



Science Intermediate Level

3D Learning & Assessments

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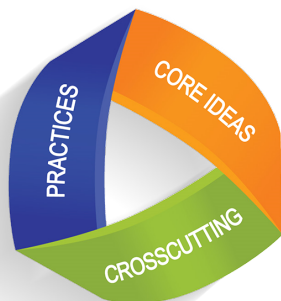
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TO THE TEACHER

The Next Generation Science Standards (NGSS) provides a three-dimensional approach to the teaching and learning of science. Shown on the Mobius Loop NGSS logo are Crosscutting



Concepts, Science and Engineering Practices and the Disciplinary Core Ideas. “Crosscutting” concepts such as cause and effect permeate the four main domains of NGSS: Physical Science, Life Science, Earth and Space Science and Engineering & Design. “Practices” emphasize inquiry. Students learn how to investigate and analyze the natural world. “Core Ideas” encompass the age appropriate science needed for the development of science literacy. There is a caveat important for students to understand in their journey to develop science literacy.

Scientific knowledge is not a collection of immutable facts. There are times when observations cannot be explained by present scientific concepts. For example, it is Einstein’s theory of gravity that is used for GPS because time is relative and it goes faster on satellites. If we used Newton’s theory, we would get lost.

The 3D approach to learning should help students develop the critical thinking skills necessary to navigate an increasingly complex world. The Performance expectations in Unit 7 provides a number of 3D learning assessments.

This book does not cover all of the engineering standards since that is better taught through a technology course. However, they are addressed as they play an important role in our understanding and advancements in science. We highly recommend all intermediate level teachers work with math and technology teachers to coordinate curriculum and team together on projects when feasible.

TO THE STUDENT

Understanding the natural world is an important part of your education. This book should strengthen your knowledge of important core science ideas and help you to develop critical thinking skills needed to make informed decisions. The book is designed to help you with middle level assessments.

The first section of this book called “Assessing and Understanding” and the last section of the book called “General Science Skills” are all about the practices that are used in all areas of science and engineering. It also provides many crosscutting concepts explained above.

All units are followed by assessments useful to both students and teachers as a way of measuring a student’s strengths and weaknesses in 3D learning. You should appreciate that the great strides made in science is due to the work of great minds. A famous quote by Sir Isaac Newton (1675) is “If I have seen further it is by standing on the shoulders of Giants.”

ASSESSING YOUR UNDERSTANDING

The questions at the end of each chapter test your understanding of core ideas in science, your ability to analyze and interpret data, use models, explain phenomena and propose solutions to problems. It will also ask you to look for patterns and cause and effect relationships in the natural world.

ASSESSING YOUR WRITING FOR SHORT ANSWERS

When writing answers to questions strive to create answers that clearly show you are using scientific thinking. Refer to the “Credits” list below. Note: papers that meet the criteria at the top of the list are the best papers, deserving of excellent grades. Papers written to the criteria in the middle of the list receive partial credit, while papers near the bottom of the credits list receive few or no points.

FULL CREDIT - EXCELLENT

YOUR RESPONSE IS COMPLETE AND CORRECT IF IT...

- DEMONSTRATES A THOROUGH UNDERSTANDING OF THE SCIENTIFIC CONCEPTS IN THE TASK
- INDICATES THAT YOU HAVE RESPONDED CORRECTLY, USING SCIENTIFICALLY SOUND REASONING
- CONTAINS CLEAR, COMPLETE EXPLANATIONS

PARTIAL CREDIT - ACCEPTABLE

YOUR RESPONSE IS MOSTLY CORRECT IF IT...

- INDICATES THAT YOU HAVE DEMONSTRATED ONLY A PARTIAL UNDERSTANDING OF THE SCIENTIFIC CONCEPTS IN THE TASK
- ADDRESSES SOME ELEMENTS OF THE TASK CORRECTLY BUT MAY BE INCOMPLETE OR CONTAIN INCORRECT REASONING

NO CREDIT - TOTALLY UNACCEPTABLE

YOUR RESPONSE IS UNACCEPTABLE IF IT...

- INDICATES A CORRECT RESPONSE HAS BEEN ARRIVED AT USING AN INCORRECT PROCEDURE
- NO RESPONSE IS GIVEN

Let us look at a sample question:

A COMPARISON OF STRUCTURES USED FOR SIMILAR FUNCTIONS

<u>ONE-CELLED ORGANISM</u>	<u>MULTICELLULAR ORGANISM</u>
mitochondria	lungs
cytoplasm	heart
cell membrane	kidney

Pick one pair of structures from the chart above and describe how their functions are alike and different.

Below are three sample answers for this question. Compare your written answer above with the sample answers below.

SAMPLE ANSWER 1 (Excellent)
Both mitochondria and lungs help the organism to release the energy stored in food. A mitochondria is different from a lung because it is where the oxygen is actually used to release energy. Lungs function to get the oxygen to the blood so it can be brought to the cells.

SAMPLE ANSWER 2 (Good)
Mitochondria and lungs both help respiration. They are different, because one does its job by itself and one is part of a system.

SAMPLE ANSWER 3 (No Credit)
Mitochondria and lungs both help circulation. They are different because only one has materials traveling through the cell membrane.

Look back at the previous page and review the criteria for rating a response answer. Based on the criteria and the sample answers above, what grade would you give your answer? Why?

Rewrite your answer. Keeping in mind the criteria for rating a response to a question. Try to improve your answer and therefore your rating.

ASSESSING YOUR WRITING FOR SHORT ESSAYS

Another typical question you will be asked to answer will be used to check if you can apply thinking and problem solving skills to what you have already learned. In order to answer a short essay question you must show a clear understanding of the science concepts being tested. Most extended short essay questions will contain more than one part, so you must be sure to address all aspects of the question. In many cases you will be analyzing, comparing and/or contrasting issues and events.

FULL CREDIT - EXCELLENT

YOUR RESPONSE IS COMPLETE AND CORRECT IF IT...

- SHOWS YOU HAVE A CLEAR UNDERSTANDING OF THE SCIENTIFIC CONCEPTS IN THE TASK
- ADDRESSES ALL ASPECTS OF THE TASK

PARTIAL CREDIT - VERY GOOD

YOUR RESPONSE IS MOSTLY CORRECT IF IT...

- SHOWS YOU UNDERSTAND AND/OR HAVE BEEN ABLE TO DEFINE THE SCIENTIFIC CONCEPTS IN THE TASK
- ADDRESSES MOST ASPECTS OF THE TASK AND INCLUDES ACCURATE FACTS, EXAMPLES, AND DETAILS, BUT MAY BE SOMEWHAT UNEVEN IN TREATMENT

PARTIAL CREDIT - GOOD

YOUR RESPONSE IS PARTIALLY CORRECT IF IT...

- PRESENTS AN ACCEPTABLE DEFINITION OF THE SCIENTIFIC CONCEPTS IN THE TASK
- FAILS TO ADDRESS ALL ASPECTS OF THE TASK
- MINIMAL FACTUAL ERRORS ARE PRESENT

PARTIAL CREDIT - POOR

YOUR RESPONSE IS ONLY PARTIALLY CORRECT IF IT...

- ATTEMPTS TO ADDRESS THE SCIENTIFIC CONCEPTS IN THE TASK, BUT USES VAGUE AND/OR INACCURATE INFORMATION
- RESPONSE LACKS FOCUS

PARTIAL CREDIT - VERY POOR

YOUR RESPONSE IS ONLY A LITTLE CORRECT IF IT...

- SHOWS LIMITED KNOWLEDGE OR UNDERSTANDING OF THE SCIENTIFIC CONCEPTS IN THE TASK
- DETAILS ARE WEAK

NO CREDIT - TOTALLY UNACCEPTABLE

YOUR RESPONSE IS NOT CORRECT AT ALL IF IT...

- FAILS TO ADDRESS THE TASK
- MAKES NO SENSE
- CONTAINS NO RESPONSE

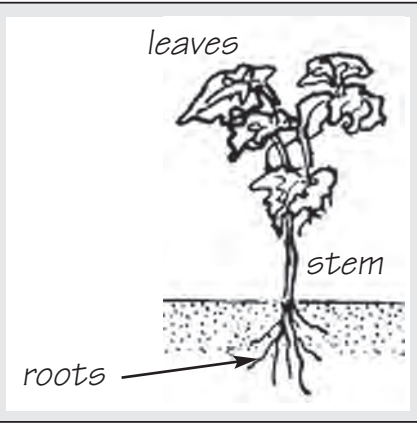
Here is an example of a **short essay** question:

Many plants have roots, stems, leaves, and flowers. Each of these structures is adapted to a specific function. Choose **TWO** of these structures and describe their function and how they are adapted to carry out that function. Include a labeled diagram of **ONE** of the structures that illustrates how the structure is adapted.

Drawing

SAMPLE ANSWER 2

The roots of some plants are adapted to support the plant in soil. They may be long, thick, and travel far down into the soil to provide balance for the plant. The leaves of the plant allow it to make food through the process of photosynthesis. They are thin and flat to collect more sunlight.



Look back at the previous page and review the credits rating a **short essay** answer. Based on the credits list and the sample answer above, what grade would you give your answer? Why? [5]

Rewrite your answer. Keeping in mind the credits for rating a **short essay**, try to improve your answer and therefore your rating.

GROWTH AND DEVELOPMENT

DISCIPLINARY CORE IDEAS:

LS1.B: GROWTH AND DEVELOPMENT OF ORGANISMS

PERFORMANCE INDICATOR 4.1

OBSERVE AND DESCRIBE THE VARIATIONS IN REPRODUCTIVE PATTERNS OF ORGANISMS, INCLUDING ASEXUAL AND SEXUAL REPRODUCTION.

Sarina was going through some old family photos and was shocked to find a picture of a baby that looked just like she did as a baby. She showed the photo to her mom who said it was a picture of her grandmother, Sarina's great grandmother. Mom said that maybe Sarina would grow up to look like her great grandmother. Sarina went back to find more pictures.

How do individual organisms create future generations? Without reproduction of new offspring, a species cannot survive and continue. All living things go through a life cycle involving the production of new individuals. All living things follow an orderly sequence of events as they develop from birth into the adult form.

PERFORMANCE INDICATOR 4.2

EXPLAIN THE ROLE OF SPERM AND EGG CELLS IN SEXUAL REPRODUCTION.

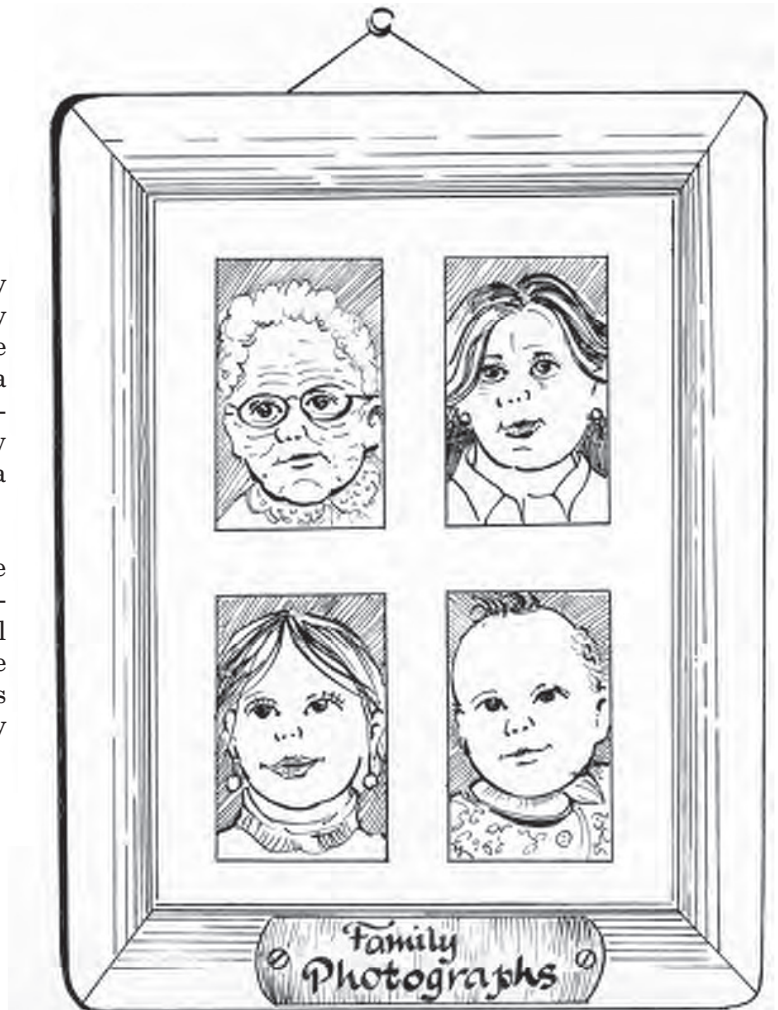
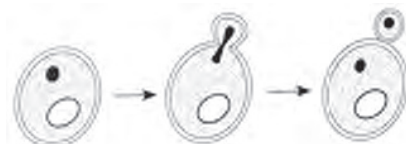
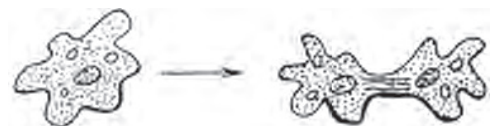
IT TAKES TWO - SOMETIMES

Reproduction is the process by which living things produce other living things like themselves. There are two major types of reproduction, sexual and asexual. Some organisms produce asexually, some sexually and some can reproduce both ways.

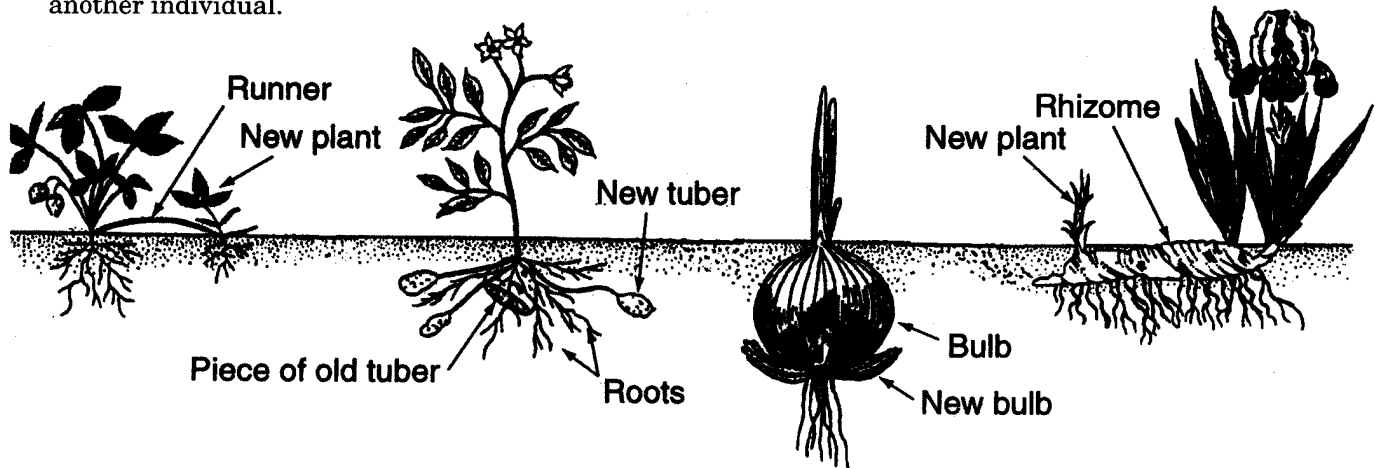
ASEXUAL REPRODUCTION

Asexual reproduction is the creation of a new individual without the joining of two cells. Types of asexual reproduction include:

- **Fission:** the splitting of a one-celled organism into two equal halves, with equal genetic and cell material, each becoming a new individual (example: fission of amoeba).
- **Budding:** the splitting of a one-celled organism into two halves, with equal genetic and unequal cell material, each becoming a new individual (example: budding in yeast).



- **Vegetative Propagation:** In some multicellular plants, a part of a plant can be separated and grown into another individual.



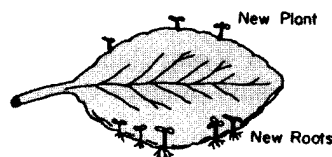
- **Cloning:** Cloning is a general term for asexual reproduction. Recent interest in this area comes from scientists using cloning to produce important gene products. Some genes or groups of genes can be taken from an organism and placed in another species. When the cells multiply, the new genes also are multiplied. For example, the gene for producing insulin has been placed in bacterial cells. These cells manufacture insulin for use by diabetics.

SEXUAL REPRODUCTION

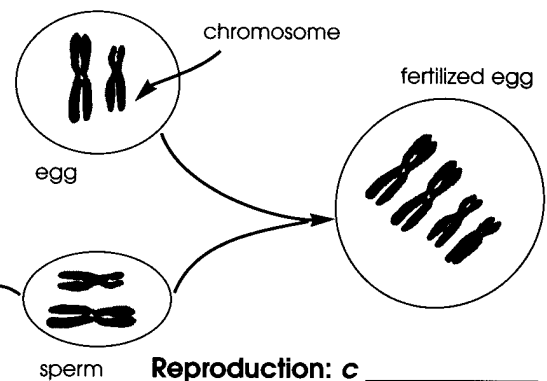
Sexual reproduction involves the joining of two cells to begin the development of a new individual. In many species that reproduce by sexual reproduction, the sex cells are different. One is the sperm (from the male) and one is the egg (from the female).

The sex cells are very special cells. They are created through a special process of division so that they each end up with one-half of the genetic information needed for a new organism. For a new organism to be complete, the male cell – the **sperm**, and the female cell – the **egg**, must unite. The joining of the sperm and egg is called **fertilization**. A fertilized egg (**zygote**) contains a full set of genetic information, one half of the information from each parent. Fertilization can occur inside or outside of an organism's body, depending on the type of organism. In most fish, fertilization occurs externally, in the water around the fish. In reptiles, fertilization occurs internally, inside the female's body.

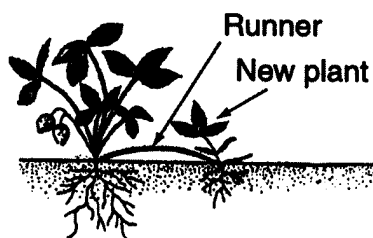
- 93 On the lines given, identify the type of reproduction shown in each of the following diagrams (sexual or asexual reproduction).



Reproduction: a _____

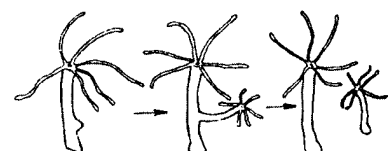
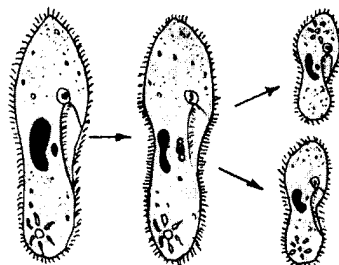


Reproduction: c _____



Reproduction: d _____

Reproduction: b _____



Reproduction: e _____

DISCIPLINARY CORE IDEAS:

LS1.B: GROWTH AND DEVELOPMENT OF ORGANISMS

MULTIPLYING BY DIVIDING

Why does a fertilized frog egg cell grow into a frog? When formed by either asexual or sexual reproduction, how is a new organism given the directions, for what it is to do and become? The answers come from looking at how cells divide.

In **mitotic cell division**, each new daughter cell normally receives a complete and identical set of chromosomes. Chromosomes contain the genetic information that directs an organism's growth and development. During mitotic cell division, the chromosomes are duplicated by the cell. The duplicated pair separate. One identical set of chromosomes goes to each of the resulting daughter cells. Therefore, each new cell gets identical hereditary information.

In multicellular organisms these new cells allow for growth, maintenance, and repair of body cells. In some one-celled organisms, this type of division is a form of asexual reproduction.

In **meiotic cell division**, each new daughter cell normally receives one-half of a complete set of chromosomes. Cells with one-half of a set of chromosomes are called **sex cells**. A male sex cell is called a sperm. A female sex cell is called an egg. Both sperm and eggs contain one-half of the hereditary information needed by a new organism. Only when they unite, when the egg is fertilized, is the whole set of chromosomes united and a new organism formed.

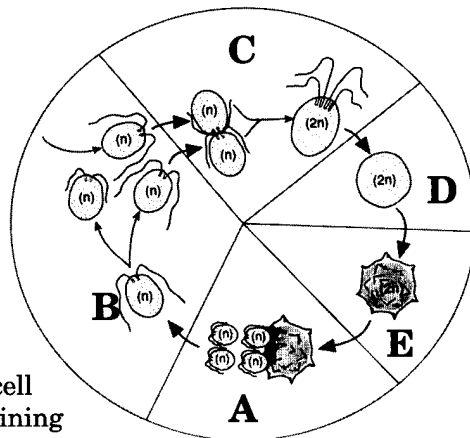
94 Why is mitotic cell division so important for the growth and repair of a multicellular organism? _____

The diagram at the right represents the life cycle of a green alga.

Note: the letter "n" in the diagram represents one (1) set of chromosomes. A complete set is represented by "2n."

95 Which letter represents the phase where cells are produced by meiotic division? _____

96 Which letter represents fertilization? _____



R.G. Harrison (1907) and Fell (1928) found that even after a type of cell is removed from a body the cells will continue to grow and divide retaining their traits. For example, a skin cell will produce more skin cells. Therefore, cells seem to have an internal regulating system. **Cancer** is a general name for diseases caused by unregulated cell growth. It is caused by a change in the genes that regulate cell growth.

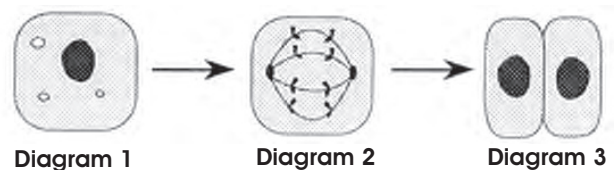
97 Why would production of abnormal cells cause problems for a living thing? _____

Section Two

LIFE SCIENCE REVIEW 4

MULTIPLE CHOICE

- The joining of cells that begins the development of a new organism is a type of reproduction called
(1) budding (2) fission (3) sexual (4) vegetative
- The merging of a sperm cell and an egg cell is called
(1) asexual reproduction (2) budding (3) development (4) fertilization
- How much of a new individual's genetic information is carried in a sex cell?
(1) 1/4 (2) 1/2 (3) all (4) twice what is needed
- Cells identical to the parent cell are created by the process of
(1) fertilization (2) meiosis (3) mitosis (4) mutation
- Which represents the correct sequence of development for complete metamorphosis?
(1) egg, larva, pupa, adult (3) egg, pupa, larva, adult
(2) egg, nymph, adult (4) adult, egg, pupa, larva
- A colony of organisms is found, all containing identical genes. This group of organisms most likely reproduces
(1) asexually (2) sexually (3) through fertilization (4) slowly
- The type of reproduction that happens when an organism reproduces by splitting in two equal halves is called
(1) budding (2) grafting (3) fission (4) sexual
- Fertilization of various organisms may occur
(1) only internally (3) internally or externally
(2) only externally (4) with only one parent cell
- The human female sex cell is called a (an)
(1) egg (2) ovary (3) sperm (4) embryo
- The genetic information found in any human body cell will
(1) be identical (3) differ according to cell function
(2) match its parents (4) differ according to cell location
- In multicellular organisms, growth and maintenance are accomplished through
(1) fertilization (2) meiosis (3) mitosis (4) the production of sex cells
- Seed bearing plants have an advantage over other types of plants because seeds contain
(1) extra water (2) many plants (3) stored food (4) a new plant
- The diagram at the right represents a cell process. If the cell in diagram 1 contains 4 chromosomes, what is the number of chromosomes in each cell in diagram 3?
(1) 8 (3) 16
(2) 2 (4) 4



2 Which diagram at the right represents correct meiotic division?

_____ Explain why you chose that letter. (2 points)

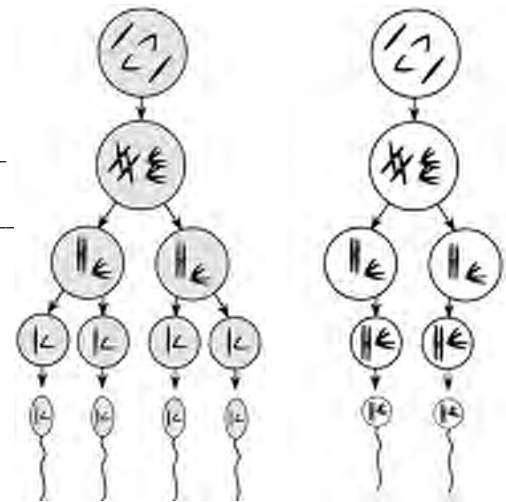


Diagram A

Diagram B

SHORT ESSAY

1 Organism A is one-celled and has 2 pairs (4 total) chromosomes.

a Describe and diagram the process of cell division if Organism A were to reproduce asexually. (2 points)

Organism A



Asexual Reproduction Diagrams:



b Describe and diagram the process of cell division if Organism A were to reproduce sexually. (3 points)

Sexual Reproduction Diagrams:



Section Three

EARTH AND SPACE SCIENCE

EARTH'S PLACE IN THE UNIVERSE

DEVELOPING AND USING MODELS: PATTERNS AND APPARENT MOTION OF THE SUN, THE MOON, AND STARS. THE SKY CAN BE OBSERVED, DESCRIBED, PREDICTED, AND EXPLAINED WITH MODELS.

DISCIPLINARY CORE IDEAS:

ESS1.A: THE UNIVERSE AND ITS STARS

ESS1.B: EARTH AND THE SOLAR SYSTEM



MODELS OF THE UNIVERSE

IMPORTANCE OF USING MODELS

Scientists make observations about the natural world. They formulate hypotheses and then test them. Sometimes their hypotheses are proven to be correct. Other times, new hypotheses are needed. Often, scientists will create a model to explain their observations.

MODELS OF THE UNIVERSE

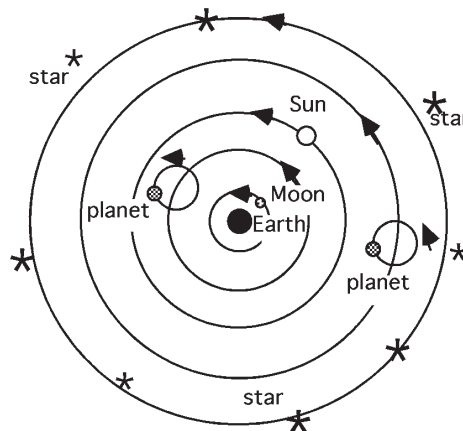
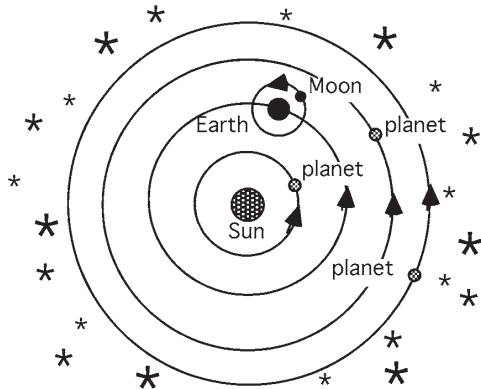
To understand the early models of the universe, it must be understood how motion is detected. All motion is relative to a frame of reference (point or object). For example, if you are standing still on a platform at a train station and a train passes by, your measurement of its speed would be relative to your position. Suppose you measured the speed to be 50 km/hr when you are standing still. After doing this, you decide to remeasure the speed of the train while you were walking at a rate of 5 km/hr in the same direction as the train. Now, to your frame of reference, the train would seem to be going only 45 km/hr. The speed of the train appeared to change because there was also a change in your frame of reference.

1 How is motion detected? _____



GEOCENTRIC MODEL

There was a time in history when Earth was considered to be the center of the universe. This was known as the **geocentric model**. It was proposed in 150 A.D. by the Greek astronomer, **Claudius Ptolemy**. Earth was believed to be the center of the universe with the Moon, Sun, planets, and constellations orbiting Earth. This model lasted for hundreds of years because it could satisfactorily explain most celestial motion.



HELIOCENTRIC MODEL

One of the weaknesses of the geocentric model was that it could not easily explain the apparent backward motion of some of the planets. However, it was not until 1543 that **Nicholas Copernicus** proposed the **heliocentric model**. It placed the Sun in the center of the universe. This model was superior to the geocentric model because it more accurately explained the apparent backward motion of the planets.

2 What is the difference between the heliocentric and geocentric models of the universe? _____

DISCIPLINARY CORE IDEAS:

ESS1.A: THE UNIVERSE AND ITS STARS

ESS1.B: EARTH AND THE SOLAR SYSTEM

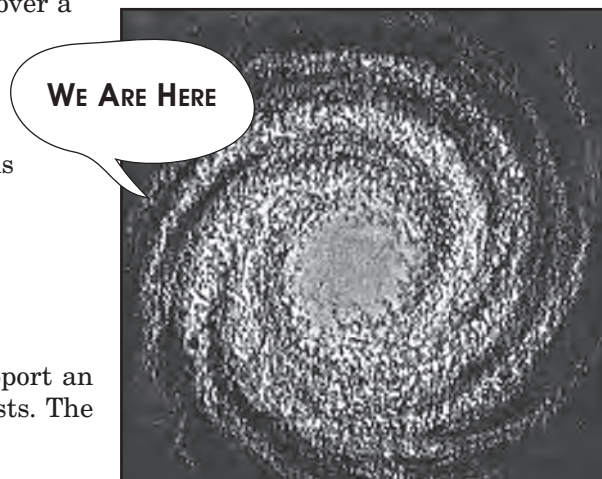
MODERN DAY MODEL OF THE UNIVERSE

Today's model of the universe reflects the idea that all celestial bodies are in motion relative to Earth and one another. In the age when Copernicus lived, there was no method for measuring star distances. The immense size of the universe that we know exists today was unimaginable. Both the heliocentric and geocentric models showed the solar system to make up the entire universe with the constellations placed at its farthest boundary. Today, we know that the Sun is one of millions of stars that reside off one arm of the **Milky Way Galaxy** (home for the solar system). The Sun is an average size star, though over a million times greater in volume than Earth.

The Milky Way Galaxy is one of billions of galaxies which are all in motion relative to one another. There is even recent evidence that supports the hypothesis that new solar systems are being formed in some of these galaxies.

OUR PRESENT DAY UNDERSTANDING OF THE UNIVERSE SHOWS HOW SCIENCE WORKS.

When observations about the natural world no longer support an accepted model, the theory is changed or modified by scientists. The new theory reflects the new observations.



3 Why do scientists use models? _____

MOTIONS OF EARTH

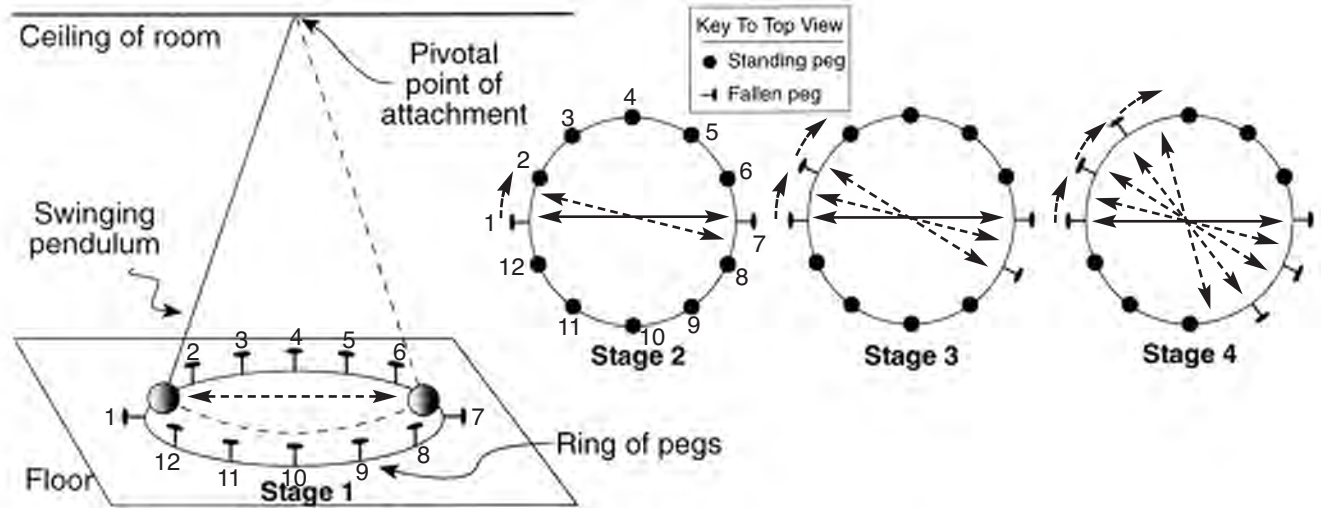
What causes night and day? Why does the shape of the Moon appear to change periodically in the evening sky? Why are there seasons?

Earth both rotates on its axis and revolves around the Sun. The motions of Earth are used to measure time in days and years. One complete rotation of Earth equals a day, while one revolution around the Sun accounts for one year.

EARTH'S ROTATION (DAY & NIGHT)

EVIDENCE THAT EARTH ROTATES

Evidence that Earth rotates was determined in 1851 by the French scientist, **Jean Foucault**. He suspended a large metal ball by a 60 meter steel cable from the dome ceiling of the Pantheon in Paris. Once a pendulum is set in motion, it will only swing in that direction. After one hour, the pendulum's plane of motion appeared to change. Foucault was able to attribute this change in motion to the rotation of Earth.



A modern piece of evidence that supports the idea that Earth rotates is satellite pictures. For example, a satellite placed in a polar orbit can take pictures of places at different meridians (degrees of longitude). If a camera was placed on Earth to take continual pictures of the night sky, Earth's motion would create **star trails** (arcs of light). The size of the arc was directly related to the amount of time the camera was photographing the evening sky.



CFHT Star trails – 5 September 2000
Canada-France-Hawaii Telescope

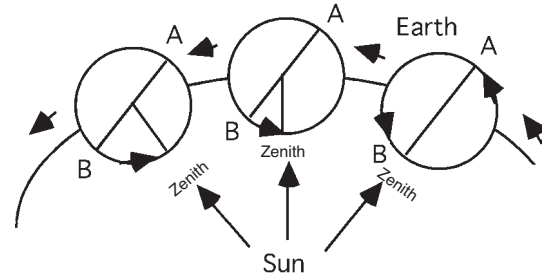
4 Describe two pieces of evidence that support the idea that Earth is rotating. _____

RISING & SETTING OF THE SUN (A DAY)

Since ancient times, humans have woven together many stories to explain the rising and setting of the Sun. Foucault was able to show that the Earth rotates. Due to his work and that of others, it is now known that the rising and setting of the Sun has to do with the rotation of Earth on its axis. As in all motion, there is a need for a frame of reference.

When the Sun is used as a frame of reference, it is called a **solar day**. A solar day is the amount of time needed for Earth to rotate from one given meridian (lines of longitude) back to the same meridian. This takes about 24 hours. The reason has to do with the size of the circumference of Earth at the equator and the rate of its rotation. The circumference is a little over 38,400 km (24,000 miles) at the equator and Earth's rotational speed at this point is about 1600 km/hr (1000 mi/hour). Therefore, Earth rotates about 15 degrees every hour. It should take about 24 hours to complete one rotation (a complete circle).

The U.S. Naval Observatory, which keeps time for the United States, uses **sidereal day**, because it is more accurate. In this case, a star is used as the frame of reference for when Earth has completed one rotation on its **axis** as compared to that star's position (23 hours, 56 minutes, 4.09 seconds in units of mean solar time).



Earth's rotation and revolution are counter-clockwise. As Earth revolves, Earth must rotate more than 360° for the Sun's zenith to return to the same Earth longitude.

5 What is the difference between a solar and sidereal day? _____

EFFECTS OF EARTH'S ROTATION

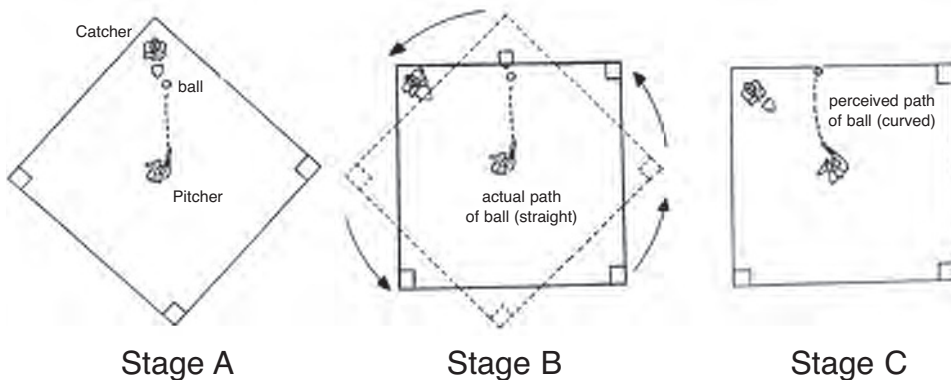
Earth's rotation affects the apparent motion of the winds and ocean currents. Remember, motion is detected by a frame of reference. An observer on Earth will view objects moving over the surface of Earth as being deflected from a straight path.

In the Northern Hemisphere, the winds and ocean currents appear to be deflected to the right because Earth is viewed as rotating counterclockwise. Viewed from the Southern Hemisphere, the winds and ocean currents are deflected to the left because Earth appears to be moving clockwise. This effect of the motion of winds and the ocean currents is called the **Coriolis Effect** – named after the French mathematician, Gaspard Coriolis who first described this effect in the 19th century.

Coriolis Effect

A ball being thrown between two persons riding on a rotating platform illustrates the Coriolis effect.

A – On a stationary platform, the pitcher throws the baseball to the catcher in an apparent straight line.



B – As the platform rotates counter-clockwise, the pitcher throws the baseball in the direction of the catcher, but the turning platform has carried the catcher counter-clockwise away from the incoming ball.

C – From above the platform, the baseball appears to have curved to the right as the platform moved counterclockwise to the left, thus demonstrating the Coriolis Effect on the surface of the rotating Earth.

6 What effect does Earth's rotation have on ocean currents and wind?

CORIOLIS EFFECT

In the Northern Hemisphere what a sight
A moving object drifts to the right.

And generally, storms swirl counterclockwise
While seawater chooses to circle clockwise.

If all of this seems a bit much to rehearse
Remember, the Southern Hemisphere does it all in reverse.

EARTH'S REVOLUTION (A YEAR AND ITS SEASONS)

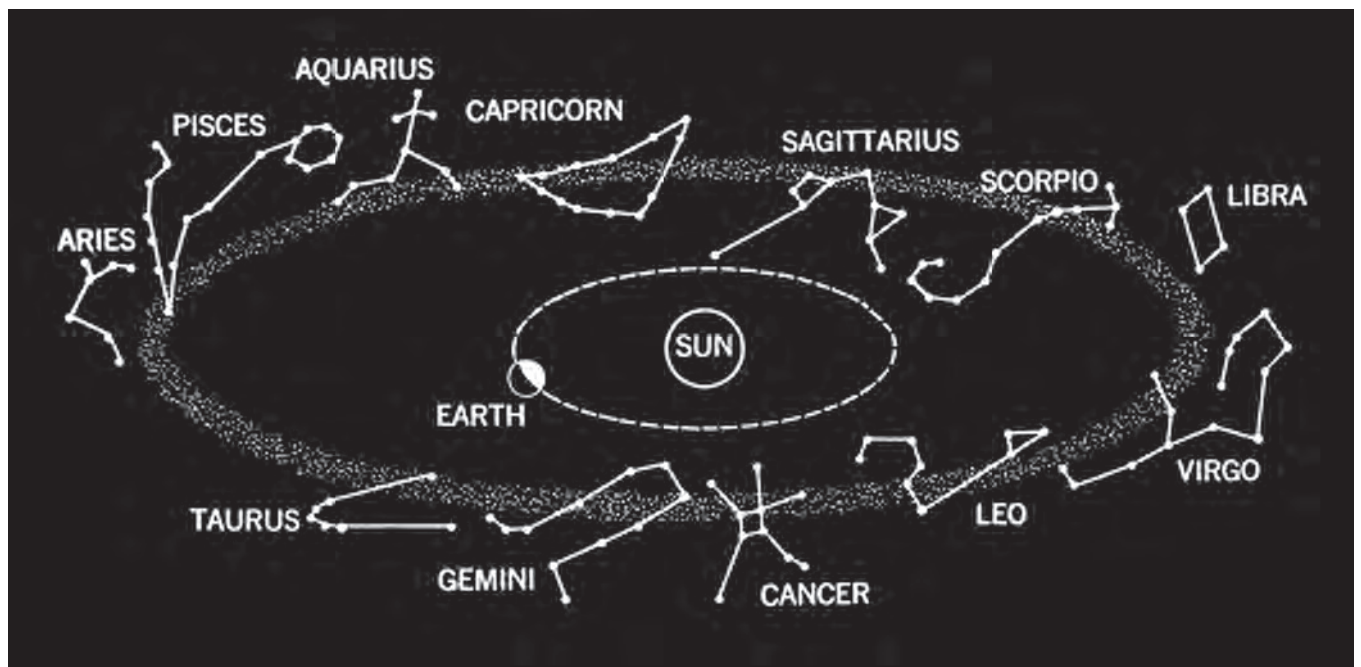
EVIDENCE THAT EARTH REVOLVES AROUND THE SUN

The earliest proof that Earth is revolving in space around the Sun can be traced to the first use of telescopes. Since stars are so far away, their relative position in the night sky to one another appears fixed. However, over the course of a year, telescopes showed the position between a relatively close star and one much farther away appeared to change in relationship to one another. This could best be explained if Earth was moving around the Sun.

Another observation that supported the model of an Earth revolving around the Sun was that the **constellations** (patterns of stars) appeared to move. During a year, the constellations visible to the eye in the evening sky change cyclically (repeating pattern).

Observation of Earth's closest star, the Sun, showed it to appear larger during the winter months and smaller as summer approached. This cyclic change could best be understood if Earth was revolving around the Sun. As the Earth revolves around the Sun, the altitude of the east-west path of the Sun across the Earth changes. During winter months in the Northern Hemisphere, the altitude is lower and so closer to the horizon. During summer, the altitude becomes higher. The change in altitude of the Sun makes it appear to be larger or smaller.

The strongest evidence that Earth is revolving around the Sun is the changing **seasons**. Earth rotates on an axis. This is an imaginary line from the **north** to **south pole**. Earth's axis is tilted about $23\frac{1}{2}^\circ$ away from its vertical. As



Section Three

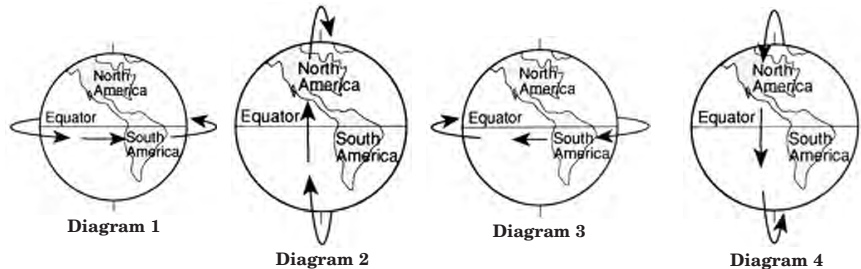
SPACE SCIENCE REVIEW

MULTIPLE CHOICE

- The geocentric model of the universe states that all objects in the universe revolve around the
 (1) Earth (2) Moon (3) Sun (4) Milky Way
- One complete rotation of Earth on its axis makes up a
 (1) day (2) week (3) month (4) year
- Foucault's pendulum helped prove that the
 (1) Earth revolves around the Sun (3) Moon revolves around Earth
 (2) Sun revolves around Earth (4) Earth rotates on its axis
- The cyclic change in the apparent size of the Sun is due to the Earth's
 (1) rotation (2) tilt (3) revolution (4) shape

- 5 Which diagram best illustrates Earth's rotation?

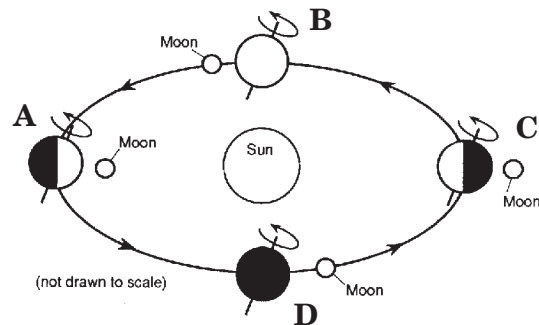
- (1) 1 (3) 3
 (2) 2 (4) 4



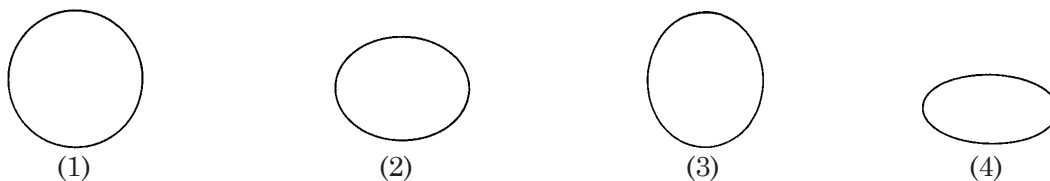
- 6 One complete revolution of Earth around the Sun equals a
 (1) day (2) week (3) month (4) year

- 7 Which position of Earth shown in the diagram represents summer in the Northern Hemisphere?

- (1) A (3) C
 (2) B (4) D

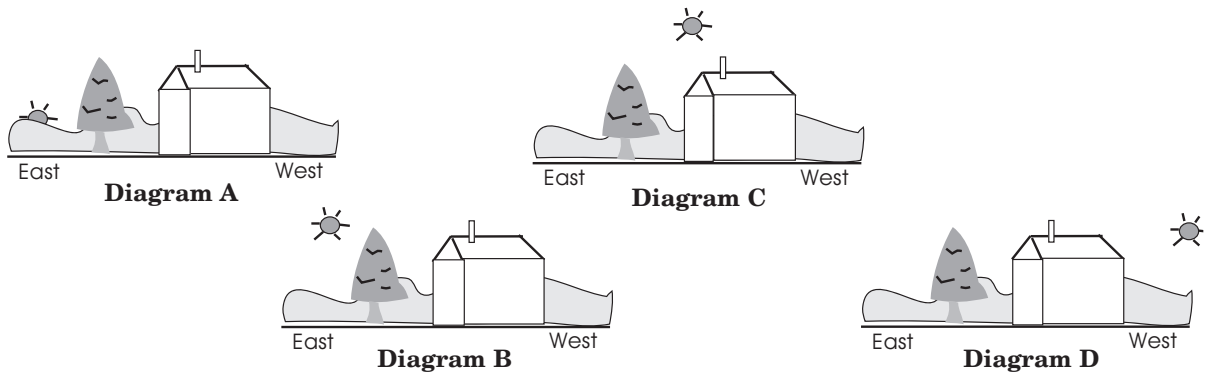


- 8 Which diagram best illustrates the shape of Earth from



- 9 The Moon shines because it
 (1) is very hot (3) reflects light from Earth
 (2) reflects light from the Sun (4) have special rocks that fluoresce (glow)
- 10 The length of a month is determined by the
 (1) rotation of Earth (3) revolving of the Moon around Earth
 (2) rotation of the Moon (4) revolving of Earth around the Moon

18 Which diagram below illustrates sunrise?



- (1) A (2) B (3) C (4) D

19 The position of the Polar Star changes in the evening sky because

- (1) Earth is revolving around the Sun (3) the Polar Star is rotating on its axis
 (2) the Polar Star is revolving around Earth (4) Earth is rotating on its axis

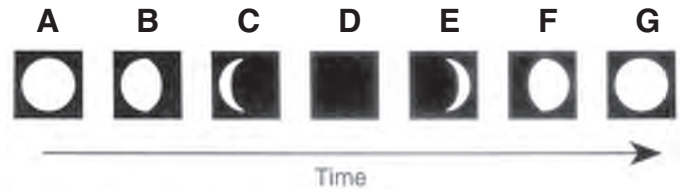
20 The force that holds the solar system together is

- (1) magnetism (2) electricity (3) gravity (4) inertia

THE QUESTIONS THAT FOLLOW TEST YOUR UNDERSTANDING OF SCIENTIFIC PRACTICES, CORES IDEAS IN SCIENCE AND CROSS-CUTTING CONCEPTS SUCH AS PATTERNS AND CAUSE AND EFFECT RELATIONSHIPS.

SHORT ANSWER

1 Directions: Use the diagram of the Moon’s phases to answer the questions that follow:



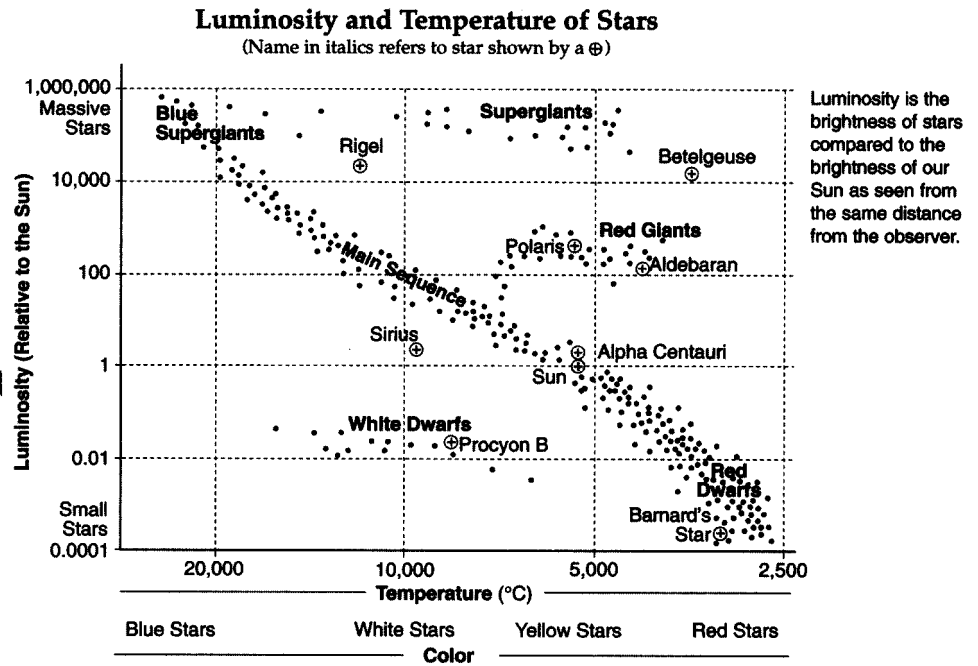
a Which position of the Moon represents a New Moon? (1 point) _____

b Explain why you chose that answer (2 points) _____

SHORT ESSAY

- 1 Use the chart of the brightness of stars to answer the questions that follow.

Reminder: *Luminosity* as used on this chart means the same as *brightness*.



a How does the Sun's brightness compare to other stars? _____

b Generally, what is the relationship between temperature and brightness of a star? Name a star that does not follow that pattern? _____

- 2 Below is a list of information that can be used to support the idea that Earth revolves around the Sun. Explain how each piece of information supports that idea.

a tilt of Earth _____

b seasons _____

c Constellations _____
