Stars begin life as a cloud of gas and dust. The birth of a star begins when a disturbance, such as the shock wave from a supernova, triggers the cloud of gas and dust to collapse inward.

1) Imagine that you are observing the region of space where a cloud of gas and dust is beginning to collapse inward to form a star (the object that initially forms in this process is called a protostar). Will the atoms in the collapsing cloud move away from one another, move closer to one another, or stay at the same locations?

2) What physical interaction, or force, causes the atoms to behave as you described they would in Question 1?

3) Would you expect the temperature at the center of the protostar to increase or decrease with time? Explain your reasoning.

The inward collapse of material causes the center of the protostar to become very hot and dense. Once the central temperature and density reach critical levels, nuclear fusion begins. During the fusion reaction, hydrogen atoms are combined together to form helium atoms. When this happens, photons of light are emitted. Once the outward pressure created by the energy given off during nuclear fusion balances the inward gravitational collapse of material, a state of *hydrostatic equilibrium* is reached, and the star no longer collapses. When this happens, the protostar becomes a main sequence star.

Consider the information shown in the table below when answering Questions 4 through 7.

Mass of the Star (in multiples of Sun masses, M_{sun})	**Approximate Main Sequence Lifetime of the Star**
0.5 M_{sun}	50 billion years
1.0 M_{sun}	10 billion years
2.0 M_{sun}	2 billion years
6.0 M_{sun}	110 million years
60 M_{sun}	360 thousand years

4) Which live longer, high-mass or low-mass stars?

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5) Based on your answer to Question 4, do you think that the rate of nuclear fusion in a high-mass star is greater than, less than, or equal to the rate of nuclear fusion in a low-mass star?

6) Which of the following statements best describes how the lifetimes compare between Star A (a star with a mass equal to the Sun) and Star B (a star with six times the mass of the Sun)? Circle the best possible response given below. (Note: It may be helpful to examine the information given in the table on the previous page.)

a) Star A will live less than 1/6th as long as Star B.

b) Star A will live 1/6th as long as Star B.

c) Star A will have the same lifetime as Star B.

d) Star A will live six times longer than Star B.

e) Star A will live more than six times longer than Star B.

Explain your reasoning for the choice you made.

7) The Sun has a lifetime of approximately 10 billion years. If you could determine the rate of nuclear fusion for a star with twice the mass of the Sun, which of the following would best describe how its fusion rate would compare to the Sun? Circle the best possible response to complete the sentence given below. (Note: It may be helpful to examine the information given in the table on the previous page.)

A star with twice the mass of the Sun would have a rate of nuclear fusion that is _______ the rate of fusion in the Sun.

a) less than

b) a little more than

c) twice

d) more than twice

Explain your reasoning for the choice you made.

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