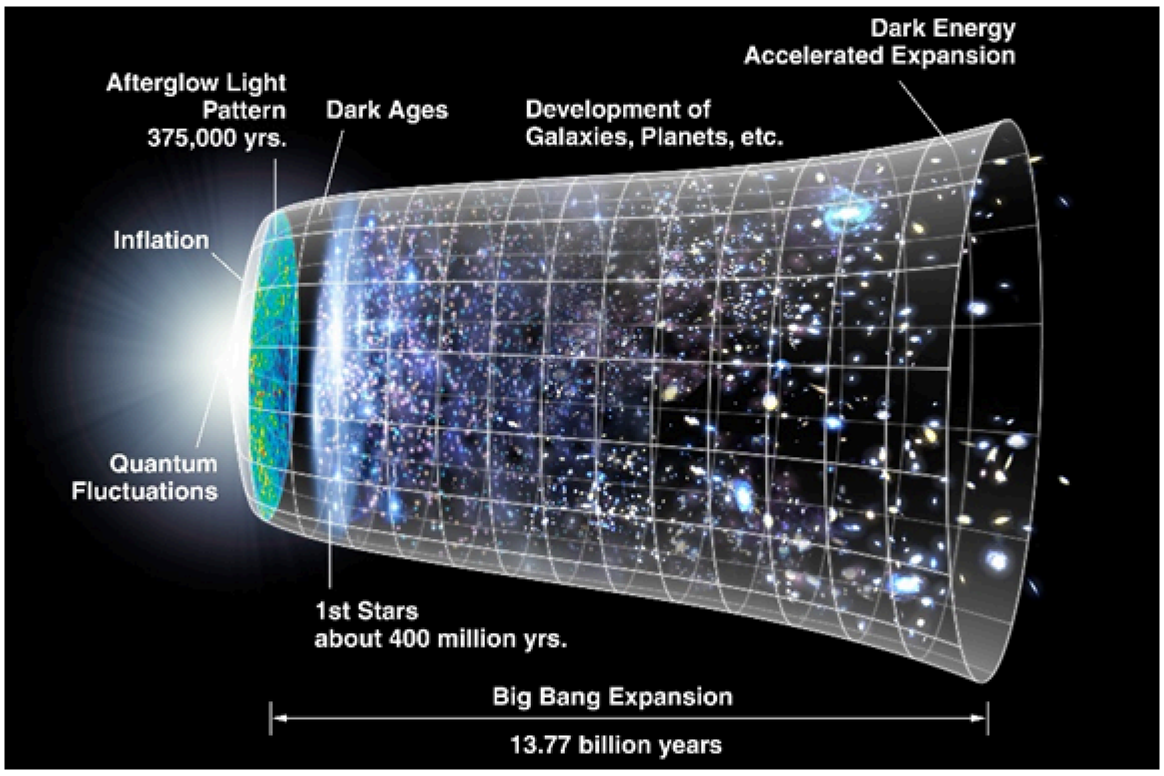
Form	**BA - 1, Science, Chemistry with ESS, SY 24-25**
Identifier	F-7ZWBC5_C17822

Item	**BA-1_Chemistry with ESS_1_Evidence Supporting the Big Bang Theory**
Identifier	I-SCI-F-S000026_C23398
Standards	SCI.9-12.HS-ESS1-2

Evidence Supporting the Big Bang Theory

Recent astronomical observations provide compelling evidence supporting the Big Bang theory, the prevailing explanation for the origin and evolution of the universe. Light spectra from distant galaxies reveal a redshift, indicating these galaxies are moving away from us. This redshift is a key piece of evidence indicating the expansion of the universe and aligns with the predictions of the Big Bang theory.



Furthermore, the motion of distant galaxies also supports the idea of an expanding universe. By observing the Doppler effect in the light emitted by these galaxies, astronomers can deduce their speed and direction of movement. This motion away from us is consistent with the notion that the universe is continuously expanding from a point of origin.

Additionally, the composition of matter in the universe provides further evidence for the Big Bang theory. The abundance of light elements such as hydrogen and helium throughout the universe matches the predictions of nucleosynthesis that occurred during the early stages of the Big Bang. This cosmic nucleosynthesis explains the origin of these light elements and their distribution in the universe.

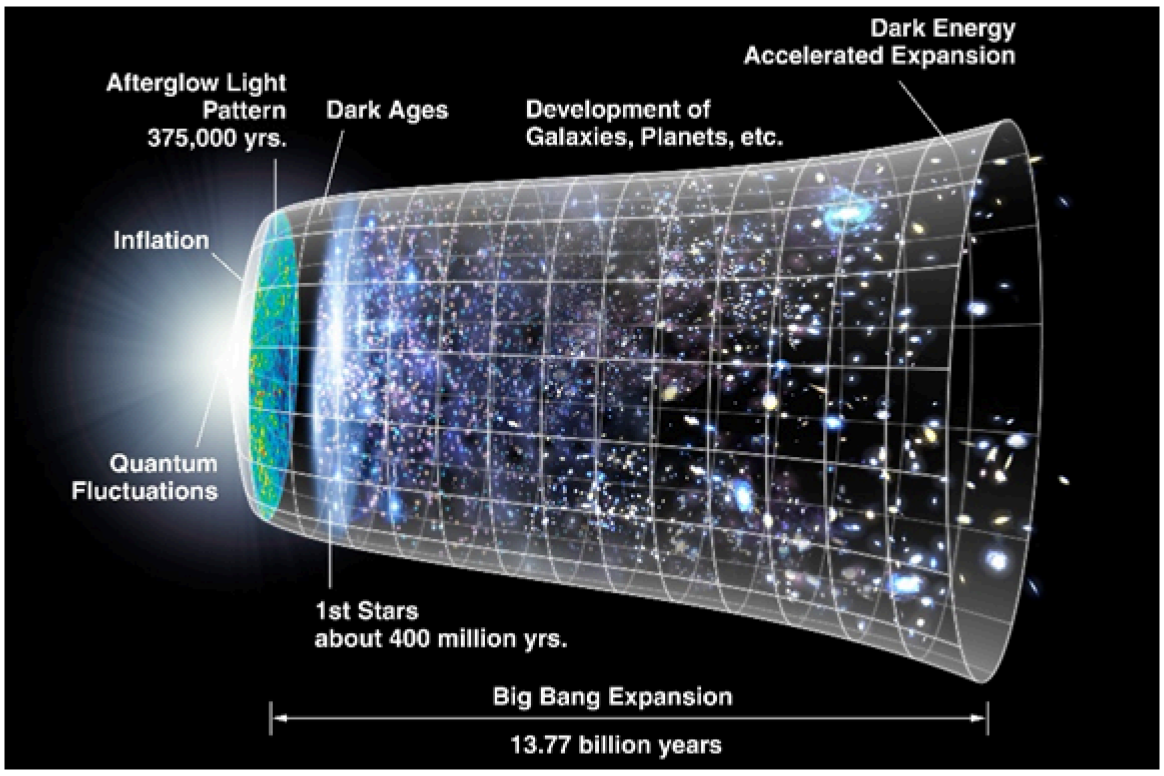
How does the composition of matter in the universe provide evidence for the Big Bang theory?

- A The ratio of heavy elements to light elements in distant stars is higher than expected.
- B The distribution of hydrogen and helium matches predictions from models of nucleosynthesis during the Big Bang.
- C The concentration of dark matter is uniform across the universe.
- D The presence of carbon in distant galaxies suggests a common origin for all matter.

Item	BA-1_Chemistry with ESS_2_Evidence Supporting the Big Bang Theory
Identifier	I-SCI-F-S000026_C28922
Standards	SCI.9-12.HS-ESS1-2

Evidence Supporting the Big Bang Theory

Recent astronomical observations provide compelling evidence supporting the Big Bang theory, the prevailing explanation for the origin and evolution of the universe. Light spectra from distant galaxies reveal a redshift, indicating these galaxies are moving away from us. This redshift is a key piece of evidence indicating the expansion of the universe and aligns with the predictions of the Big Bang theory.



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Additionally, the composition of matter in the universe provides further evidence for the Big Bang theory. The abundance of light elements such as hydrogen and helium throughout the universe matches the predictions of nucleosynthesis that occurred during the early stages of the Big Bang. This cosmic nucleosynthesis explains the origin of these light elements and their distribution in the universe.

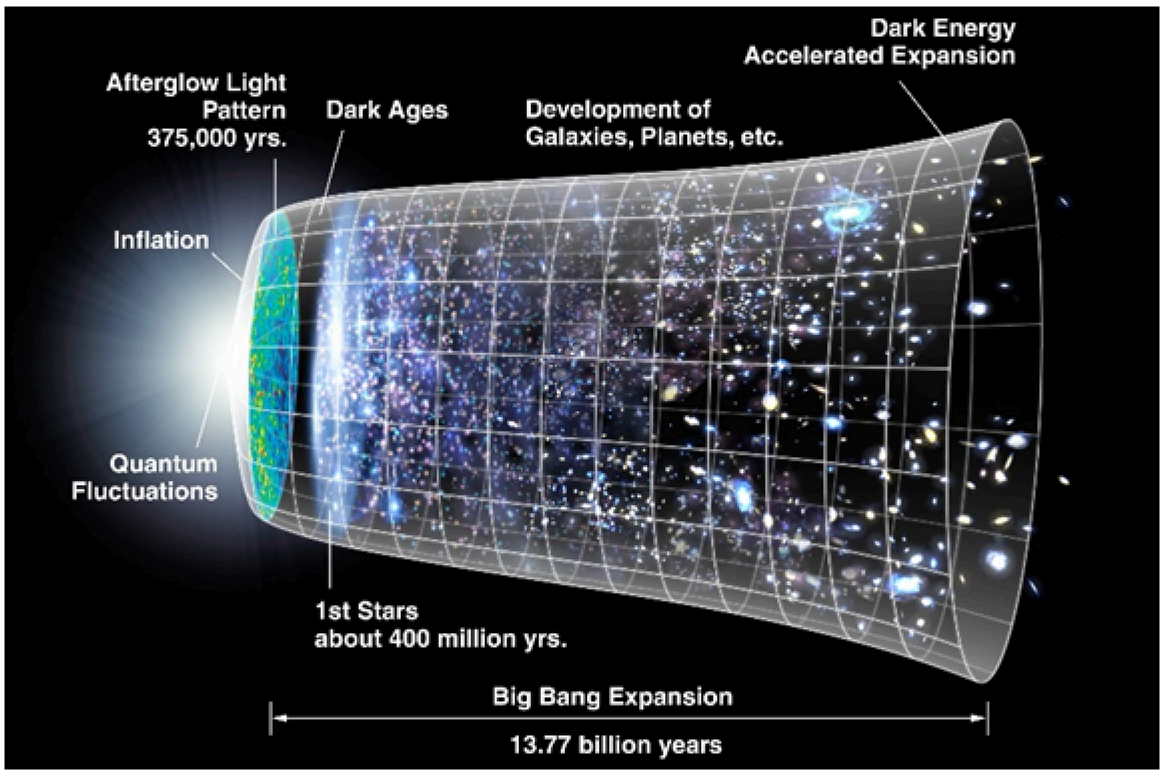
Which of the following observations **BEST** supports the conclusion that the universe is expanding as predicted by the Big Bang theory?

- A The presence of cosmic microwave background radiation in the universe.
- B The detection of black holes at the centers of galaxies.
- C The discovery of exoplanets in distant star systems.
- D The observation of a redshift in the light spectra from distant galaxies.

Item	BA-1_Chemistry with ESS_3_Evidence Supporting the Big Bang Theory
Identifier	I-SCI-F-S000026_C75662
Standards	SCI.9-12.HS-ESS1-2

Evidence Supporting the Big Bang Theory

Recent astronomical observations provide compelling evidence supporting the Big Bang theory, the prevailing explanation for the origin and evolution of the universe. Light spectra from distant galaxies reveal a redshift, indicating these galaxies are moving away from us. This redshift is a key piece of evidence indicating the expansion of the universe and aligns with the predictions of the Big Bang theory.



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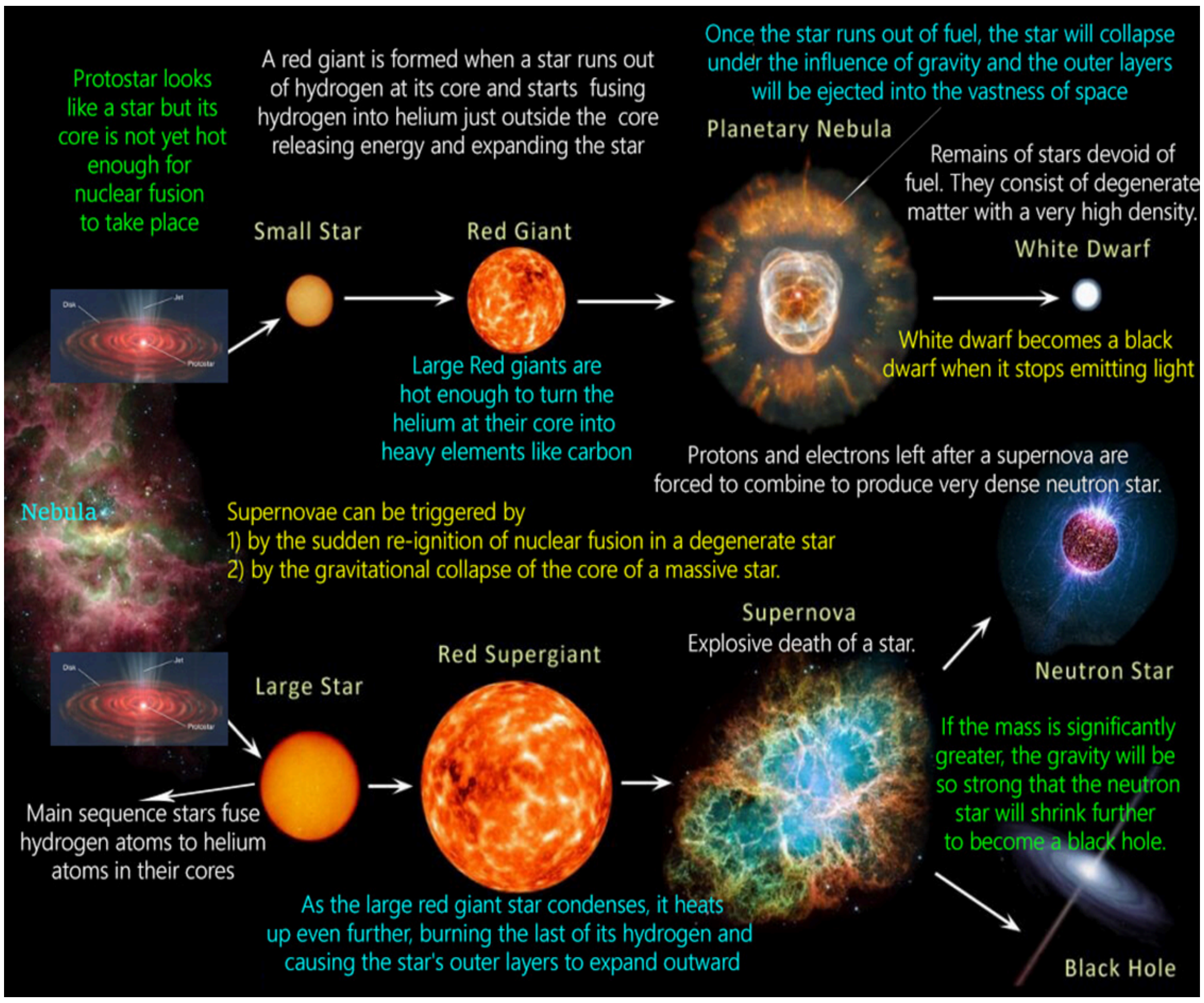
Additionally, the composition of matter in the universe provides further evidence for the Big Bang theory. The abundance of light elements such as hydrogen and helium throughout the universe matches the predictions of nucleosynthesis that occurred during the early stages of the Big Bang. This cosmic nucleosynthesis explains the origin of these light elements and their distribution in the universe.

What role does the observed proportion of hydrogen and helium in stars and interstellar gases play in supporting the Big Bang theory?

- A It suggests that stars are continuously producing these elements in the same ratio as during the Big Bang.
- B It confirms that all elements heavier than helium were formed in the early universe.
- C It matches the predicted ratio from the early universe, providing evidence for nucleosynthesis during the Big Bang.
- D It indicates that these elements were evenly distributed by black holes after the Big Bang.

Item	BA-1_Chemistry with ESS_4_Life Cycle of Stars and Stellar Nucleosynthesis
Identifier	I-SCI-F-S000026_C38508
Standards	SCI.9-12.HS-ESS1-3

Life Cycle of Stars and Stellar Nucleosynthesis

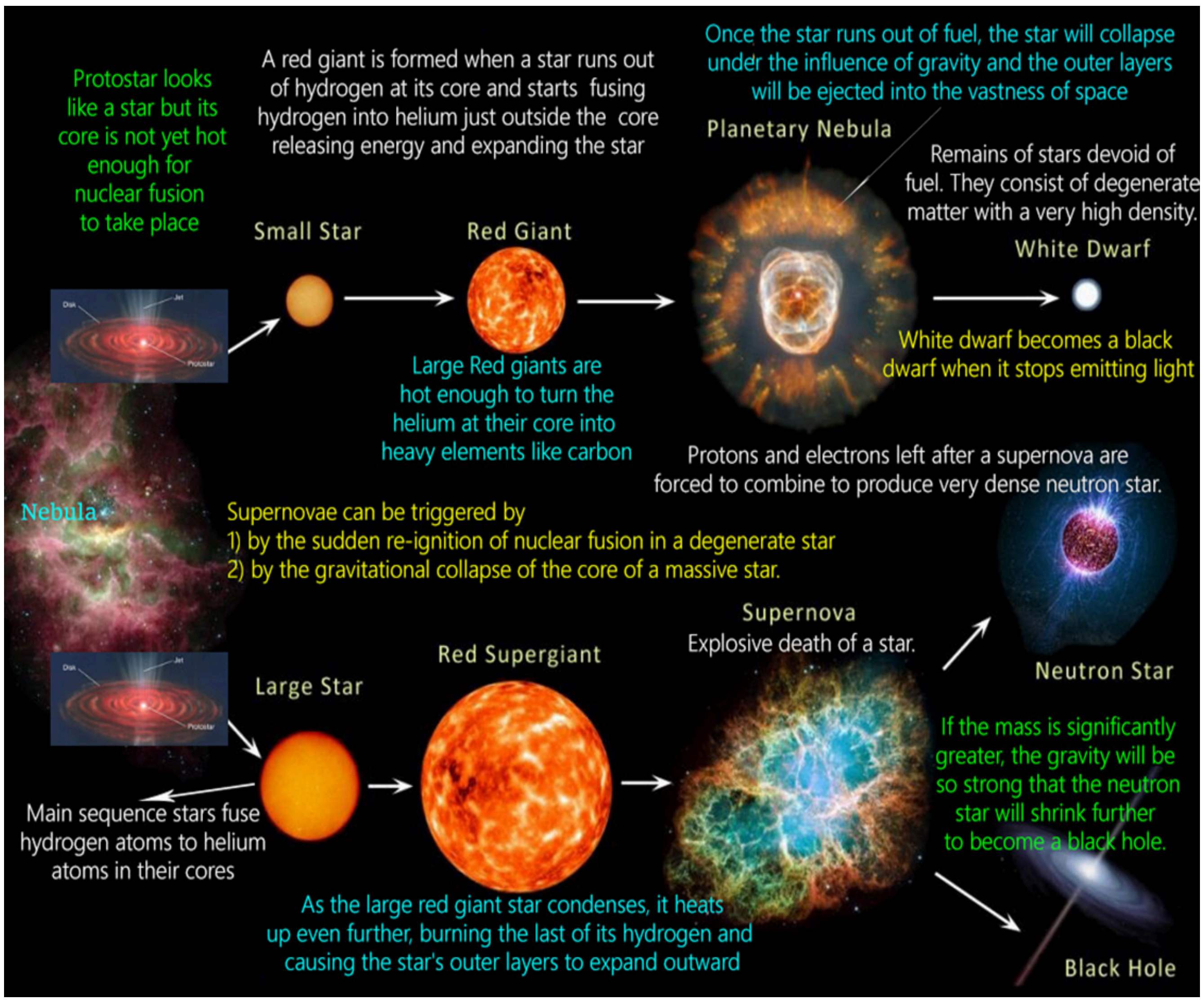


Which statement accurately describes the relationship between the life cycle of a star and the distribution of elements in the universe?

- A The elements produced by a star during its life cycle remain confined within the star until it becomes a black hole.
- B Stars distribute elements into the universe primarily through stellar winds and planetary nebulae, with little contribution from supernovae.
- C Elements produced by stars are gradually absorbed by planets and do not contribute to the cosmic abundance of elements.
- D The elements produced in the core of a star are expelled into the universe during the later stages of the star’s life, especially during supernova explosions, enriching the interstellar medium.

Item	BA-1_Chemistry with ESS_5_Life Cycle of Stars and Stellar Nucleosynthesis_C69497
Identifier	I-SCI-F-S000026_C69497
Standards	SCI.9-12.HS-ESS1-3

Life Cycle of Stars and Stellar Nucleosynthesis

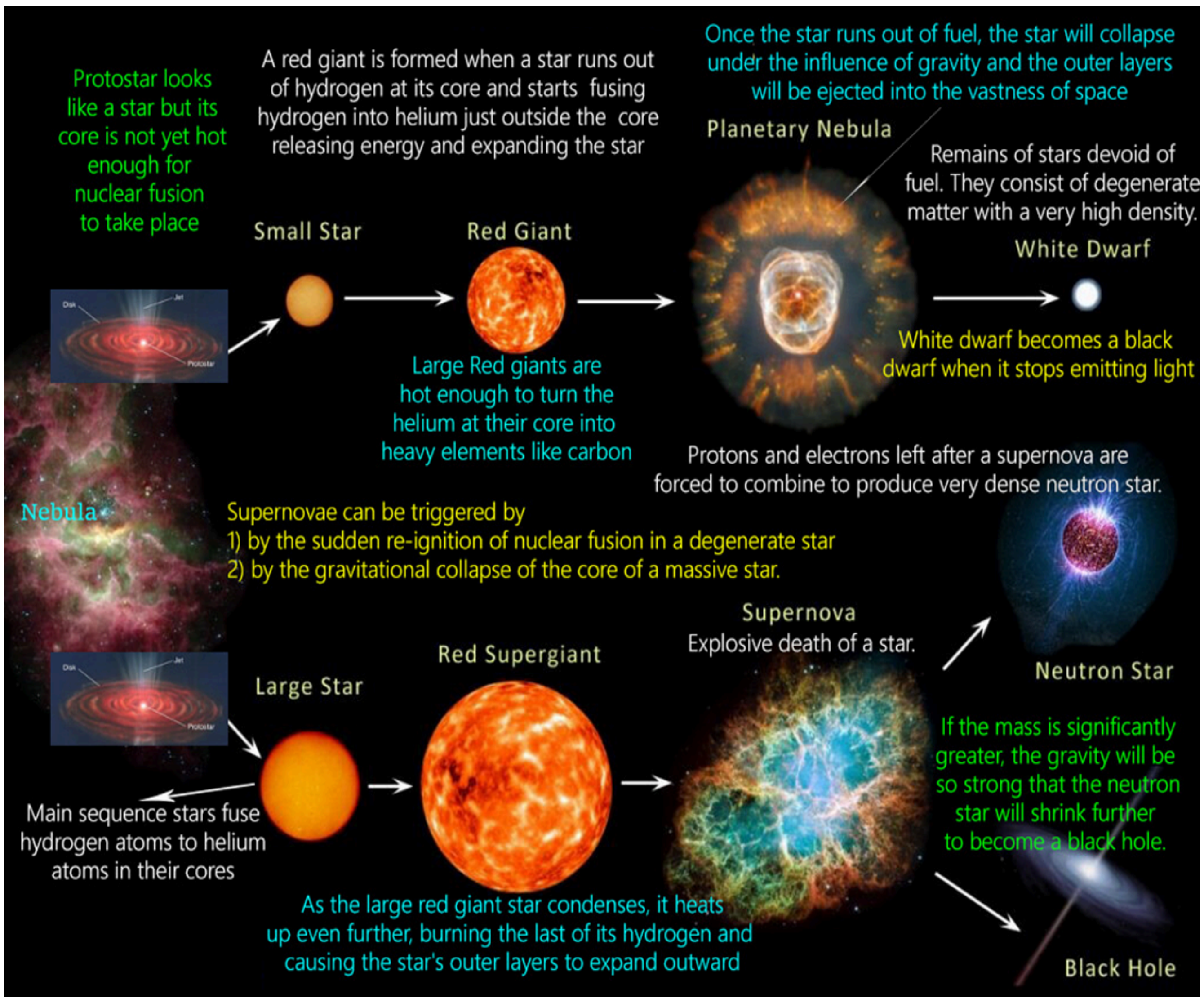


During which stage of a star's life cycle does hydrogen fusion primarily occur, and what element is produced because of this fusion process?

- A Main sequence phase, producing helium.
- B Red giant phase, producing helium.
- C Protostar phase, producing carbon.
- D White dwarf phase, producing oxygen.

Item	BA-1_Chemistry with ESS_6_Life Cycle of Stars and Stellar Nucleosynthesis
Identifier	I-SCI-F-S000026_C07831
Standards	SCI.9-12.HS-ESS1-3

Life Cycle of Stars and Stellar Nucleosynthesis



Why is the fusion of heavier elements, such as iron, not sustainable for a star in terms of energy production over its lifetime?

- A Heavier element fusion requires extremely high temperatures, which cannot be sustained by the star's core.
- B Fusion of heavier elements releases less energy compared to fusion of lighter elements.
- C Fusion of heavier elements consumes more energy than it releases, leading to a net loss of energy for the star.
- D Fusion of heavier elements leads to a rapid depletion of the star's fuel, causing it to collapse under its own gravity.

Item	BA-1_Chemistry with ESS_7_Changes in Atom Nuclei Composition and Energy Release
Identifier	I-SCI-F-S000026_C78881
Standards	SCI.9-12.HS-PS1-8

Changes in Atom Nuclei Composition and Energy Release

Process	Nucleus Composition Changes	Energy Released
Fission	• A heavy nucleus splits into two smaller nuclei • Example: Uranium-235 splits into Barium-141 and Krypton-92 • Neutrons are also released in the process.	Significant energy is released, typically in the range of hundreds of MeV (Mega electron Volts) per fission event.
Fusion	• Two light nuclei combine to form a heavier nucleus • Example: Hydrogen-2 and Hydrogen-3 combine to form Helium-4 • Often accompanied by the release of a neutron or other subatomic particles.	Even more energy is released than in fission, typically in the range of several MeV per fusion event.
Radioactive Decay	• An unstable nucleus loses energy by emitting radiation (alpha particles, beta particles, or gamma rays). • The nucleus transforms into a different element or isotope.	Energy released is relatively small compared to fission and fusion, typically in the range of keV (kilo electron Volts) to a few MeV per decay.

Explain the differences in the nucleus composition changes between fission and fusion processes based on the data table.

A Fission entails the splitting of nuclei into smaller parts, while fusion entails the merging of nuclei to form a larger nucleus.

B Fission results in the emission of radiation and nucleus transformation, while fusion results in the splitting of nuclei and energy release.

C Fission involves very small atomic nuclei splitting into separate subatomic particles releasing large amounts of energy.

D Fission involves the merging of nuclei to form a larger nucleus, while fusion involves the splitting of a nucleus into smaller nuclei.

Item	BA-1_Chemistry with ESS_8_Changes in Atom Nuclei Composition and Energy Release
Identifier	I-SCI-F-S000026_C64012
Standards	SCI.9-12.HS-PS1-8

Changes in Atom Nuclei Composition and Energy Release

Process	Nucleus Composition Changes	Energy Released
Fission	• A heavy nucleus splits into two smaller nuclei • Example: Uranium-235 splits into Barium-141 and Krypton-92 • Neutrons are also released in the process.	Significant energy is released, typically in the range of hundreds of MeV (Mega electron Volts) per fission event.
Fusion	• Two light nuclei combine to form a heavier nucleus • Example: Hydrogen-2 and Hydrogen-3 combine to form Helium-4 • Often accompanied by the release of a neutron or other subatomic particles.	Even more energy is released than in fission, typically in the range of several MeV per fusion event.
Radioactive Decay	• An unstable nucleus loses energy by emitting radiation (alpha particles, beta particles, or gamma rays). • The nucleus transforms into a different element or isotope.	Energy released is relatively small compared to fission and fusion, typically in the range of keV (kilo electron Volts) to a few MeV per decay.

Which of the following statements best compares the energy released during fission, fusion, and radioactive decay?

- A Fusion releases the least energy, while radioactive decay releases the most energy.
- B Fission and fusion release very large amounts of energy, which are both significantly higher than the energy released by radioactive decay.
- C Radioactive decay releases more energy than fission, but less than fusion.
- D Fission releases the most energy, followed by radioactive decay, with fusion releasing the least.

Item	BA-1_Chemistry with ESS_9_Changes in Atom Nuclei Composition and Energy Release
Identifier	I-SCI-F-S000026_C06032
Standards	SCI.9-12.HS-PS1-8

Changes in Atom Nuclei Composition and Energy Release

Process	Nucleus Composition Changes	Energy Released
Fission	• A heavy nucleus splits into two smaller nuclei • Example: Uranium-235 splits into Barium-141 and Krypton-92 • Neutrons are also released in the process.	Significant energy is released, typically in the range of hundreds of MeV (Mega electron Volts) per fission event.
Fusion	• Two light nuclei combine to form a heavier nucleus • Example: Hydrogen-2 and Hydrogen-3 combine to form Helium-4 • Often accompanied by the release of a neutron or other subatomic particles.	Even more energy is released than in fission, typically in the range of several MeV per fusion event.
Radioactive Decay	• An unstable nucleus loses energy by emitting radiation (alpha particles, beta particles, or gamma rays). • The nucleus transforms into a different element or isotope.	Energy released is relatively small compared to fission and fusion, typically in the range of keV (kilo electron Volts) to a few MeV per decay.

How does the energy released during radioactive decay compare to the energy released during fission and fusion processes, according to the information provided in the data table?

A Radioactive decay releases a larger amount of energy compared to both fission and fusion processes.

B Radioactive decay releases a variable amount of energy, like the energy released during fission and fusion processes.

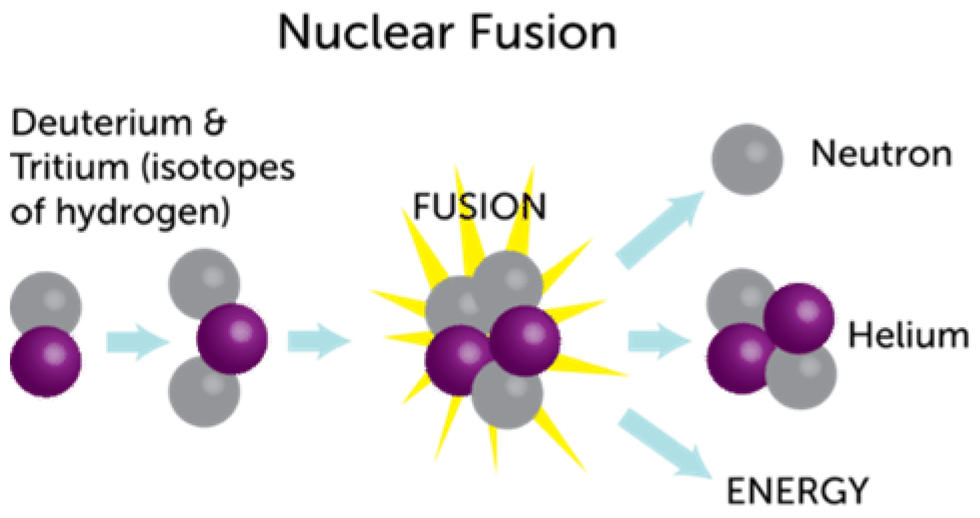
C Radioactive decay releases a smaller amount of energy compared to both fission and fusion processes.

D Radioactive decay releases energy in the form of radiation, while fission and fusion release energy because of nucleus composition changes.

Item	BA-1_Chemistry with ESS_10_The Life Span of the Sun and Nuclear Fusion
Identifier	I-SCI-F-S000026_C88387
Standards	SCI.9-12.HS-ESS1-1

The Life Span of the Sun and Nuclear Fusion

The Sun, a massive ball of burning gas, is the center of our solar system and the primary source of energy for life on Earth. The Sun's energy is produced through a process called nuclear fusion, which takes place in its core. In the core of the Sun, hydrogen atoms combine to form helium through a series of fusion reactions. This fusion releases an immense amount of energy in the form of radiation, mainly visible light, and heat. Over time, the Sun will eventually exhaust its hydrogen fuel and undergo changes that will affect its size, brightness, and life span.



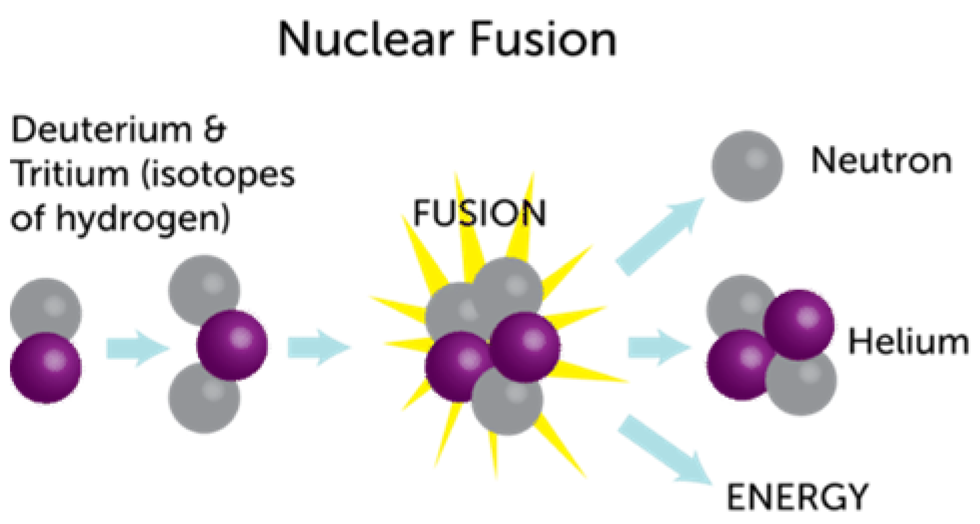
Describe the process through which the Sun generates energy in its core. What role does nuclear fusion play in this energy production?

- A The Sun produces energy through the combustion of gases in its atmosphere, releasing heat and light.
- B Energy production in the Sun's core is a result of gravitational compression, with nuclear fusion contributing to the generation of heat.
- C The Sun's energy is primarily derived from chemical reactions occurring in its core, with nuclear fusion serving as a secondary process.
- D Energy in the Sun's core is generated through the conversion of matter into energy, with nuclear fusion playing a key role in this process.

Item	BA-1_Chemistry with ESS_11_The Life Span of the Sun and Nuclear Fusion
Identifier	I-SCI-F-S000026_C00463
Standards	SCI.9-12.HS-ESS1-1

The Life Span of the Sun and Nuclear Fusion

The Sun, a massive ball of burning gas, is the center of our solar system and the primary source of energy for life on Earth. The Sun's energy is produced through a process called nuclear fusion, which takes place in its core. In the core of the Sun, hydrogen atoms combine to form helium through a series of fusion reactions. This fusion releases an immense amount of energy in the form of radiation, mainly visible light, and heat. Over time, the Sun will eventually exhaust its hydrogen fuel and undergo changes that will affect its size, brightness, and life span.

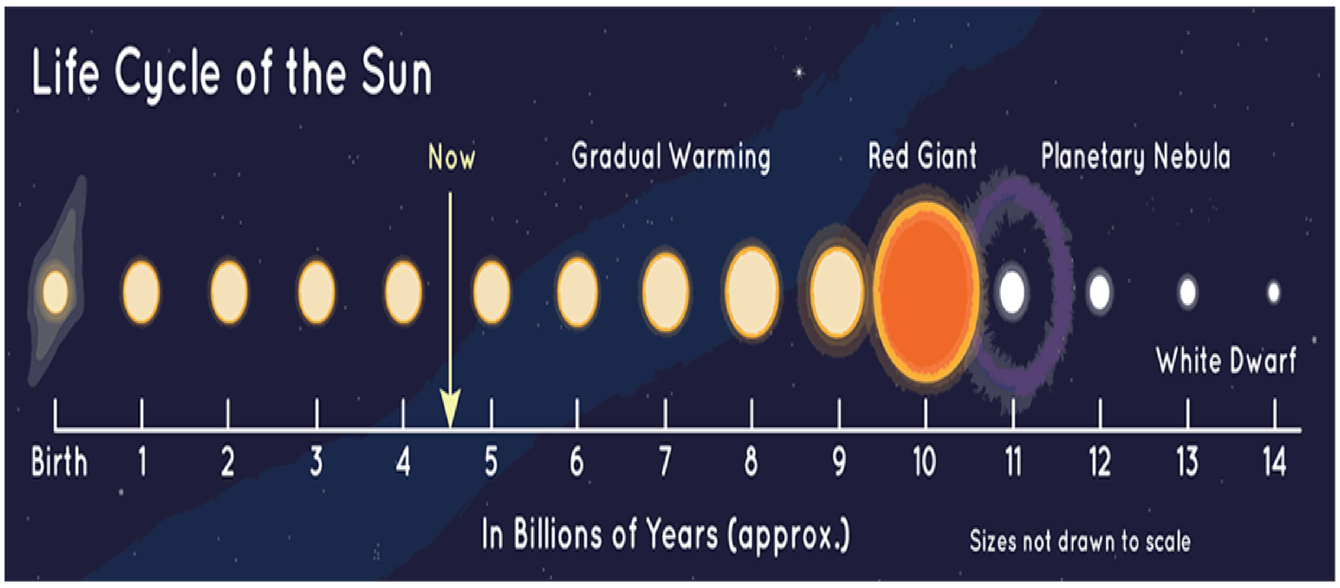


How does the energy released from the Sun's core in the form of radiation impact Earth and other planets in the solar system?

- A The Sun's radiation has no significant impact on Earth or other planets in the solar system.
- B The Sun's radiation powers the magnetic fields of planets, affecting their climate and weather patterns.
- C Solar radiation provides light and heat to Earth, driving weather systems, photosynthesis, and sustaining life.
- D The Sun's radiation primarily affects the outer layers of planets, causing them to lose atmosphere over time.

Item	BA-1_Chemistry with ESS_12_The Life Span of the Sun and Nuclear Fusion
Identifier	I-SCI-F-S000026_C39754
Standards	SCI.9-12.HS-ESS1-1

The Life Span of the Sun and Nuclear Fusion



Predict what changes might occur in the Sun as it progresses through its life span and evolves from a main sequence star into a red giant.

A The Sun will decrease in size and brightness, eventually collapsing into a black hole.

B As the Sun exhausts its hydrogen fuel, it will expand into a red giant, engulfing inner planets like Earth.

C The Sun will maintain its size and luminosity throughout its life span, eventually burning out similar to how a campfire burns out if no wood is added.

D The Sun's core will cool down, causing it to shrink and become a white dwarf, while the outer layers expand into a planetary nebula.

Item	**BA-1_Chemistry with ESS_13_Predicting Element Properties based on Electron Configuration**
Identifier	I-SCI-F-S000026_C70502
Standards	SCI.9-12.HS-PS1-1

Predicting Element Properties based on Electron Configuration

Element	Outermost Energy Level	Number of Valence Electrons	Predicted Property
Sodium (Na)	3	1	Metal
Neon (Ne)	2	8	Noble Gas
Aluminum (Al)	3	3	Metal
Sulfur (S)	3	6	Nonmetal
Magnesium (Mg)	3	2	Metal

Based on the data table, explain how the predicted properties of the elements relate to the number of electrons in their outermost energy level.

- A The number of electrons in the outermost energy level usually determines whether an element will exhibit metallic or nonmetallic properties.
- B Elements with partially filled outermost energy levels tend to be noble gases.
- C Elements with a higher number of electrons in their outermost energy level tend to exhibit magnetic properties.
- D Elements with fewer electrons in their outermost energy level tend to be gasses at room temperature.

Item	BA-1_Chemistry with ESS_14_Predicting Element Properties based on Electron Configuration
Identifier	I-SCI-F-S000026_C59376
Standards	SCI.9-12.HS-PS1-1

Predicting Element Properties based on Electron Configuration

Element	Outermost Energy Level	Number of Valence Electrons	Predicted Property
Sodium (Na)	3	1	Metal
Neon (Ne)	2	8	Noble Gas
Aluminum (Al)	3	3	Metal
Sulfur (S)	3	6	Nonmetal
Magnesium (Mg)	3	2	Metal

Predict the most likely type of bond that will form between sulfur (S) and magnesium (Mg) based on their valence electron configuration.

- A Covalent bond
- B Metallic bond
- C Ionic bond
- D Hydrogen bond

Item	BA-1_Chemistry with ESS_15_Predicting Element Properties based on Electron Configuration
Identifier	I-SCI-F-S000026_C35545
Standards	SCI.9-12.HS-PS1-1

Predicting Element Properties based on Electron Configuration

Element	Outermost Energy Level	Number of Valence Electrons	Predicted Property
Sodium (Na)	3	1	Metal
Neon (Ne)	2	8	Noble Gas
Aluminum (Al)	3	3	Metal
Sulfur (S)	3	6	Nonmetal
Magnesium (Mg)	3	2	Metal

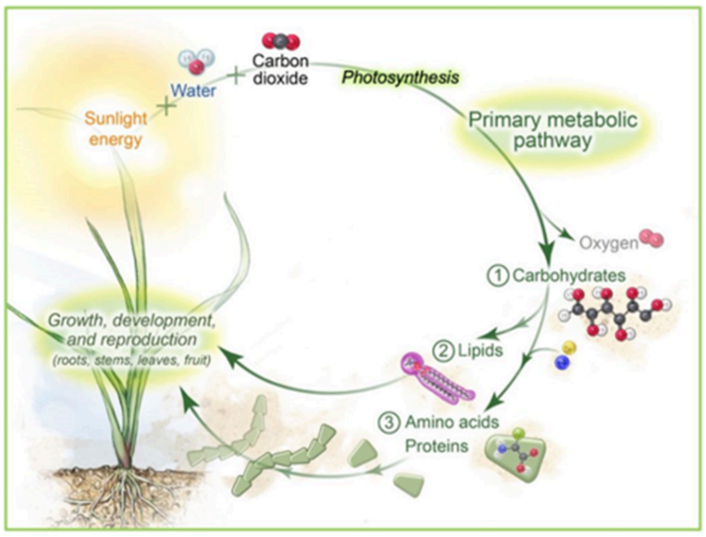
Based on the periodic trends, which element from the table is **LEAST** likely to participate in a chemical reaction?

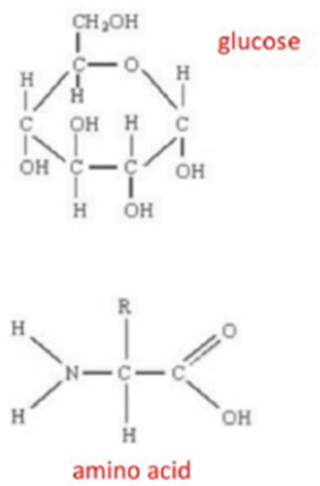
- A Sodium (Na)
- B Neon (Ne)
- C Magnesium (Mg)
- D Sulfur (S)

Item	BA-1_Chemistry with ESS_16_Formation of Amino Acids from Sugar Molecules in Plant Cells
Identifier	I-SCI-F-S000026_C37171
Standards	SCI.9-12.HS-LS1-6

Formation of Amino Acids from Sugar Molecules in Plant Cells

In plant cells, the process of photosynthesis allows for the transformation of carbon, hydrogen, and oxygen from sugar molecules into amino acids - the building blocks of proteins. During photosynthesis, plants absorb carbon dioxide from the atmosphere and water from the soil, using sunlight as an energy source.
Through a series of enzymatic reactions in the chloroplasts, the carbon, hydrogen, and oxygen atoms in glucose molecules are rearranged to form various amino acids such as alanine, lysine, and glutamine.





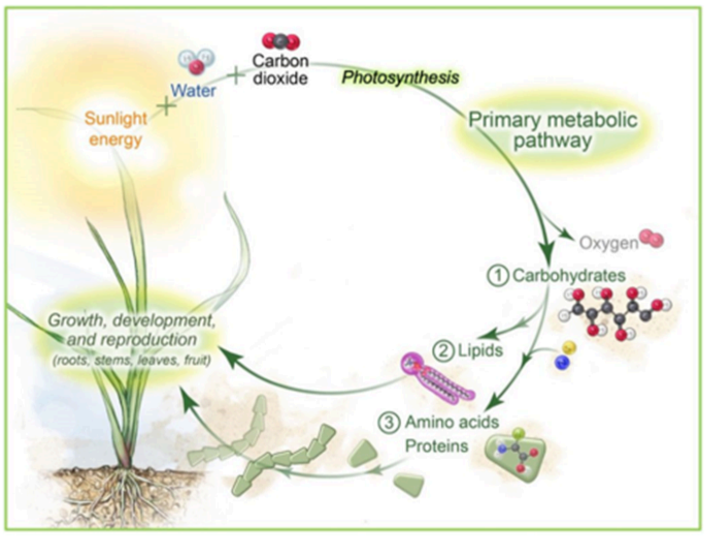
How do plants utilize carbon, hydrogen, and oxygen from sugar molecules to form amino acids?

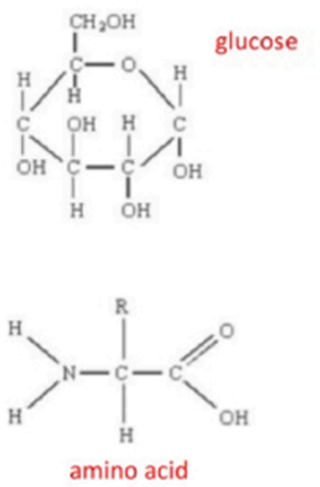
- A By releasing carbon dioxide and oxygen as byproducts.
- B By breaking down sugar molecules into individual atoms.
- C By converting sugar molecules directly into amino acids.
- D By rearranging the atoms in sugar molecules through enzymatic reactions.

Item	BA-1_Chemistry with ESS_17_Formation of Amino Acids from Sugar Molecules in Plant Cells
Identifier	I-SCI-F-S000026_C42665
Standards	SCI.9-12.HS-LS1-6

Formation of Amino Acids from Sugar Molecules in Plant Cells

In plant cells, the process of photosynthesis allows for the transformation of carbon, hydrogen, and oxygen from sugar molecules into amino acids - the building blocks of proteins. During photosynthesis, plants absorb carbon dioxide from the atmosphere and water from the soil, using sunlight as an energy source.
Through a series of enzymatic reactions in the chloroplasts, the carbon, hydrogen, and oxygen atoms in glucose molecules are rearranged to form various amino acids such as alanine, lysine, and glutamine.





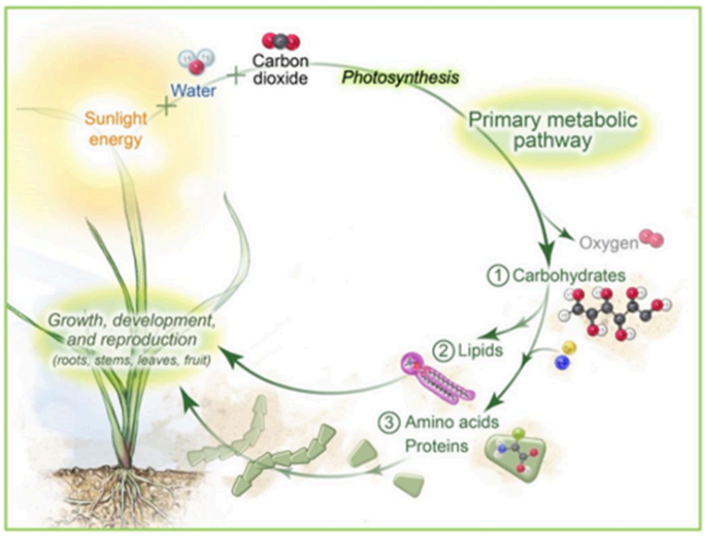
Describe the role of sunlight in the process of transforming sugar molecules into amino acids in plant cells.

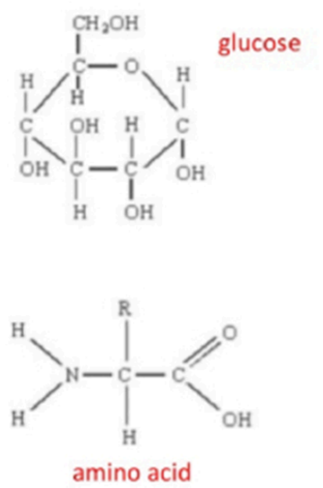
- A Sunlight provides the energy required for photosynthesis, which produces the necessary precursor molecules for amino acid synthesis.
- B Sunlight directly converts sugar molecules into amino acids.
- C Sunlight activates enzymes involved in the synthesis of amino acids.
- D Sunlight provides the energy needed for the breakdown of sugar molecules.

Item	**BA-1_Chemistry with ESS_18_Formation of Amino Acids from Sugar Molecules in Plant Cells**
Identifier	I-SCI-F-S000026_C88823
Standards	SCI.9-12.HS-LS1-6

Formation of Amino Acids from Sugar Molecules in Plant Cells

In plant cells, the process of photosynthesis allows for the transformation of carbon, hydrogen, and oxygen from sugar molecules into amino acids - the building blocks of proteins. During photosynthesis, plants absorb carbon dioxide from the atmosphere and water from the soil, using sunlight as an energy source.
Through a series of enzymatic reactions in the chloroplasts, the carbon, hydrogen, and oxygen atoms in glucose molecules are rearranged to form various amino acids such as alanine, lysine, and glutamine.





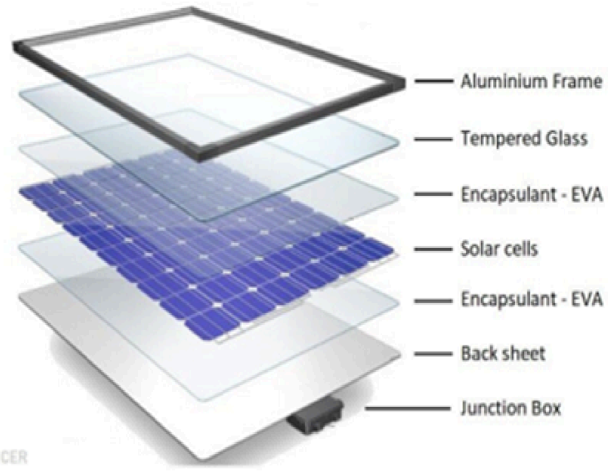
If a plant is deprived of water, how might this impact the production of amino acids from sugar molecules during photosynthesis?

- A It would have no effect on amino acid production.
- B Amino acid production would increase due to decreased water competition.
- C Amino acid production would decrease because water is necessary for photosynthesis.
- D Amino acid production would stop completely without water.

Item	**BA-1_Chemistry with ESS_19_Impact of Molecular-Level Structure on the Functioning of Solar Panels**
Identifier	I-SCI-F-S000026_C50713
Standards	SCI.9-12.HS-PS2-6

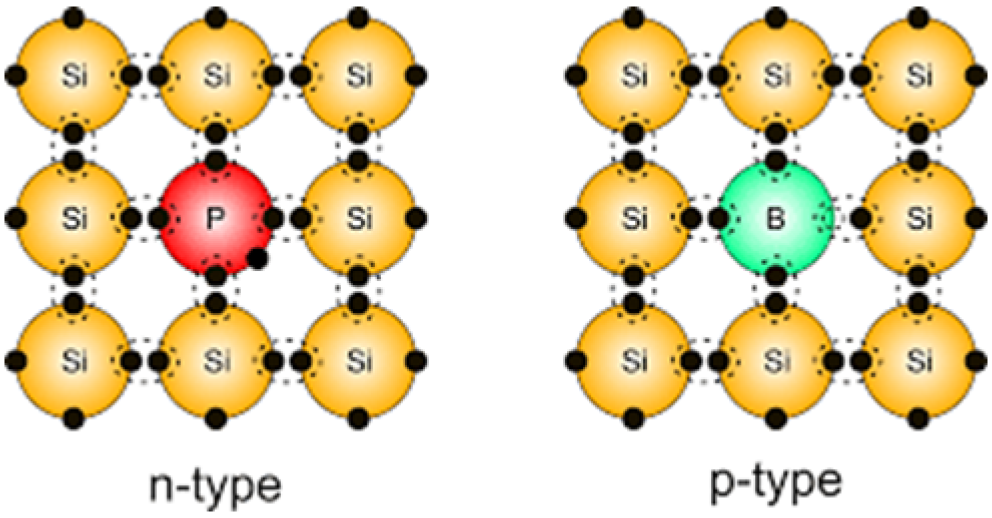
Impact of Molecular-Level Structure on the Functioning of Solar Panels

Solar panels are an essential component in the generation of renewable energy. These panels consist of multiple layers, with each layer serving a specific purpose in capturing sunlight and converting it into electricity.



The molecular-level structure of the semiconductor material used in solar panels, such as silicon, plays a crucial role in their functioning. Silicon atoms are arranged in a crystalline structure, forming a lattice that allows for the movement of electrons when photons from sunlight are absorbed. This movement of electrons creates an electric current, which can then be harnessed for various applications.

Furthermore, the doping (doping is the process of adding some impurity atoms in a pure or (intrinsic) semiconductor to increase the conductivity of a semiconductor) of silicon with other elements, such as phosphorus and boron, alters its molecular structure and enhances its conductivity. Phosphorus adds extra electrons to the structure, creating a negative charge, while boron creates "holes" where electrons are missing, resulting in a positive charge. This difference in charges improves the flow of electrons and increases the overall efficiency of the solar panel.



In summary, the specific arrangement of silicon atoms at the molecular level, along with the deliberate doping process, is crucial in ensuring the optimal functioning of solar panels and the efficient conversion of sunlight into electricity.

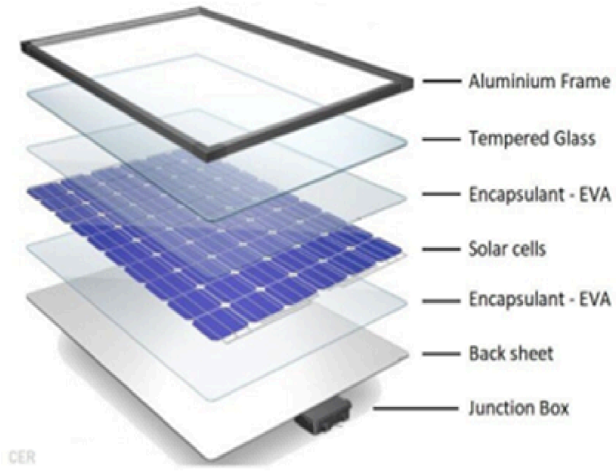
Describe the role of the molecular-level structure of the semiconductor material, such as silicon, in the functioning of solar panels.

- A It determines the color of the solar panel.
- B It enhances the absorption of sunlight.
- C It creates a lattice that allows for the movement of electrons.
- D It regulates the temperature of the solar panel.

Item	**BA-1_Chemistry with ESS_20_Impact of Molecular-Level Structure on the Functioning of Solar Panels**
Identifier	I-SCI-F-S000026_C07525
Standards	SCI.9-12.HS-PS2-6

Impact of Molecular-Level Structure on the Functioning of Solar Panels

Solar panels are an essential component in the generation of renewable energy. These panels consist of multiple layers, with each layer serving a specific purpose in capturing sunlight and converting it into electricity.



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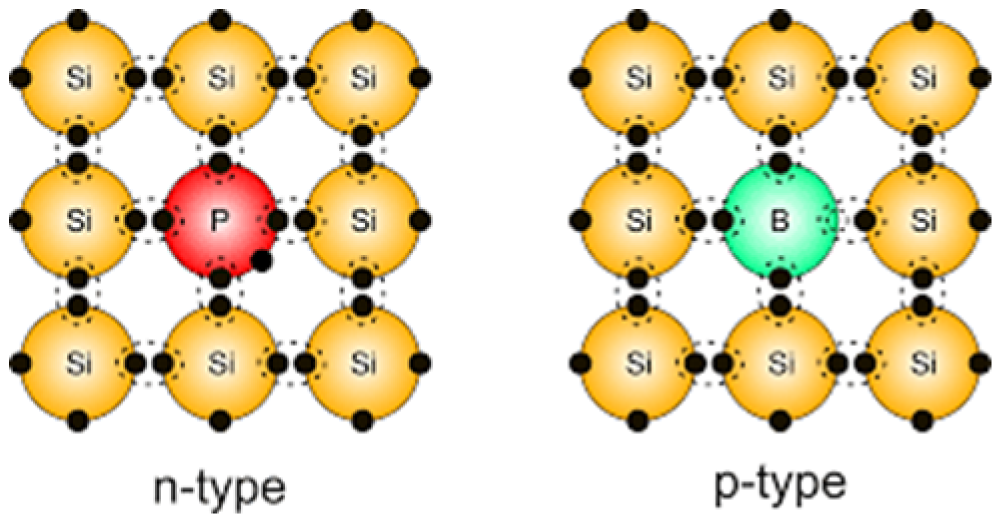


In summary, the specific arrangement of silicon atoms at the molecular level, along with the deliberate doping process, is crucial in ensuring the optimal functioning of solar panels and the efficient conversion of sunlight into electricity.

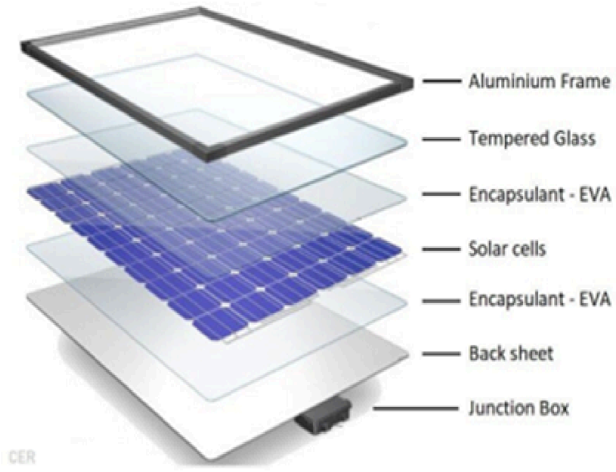
How does the doping of silicon with elements like phosphorus and boron impact the conductivity of the material and the efficiency of solar panels?

- A Phosphorus remove electrons creating a positive charge, while boron adds protons, leading to improved efficiency.
- B Phosphorus creates a negative charge by adding extra electrons, while boron creates "holes" where electrons are missing causing a positive charge leading to improved efficiency.
- C Both phosphorus and boron are less expensive than other materials increasing the return on investment.
- D Phosphorus decreases conductivity in addition to adding boron with the same effect, leading to improved efficiency.

Item	BA-1_Chemistry with ESS_21_Impact of Molecular-Level Structure on the Functioning of Solar Panels
Identifier	I-SCI-F-S000026_C39325
Standards	SCI.9-12.HS-PS2-6

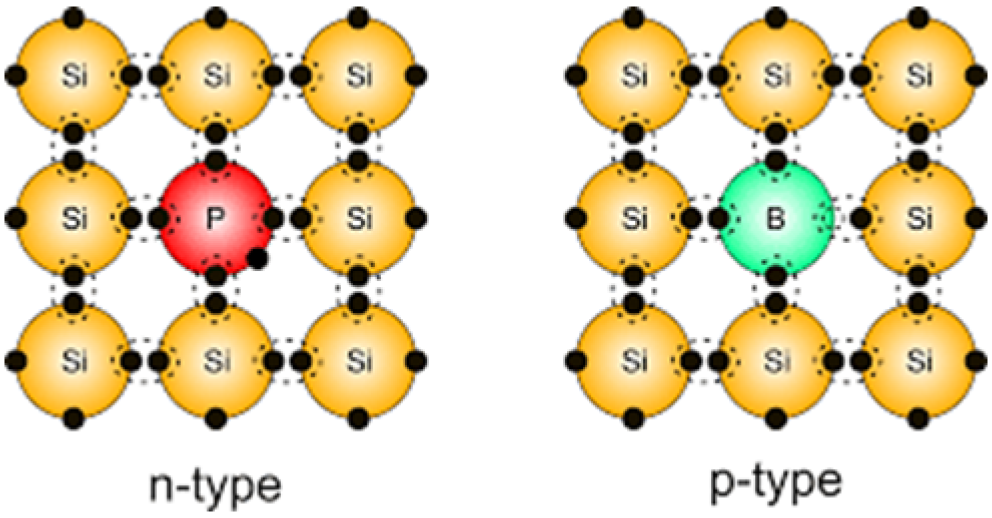
Impact of Molecular-Level Structure on the Functioning of Solar Panels

Solar panels are an essential component in the generation of renewable energy. These panels consist of multiple layers, with each layer serving a specific purpose in capturing sunlight and converting it into electricity.



The molecular-level structure of the semiconductor material used in solar panels, such as silicon, plays a crucial role in their functioning. Silicon atoms are arranged in a crystalline structure, forming a lattice that allows for the movement of electrons when photons from sunlight are absorbed. This movement of electrons creates an electric current, which can then be harnessed for various applications.

Furthermore, the doping (doping is the process of adding some impurity atoms in a pure or (intrinsic) semiconductor to increase the conductivity of a semiconductor) of silicon with other elements, such as phosphorus and boron, alters its molecular structure and enhances its conductivity. Phosphorus adds extra electrons to the structure, creating a negative charge, while boron creates "holes" where electrons are missing, resulting in a positive charge. This difference in charges improves the flow of electrons and increases the overall efficiency of the solar panel.



In summary, the specific arrangement of silicon atoms at the molecular level, along with the deliberate doping process, is crucial in ensuring the optimal functioning of solar panels and the efficient conversion of sunlight into electricity.

Explain why the movement of electrons within the crystalline lattice of silicon is essential for the conversion of sunlight into electricity in solar panels.

A Electron movement generates heat, which is converted into electricity.

B Electron movement creates a magnetic field, which generates electricity.

C Electron movement produces photons, which are converted into electricity.

D Electron movement creates an electric current when photons from sunlight are absorbed, allowing for the conversion of sunlight into electricity.