NATURAL SCIENCES

GRADE 9

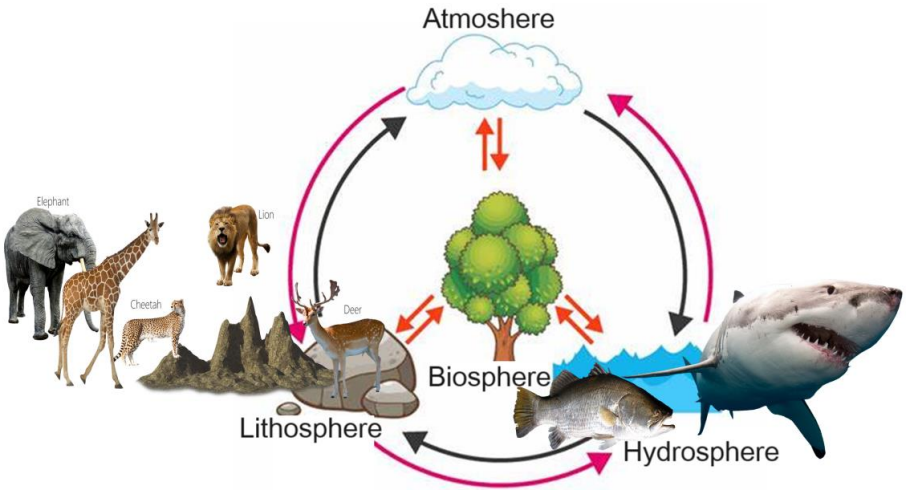
LEARNER GUIDE

EARTH AND BEYOND

SPHERES OF THE EARTH

(a) The Earth makes up a system where different parts called spheres interact with each other.

(b) The following are the spheres of the Earth:



i. Atmosphere – it is the protective layer of gases.

ii. Hydrosphere – the water part of the Earth.

iii. Lithosphere – the rock and soil part of the Earth.

iv. Biosphere – the part of the Earth where organisms live and their requirements.

Answer the following questions:

1. What are the four spheres of the Earth?

   _____

2. Describe each of the four spheres of the Earth.

   _____

   _____

3. What is a biosphere?

   _____

4. Mention organisms found in each sphere.

   _____

   _____

LITHOSPHERE

(a) The lithosphere is the rocky rigid part of the Earth.

(b) The lithosphere includes soils, rocks, mountains, valleys, cliffs, land etc.

(c) The Lithosphere consists of three layers; viz. the Core, Mantle and Crust.

(d) The Inner core is solid while the outer core is liquid.

(e) The Mantle is the bigger part of the lithosphere, about 2900 km deep.

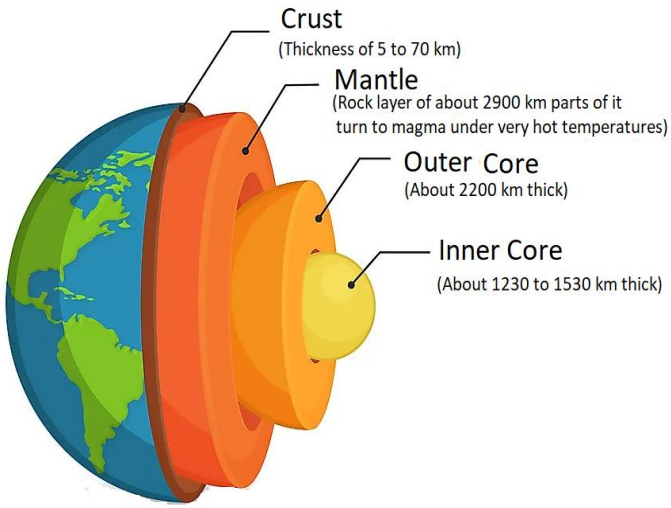
(f) The Mantle is 2900 km deep and is mainly magma with temperatures of up to 4500 °C.

(g) The Crust is the outer layer of the Earth and is like the skin of the Earth.

(h) Elements and compounds are found in the crust.

(i) Elements found in the earth's crust include copper, uranium, gold, silver, and

(j) Compounds producing minerals include iron oxide (hematite), silicon dioxide (sand or quartz) and calcium carbonate (chalk, lime or marble).



Answer the following questions:

1. What are the layers of the lithosphere?

   _____

2. What do we find in the crust layer of the Earth?

   _____

3. Mention five elements found in the Earth's crust.

   _____

4. Which compounds are found in the lithosphere?

   _____

5. Which metals are obtained from the compounds iron oxide, sand and calcium carbonate?

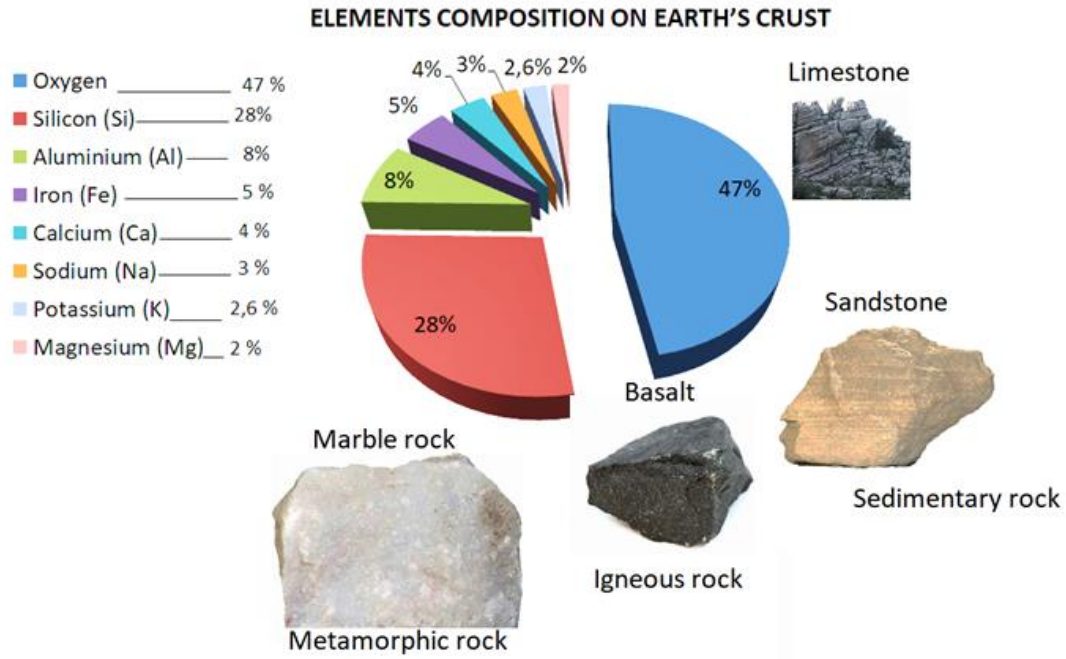
   _____

   _____

   _____

ELEMENTS ON THE EARTH'S CRUST

Use the diagram to answer some of the questions that follow:



1. List the elements found in the Earth's crust.

   _____

2. What are the percentages on the elements in the Earth's crust?

   _____

   _____

3. Give examples of some stones found in the Lithosphere and the main rock they belong to.

   _____

   _____

4. Discuss the difference between a rock and a stone.

   _____

   _____

ROCK CYCLE

(a) The rock cycle explains how the three main types of rocks change from one form to another.

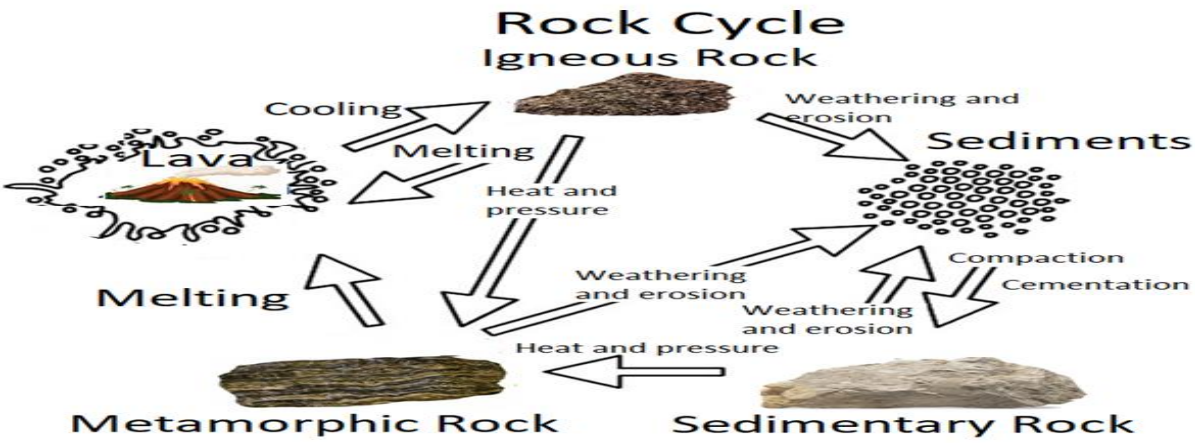
(b) The three main rock types are sedimentary, metamorphic, and igneous.

(c) Metamorphic rock melts into magma when heat and pressure build up around it.

(d) Magma is molten material that erupts from volcanoes.

(e) When magma cools, it hardens and becomes igneous rock.

(f) Sedimentary rock is made from sediments (small particles of rock and material).



(g) Erosion and weathering (from heat, cold, wind, and water) break down rocks into smaller pieces.

(h) These particles are transported and settle on top of each other, forming layers of sediments.

(i) Heat and pressure can change the structure of rock, turning it into metamorphic rock.

(j) If heat builds up around metamorphic rock, it melts into magma.

(k) Magma is molten or semi-molten rock below Earth's surface, forming igneous rocks like pumice and granite.

(l) When magma cools slowly beneath the surface, it forms intrusive igneous rocks, which are large.

(m) When magma moves toward the surface, it becomes lava.

(n) Lava is magma that flows out after erupting from a volcano.

(o) When lava cools quickly, it forms smaller crystal rocks or rocks with a glassy texture

Answer the following questions

Low Order Questions

1. What are the three main types of rocks in the rock cycle?

   _____

2. What is magma?

   _____

   _____

3. What happens when magma cools down?

   _____

4. What is sedimentary rock made from?

   _____

5. What process breaks down rocks into smaller particles?

   _____

Middle Order Questions (Application, explanation, and understanding)

6. Explain how heat and pressure affect metamorphic rocks.

   _____

7. How does magma differ from lava?

   _____

8. Describe the process of how sedimentary rocks form.

   _____

9. What happens to metamorphic rock when it is subjected to intense heat and pressure?

   _____

10. What causes magma to become igneous rock?

    _____

11. How does erosion contribute to the rock cycle?

    _____

12. What is the difference between intrusive and extrusive igneous rocks?

    _____

13. How are sedimentary rocks connected to the formation of metamorphic rocks?

_____

14. Why do rocks undergo weathering and erosion?

_____

_____

15. How does the rock cycle illustrate the relationship between sedimentary, metamorphic, and igneous rocks?

_____

_____

_____

High Order Questions (Analysis, evaluation, and creation)

16. Analyze how the rock cycle would be affected if erosion and weathering did not occur.

_____

_____

17. Evaluate the role of volcanic activity in the formation of igneous rocks and its importance in the rock cycle.

_____

_____

18. Predict what might happen to the Earth's surface if the process of rock melting into magma were to stop.

_____

_____

MINING OF MINERAL RESOURCES

Extracting ores

(a) Valuable minerals are extracted from the lithosphere by mining.

(b) The minerals are contained in the ore which has a high concentration of the mineral.

(c) While some minerals have to be mined and processed, minerals such as diamonds, sand and potash are found in their natural form.

Refining minerals

The mining of some minerals involves the physical or chemical extraction.

Iron

(a) Iron is obtained from its ores in the form of ferrous oxide and magnetite.

(b) The mining process involves digging and blasting.

(c) A blast furnace is used to refine iron from other materials that are part of the iron ore. In the past iron was produced by heating the iron ore with charcoal.

(d) Years ago Iron was traditionally mined in KZN and certain parts of Limpopo.

Gold

(a) Gold in its purest form is bright and slightly reddish yellow.

(b) Gold mining starts with breaking down the rock into smaller pieces no larger than the road gravel.

(c) The ore is then ground into powder by steel ball in rotating drums.

(d) Extracted gold is then refined by methods such as amalgamation, cyanidation, carbon-in-pulp and floatation.

(e) If the gold is still not pure, it is smelted by heating. The substance called flux is used and it bonds with the impurities and floats on top of the melted gold.

(f) The contaminated mixture is hauled away as a solid waste.

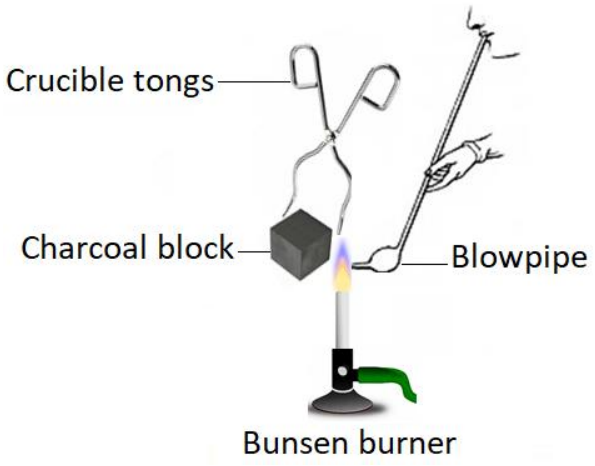
INVESTIGATION

Making lead (Pb) from lead oxide (PbO)

Aim: To extract lead from lead oxide

MATERIALS:

1. Lead(II) oxide (red)
2. Blowpipe
3. Charcoal block / Carbon block
4. Crucible tongs
5. Water
6. Bunsen burner / Sprit burner
7. Drinking straw (optional)
8. Spatula
9. Safety goggles



INSTRUCTIONS:

1. Make a hollow in the charcoal block.
2. Keep the loose charcoal particles in the hollow.
3. Wearing safety goggles add lead oxide in the hollow.
4. Make a paste of lead oxide and charcoal particles by adding a drop or two of water.
5. Attach a straw to the blowpipe and blow into the blue flame top where the lead (II) oxide-carbon paste is for 2 – 4 minutes.
6. Observe any change or keep blowing until there is a change.
7. Record your observations.

RESULTS:

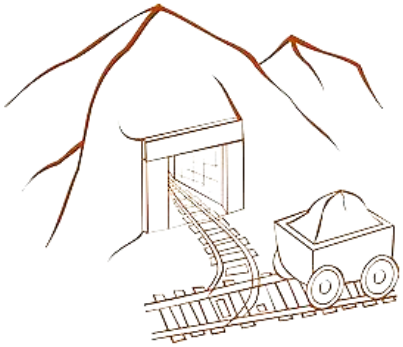
1. What colour change did you observe in this reaction?

   _____

2. Write a chemical equation to represent the reaction.

   _____

MINING IN SOUTH AFRICA



(a) Mining is very important in South Africa for the growth of the economy and job creation.

(b) Mining, however, impacts negatively on the environment.

(c) Some of the challenges include water pollution, dumps and destroying land for farming and disturbing wild live environment.

(d) Do a research about mining activities in South Africa. In your research to the following:

i. Mention where the mine is.

ii. What the mine is mining.

iii. The mining method used to extract the mineral (physical or chemical)

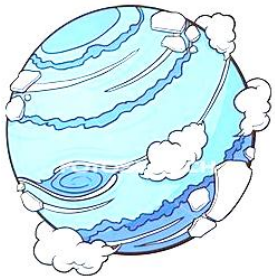
iv. The impact of the mining activities on the environment.

v. Your research must be 4 pages at least and that must include your references.

Structure of the research

1. Topic
2. Background (research)
3. Introduction
4. Body (Details of the research)
5. Results
6. Discussions
7. Conclusion
8. Bibliography

ATMOSPHERE



(a) The mixture of gases around the Earth constitutes the atmosphere.

(b) The atmosphere comprises Nitrogen (78%), Oxygen (21%) Carbon dioxide (1% or less) and other gases (1%).

(c) The density of gas particles decreases with altitude.

(d) The four layers of the atmosphere are (as you go up):

Troposphere

(a) It extends to 10 km above Earth surface with more than 70 % of atmospheric gases.

(b) The weather occurs in this region.

(c) Organisms live in the region.

Stratosphere

(a) It ranges between 10 – 50 km above the Earth's surface.

(b) It has a very thin air.

(c) Temperature changes (decreases) with altitude.

(d) The ozone layer (O_3) which protects life from the harmful ultraviolet light is in this region.

(e) Aeroplanes fly in this sphere.

(f) Temperature can be calculated as: Temperature at a point + 1 ◦C per 100 m.

Mesosphere

(a) It extends from 50 – 80 km about the surface of the Earth.

(b) It has thin air and cold temperatures.

(c) Rocks (shooting stars) burn in this sphere.

Thermosphere

(a) It starts at about 80km to about 350km above the surface of the Earth.

(b) International Space Station is hosted in this region.

(c) International Space Station serves as research laboratory for different fields of science including astronomy, physics and biology. It is in orbit at 330 – 450 km.

(d) In the thermosphere radio waves are reflected back to Earth for TV and radio broadcast.

Answer the following questions:

1. Which layer is closest to the Earth's surface?

_____

2. What is the range of this sphere?

_____

3. What is the composition of gases in this sphere?

_____

4. Mention the other three spheres in their correct order and their range.

_____

_____

5. In which sphere do we find the ozone layer?

_____

6. What is the function of the ozone layer?

_____

7. The temperature in a town is 21°C at an altitude of 30 metres. If you go up by 200 metres to reach a height of 230m, what will be the temperature at that point?

_____

8. Explain the details of the Mesosphere.

_____

_____

9. Discuss the relationship between height and the density of gas particles.

_____

10. What is the relationship between temperature and altitude?

_____

_____

11. Discuss the conditions in the Thermosphere.

_____

_____

12. What is the International Space Station?

_____

_____

13. Discuss the importance of the ISS.

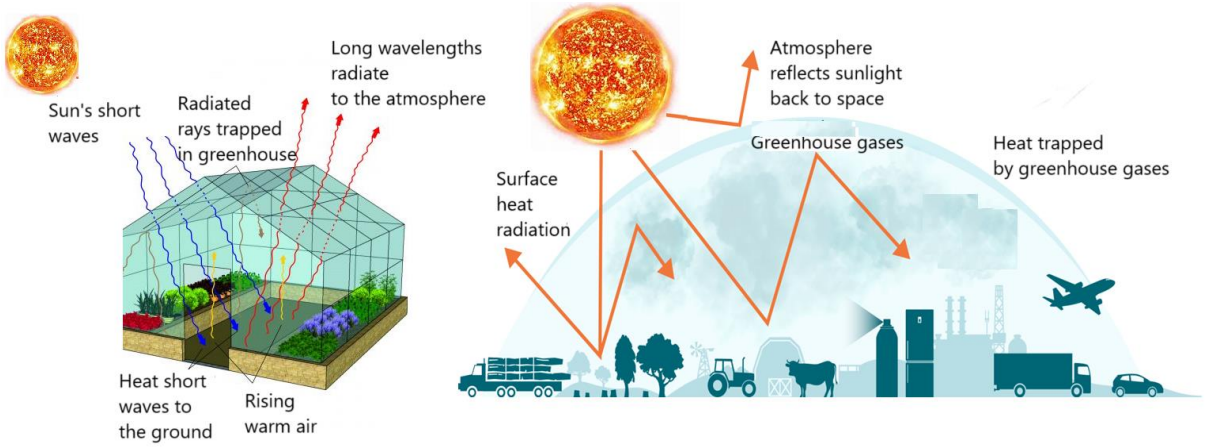
_____

_____

THE GREENHOUSE EFFECT

(a) The lower part of the atmosphere (troposphere) and the surface of the Earth are kept warm by the greenhouse effect.

(b) The greenhouse effect is caused by the presence of carbon dioxide, methane, carbon dioxide and other gases.



(c) These gases are known as greenhouse gases.

(d) The average temperature of the Earth (global warming) gradually increases as the volume of greenhouse gases increases.

(e) Global warming leads to shortages of food, change in climate, rise in sea levels and mass extinction.

Answer the following questions:

Low Order Questions

1. What is the greenhouse effect?

   _____

2. Name two gases that contribute to the greenhouse effect.

   _____

3. What happens to the Earth's temperature as the volume of greenhouse gases increases?

   _____

   _____

4. What is the lower part of the atmosphere called?

   _____

   _____

5. Which phenomenon causes the Earth's surface to stay warm?

   _____

Middle Order Questions

6. Explain how greenhouse gases contribute to global warming.
   _____
7. Why are greenhouse gases important for life on Earth?
   _____
   _____
8. What would happen if there were no greenhouse gases in the atmosphere?
   _____
   _____
9. How does an increase in global warming affect sea levels?
   _____
   _____
10. How does climate change, caused by global warming, impact food production?
    _____
    _____

High Order Questions

11. Analyze the relationship between global warming and mass extinction.
    _____
    _____
12. Predict the long-term consequences of rising greenhouse gas levels on future generations.
    _____
13. Evaluate the role of human activity in the increase of greenhouse gases.
    _____
14. How might changes in greenhouse gas levels affect global food security in the next 50 years? _____
    _____
15. Propose potential solutions to mitigate the effects of global warming and reduce greenhouse gas emissions.
    _____

BIRTH, LIFE AND DEATH OF STARS

(a) Stars live for a certain period of time.

(b) Stars are born in clouds called **nebulae**.

(c) A **nebula** is a cloud of gas and dust in space.

(d) One cloud is a nebula; more than one are called nebulae.

(e) A nebula collapses when gravity becomes strong enough to overcome the outward pressure of gas, leading the cloud to condense into denser regions that can eventually form a star.

(f) When the temperature is high enough, **nuclear fusion** turns hydrogen into helium.

(g) These processes create the colorful red, blue, and green swirls of light in space.

(h) Young, hot stars appear blue because they have more fuel, while older stars look red as they run out of fuel and emit less energy.

(i) Nebulae are mostly made of hydrogen, with 10% helium and small amounts of other elements.

Answer the following questions:

Low – Order Questions

1. What is a nebula?

_____

2. What elements make up the majority of a nebula?

_____

3. What is the process by which hydrogen is changed into helium in stars?

_____

4. What color do young stars typically appear?

_____

Middle-Order Question

5. How do the colors of stars help determine their age?

_____

_____

6. Explain why aging stars emit less energy than young stars.

_____

_____

7. Describe the role of gravity in the formation of stars from nebulae.

_____

_____

High – Order

8. What might happen if the nuclear fusion process in stars was different or did not occur?

_____

9. Evaluate the importance of helium in the life cycle of a star.

_____

_____

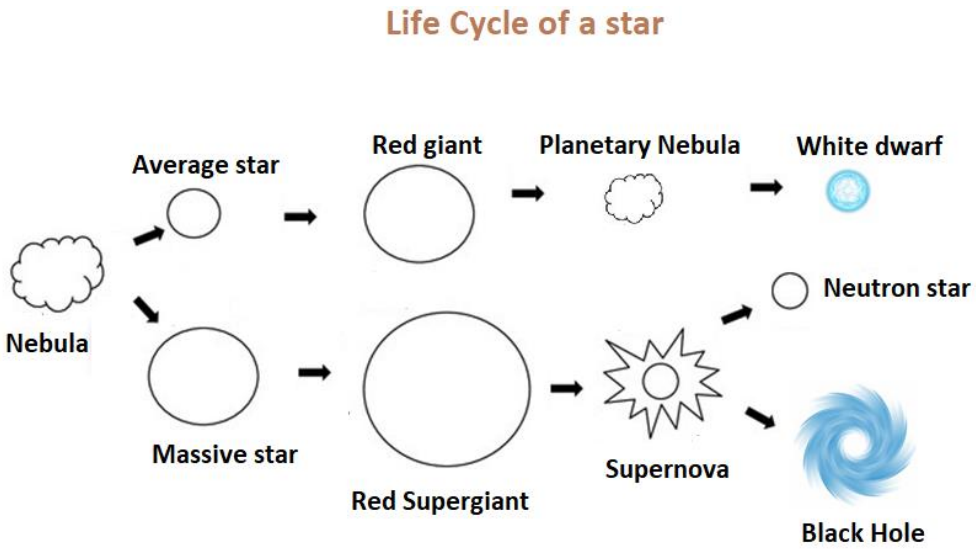
(a) A star's life cycle depends on the matter it carries.

(b) The size of the star is determined by the matter available during its formation.

(c) It begins with the hydrogen gas held together by gravity making it to spin.

(d) As it spins it heats and turns into a prostar and later a star.

(e) Large stars use their energy faster and do not live long and small stars live longer for the same reason.



(f) Blue looking stars are hotter and of a younger age than red looking stars.

(g) The Sun is said to be have a 9 billion life span and it is halfway that.

(h) Stars change hydrogen to helium and once they are out of energy, they swell up to form a "red giant."

(i) A star can become brighter that it normally is and explode.

(j) The explosion of a super red giant is known as a supernova.

(k) A super nova can form when two stars come closer and one star stealing matter from the other star and ending up exploding from too much matter.

(l) A supernova can also form when a super-giant star runs out of nuclear fuel and its core collapses followed by an explosion.

Answer the following questions:

Low – Order Questions

1. What determines the size of a star?

   _____

2. What gas is a star primarily made of at the beginning of its life cycle?

   _____

3. What color are young, hot stars?

   _____

4. What is a supernova?

   _____

   _____

5. What happens when a star runs out of hydrogen?

   _____

   _____

Middle - Order Questions

6. Explain why the amount of matter during a star's formation determines its size and life cycle. _____

   _____

7. What causes a protostar to transform into a fully formed star?

   _____

   _____

8. Why do large stars burn through their energy faster than smaller stars?

   _____

   _____

9. Compare the lifespans of blue stars and red stars, explaining the differences in their temperatures and ages.

_____

_____

10. How does a star's hydrogen-to-helium fusion process relate to the formation of a red giant?

_____

_____

11. Why does a star swell and become a red giant when it runs out of hydrogen?

_____

_____

12. How can the interaction between two stars lead to a supernova?

_____

_____

High – Order Questions:

13. Analyze how the Sun's progression into a red giant will affect life on Earth and the structure of the solar system.

_____

_____

DEATH OF A STAR

(a) Stars depend on energy generated from nuclear reaction.

(b) The core of the star contracts and turn into a white dwarf once it runs out of energy

(c) The stars do not die the same way.

(d) Small stars die peacefully turning into white dwarfs.

(e) The death of giant stars is followed by a huge explosion known as the supernova.

(f) This would sometimes result in a black hole.

(g) When the hydrogen that fuels nuclear reactions begin to run out, the star starts dying.

(h) The stars would eventually change colour and become red giants

Answer the following questions:

1. Where do stars get their energy from?

   _____

2. Explain what happens to a star once it runs out of energy.

   _____

3. Explain how small stars die.

   _____

4. What is a supernova?

   _____

5. Discuss what happens when stars eventually run out of energy.

   _____

   _____

   _____