's atmosphere is composed of 78% nitrogen, 21% oxygen, and 1% argon. This represents a \_\_\_\_\_ statement.
  
13. By far the most abundant element in the universe is \_\_\_\_\_. About \_\_\_\_\_ percent of the universe is comprised of this element?

14. The most abundant element in the universe is composed of one \_\_\_\_\_ and one \_\_\_\_\_.
15. The velocity of light in a vacuum is equivalent to \_\_\_\_\_ mi/sec or \_\_\_\_\_ km/sec.
16. A light year measures the \_\_\_\_\_.
17. \_\_\_\_\_ The hypothesis which states that the universe was created from a primordial atom which somehow appeared and was expanding.
18. \_\_\_\_\_ All of the various forms of energy which travel at the speed of light are embraced by this term.
19. \_\_\_\_\_ The name of the sun and its family of planets goes by this term.
20. \_\_\_\_\_ Earth's orbit around the sun is defined by this plane. Eclipses must happen on or near it.
21. \_\_\_\_\_ These objects form the basic way in which matter collects within the universe and are composed of stars which can number from the millions into the trillions.
22. \_\_\_\_\_ The average distance from the Earth to the sun in miles or kilometers.
23. \_\_\_\_\_ It is the Earth-sun distance expressed in relative terms.
24. Thermonuclear fusion is how \_\_\_\_\_ generate their electromagnetic radiation.
25. \_\_\_\_\_ The theoretical end product of only the most massive stars after they explode.
26. \_\_\_\_\_ A universe which started with a bang, but which possesses sufficient mass to collapse upon itself at some future time, perhaps only to explode once again.
27. All matter-energy everywhere is a good definition for the \_\_\_\_\_.
28. The theory of everything which claims to be able to unite the four forces of nature into one consistent theory is called \_\_\_\_\_.
29. \_\_\_\_\_ The force which binds electrons to the nucleus of an atom and governs the interaction of atoms with other atoms and molecules.
30. \_\_\_\_\_ The weakest force of the four; its effect spans the entire universe and governs the motion of bodies throughout space.

31. \_\_\_\_\_ This force is the glue which binds the protons of an atom and holds them within the nucleus.
32. \_\_\_\_\_ The force dictates how radioactive isotopes decay.
33. \_\_\_\_\_ It is the imaginary great circle which specifies the average location of the sun at noontime, when it is neither in the a.m. or p.m. part of the sky.

**NOTES**

**ANSWERS TO SESSION ONE QUESTIONS**

1. The science which concerns itself with the study of all matter-energy in the universe.
2. distributed
3. movements
4. rotation, 23 hours 56 minutes
5. revolution, 365.24 days
6. solid, liquid, gas, plasma
7. plasma
8. ions
9. evolution, universe, solar system
10. composition
11. qualitative
12. quantitative
13. hydrogen, 75
14. proton, electron
15. 186,000 mi/sec, 300,000 km/sec
16. the distance that light travels in one year, approximately six trillion miles (9 trillion km)
17. big bang
18. electromagnetic spectrum
19. solar system
20. ecliptic
21. galaxies
22. 93,000,000 miles (150,000,000 km)
23. astronomical unit
24. stars
25. black hole
26. oscillating or accordion universe
27. universe
28. string theory
29. electromagnetic
30. gravity
31. strong nuclear force
32. weak nuclear force
33. meridian

February 20, 2022

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