OLYMPIADS SCHOOL/GRADE 9 AND 10 WRITING/HOMEWORK 8

NAME (FIRST AND LAST):_____________________________________ GRADE:___

Announcement:
The midterm assessment is scheduled for Class 10. To prepare for it, review all the handouts and marked homework that you have received. No homework will be assigned that week.

REVIEW: SUMMARY WRITING SKILLS
Read the following article to prepare for the vocabulary and summary writing sections.

http://time.com/4217034/the-perfectly-sane-case-for-life-in-space/

The Perfectly Sane Case for Life In Space

- Jeffrey Kluger / Moffett Field, California @jeffreykluger

Feb. 11, 2016

The Hubble Heritage—NASA New research suggests cosmic biology is not just possible: it's inevitable

New research suggests cosmic biology is not just possible; it's inevitable

1. If you ask nicely, Scott Sandford will build you a piece of the universe. It won't be a big piece; that'd be way too much for a single astrobiologist in a single lab at the NASA Ames Research Center near Silicon Valley. And it won't be a very interesting piece–just the gas and dust of interstellar space. He'll swirl it all together in a little chamber in a big machine and chill it down to 40 Kelvins, which is –388°F, or –233°C–and no matter what you call it, is very, very cold.

"You're not allowed to put your tongue on that," he says, pointing to the chamber.

Then, he does a very important thing: he hits the gas and dust with radiation–all kinds of radiation, as long as it's the kind you'd find in space. And right then, everything changes.

"You get enormous chemical diversity," he says. "We get thousands if not tens of thousands of products. Some of these are more stable than others. And some are molecules like amino acids–stuff that life uses."

2. How did we–humanity, that is–get here? From the point of view of science, like it or not, the common chemical soup in Sandford's lab is all there is to it. Our growing appreciation of that is just the latest step in a long process of human humbling. Earth was the center of the universe once–until it wasn't. Our solar system, at least, was the most important place in the galaxy–but that turned out not to be so either. And the Milky Way itself is only one of at least 100 billion galaxies.

Finally though, there was life–the animation of an entire planet with things that walk and crawl and fly and swim and, in the case of human beings, think big thoughts. Surely that was the longest of long shots, something unique to the sole world with exactly the right mix of ingredients, orbiting exactly the right distance from exactly the right star. Just look around you: If life is out there, where is it?

3. That hasn't stopped people from looking, of course. For a long time, the search for life had been a more or less passive exercise: scan the skies for signals from another civilization, chop into space rocks that happen to fall on us, or wait–if you believe in such things–for aliens to land and settle the question once and for all. But in recent years the science has gotten much more serious and much more **rigorous**. The SETI (Search for Extraterrestrial Intelligence) Institute, in Mountain View, Calif., not far from NASA Ames, is expanding its work beyond just listening for signals from space to looking for optical clues like laser flashes. Other researchers want to hunt for traces of biology such as methane or carbon dioxide in the atmosphere of alien worlds.

But the most compelling work is being done in labs like Sandford's, where researchers are trying to determine not just whether extraterrestrial life exists but what it would look like and how it would function. Animating this new push for answers is the growing belief among many scientists that the question of whether alien life exists at all is an outdated one. Life is out there, all right–simply because it has to be. Water, which is **indispensable** for biology as we know it, is one of the most common compounds in the cosmos. Amino acids routinely turn up in the meteorites that have been analyzed. And while as recently as 20 years ago we knew of no other planets in the universe apart from the handful in our own solar system, we've since spotted thousands of possible or confirmed worlds circling other stars.

As humanity moves ever closer to a trip to Mars to hunt for life–and as American astronaut Scott Kelly wraps up a year aboard the International Space Station to help prove that the human body can survive the **rigors** of so long a stretch in zero G–it seems more and more that so ambitious a journey is very much worth making. Life on other worlds may be not only possible, not only likely, but chemically and mathematically inevitable.

“The universe is **hardwired** to be an organic chemist,” says Sandford. “It’s not a very clean or tidy one, but it has really big beakers and plenty of time.”

4. It is NASA Ames that is conducting the world’s most comprehensive search for life in space, coordinating its work with that of eight universities as well as with the SETI. The likelihood of any such researchers’ actually finding evidence of life in space–specifically intelligent life in our own galaxy with which we could communicate–was first formulated by astronomer Frank Drake, in 1961, with his namesake Drake equation.

Drake’s formula begins with the rate of formation of stars that could support habitable worlds, then multiplies that figure by the fraction of those stars that have planets, and further by the fraction of those planets that are suitable for life, the fraction on which life actually appears, and so on down for a few more multipliers, including the share of that life that becomes intelligent. The final **tally** of extraterrestrial civilizations you wind up with depends on how you fill in those X’s–which depends at least partly on how optimistic you are. Drake has estimated the figure to be 10,000 worlds. The late Carl Sagan put it at 1 million.

“As long as none of the factors are zero,” says Sandford, “you’d expect there to be life.”

5. The risk of getting stuck with a zero went down in 2009, after the launch of the planet-hunting Kepler space telescope. Kepler’s job was a simple one: to stare at a fixed patch of space, looking for the subtle dimming of light around a star when an orbiting planet passes in front of it. That change would be tiny–just 1 in 10,000. “If a star is 10,000 lightbulbs, the transit of an Earthlike planet is like taking one bulb away,” says Natalie Batalha, a NASA astrophysicist and the Kepler mission scientist.

Still, in the relative handful of years Kepler has been operating, it has discovered 4,706 candidate planets, of which 1,039 have been confirmed. Making that figure even more impressive, all of these worlds have been found in a very small patch of sky, just 3,000 light-years deep–or about 3% of the depth of the Milky Way–and just 10 degrees by 10 degrees across the entire canopy of the sky. “It’s like the size of my open palm held at arm’s length,” says Batalha.

6. That’s an embarrassment of planetary riches, but if you’re looking for life you can narrow the field some. First, your planet needs to be orbiting its parent sun in the so-called Goldilocks zone–the not too hot, not too cold place where liquid water can exist. It also should be a relatively small world, from one Earth radius up to about two Earth radii. Those are the places likely to have both a rocky surface and enough gravity to hold onto their atmosphere–assuming they got one in the first place. Once you have a world like that, just add some water, season with hydrocarbons, wait a billion years or so and hello ET. Sure, that might overstate it–but not by too much.

“Life on Earth got started very quickly,” says SETI astronomer Seth Shostak. “That’s like walking into a casino in Vegas, pulling the handle and winning the jackpot. You say, ‘Well, either I’m very, very lucky or this is not a difficult bet.’”

7. Shostak is decidedly on the side of its not being a difficult bet–and Sandford’s work at NASA is helping to make that case. Much of his research involves what are known as amphiphiles, hydrocarbon chains that make up our cell walls. One end of the chain is hydrophilic (it loves water); the other end is lipophilic (it hates water but loves fat). No sooner do amphiphiles start forming in a preorganic world–which is easy enough to do as atoms link up into stable molecules–than the chains solve the problem of their bipolar nature by gathering into membranes with the ends that like water on the outside and the ends that like fat on the inside.

Over time, the membranes get bigger, and if they happen to incorporate molecules that make them resistant to excessive ultraviolet radiation–which can damage cells–and to survive in a range of acidities, the hardier little membranes eventually crowd out the more fragile ones. It’s not life, but it’s a good start.

“You have to go through a phase where everything is largely driven by the chemical nature of things,” says Sandford. “[But] since the laws of physics and chemistry are the same everywhere, if you have similar starting components and similar environments, you should get similar outcomes.”

8. But the next step toward life is a big one: an incipient organism must develop an information-storage system, which on Earth is RNA and DNA. That’s a chemical trick that’s many orders of magnitude more complicated than growing a membrane–but it’s an indispensable criterion for life. Says NASA planetary scientist Chris McKay: “A hurricane is a self-organizing, self-**propagating** system with a life cycle. It’s born, it grows, it eats, and then it dies. Why isn’t it alive?”

The answer, in this view, is that it can’t remember what it’s doing or how it’s changed and pass those improvements on. The easiest answer to how an information-storage system gets started would come through a modern-day analogue to the celebrated Miller-Urey experiment, the 1953 study in which two University of Chicago researchers re-created what they believed to be the atmospheric conditions on the early Earth and shot electricity through it–representing lightning–which produced hydrocarbons. It was the **precursor** of Sandford's much more complex studies and offered a satisfyingly simple ***deus ex machina*** by which prebiotic chemistry could have taken a big jump.

9. A much more complex and theoretical answer could come through the head-spinning world of quantum physics, which demolishes our familiar concept of linear time and allows it to bend back in sort of a repeating loop. That, argues McKay, means life might effectively program itself, with the mature organisms that exist at the end of an evolutionary line writing the code for the rudimentary organisms that exist at the beginning, which then grow up and become the code writers themselves. "I'm not saying it's a mature idea or thought," he says. "I'm saying that we are so young in our appreciation of things that it would be hard to rule out anything."

10. It's also possible that we don't have to limit our search to life as we know it, because there could be uncountable kinds of life as we don't know it. The most commonly posited example of alternative biology are organisms that are not carbon-based like we are, but silicon-based. Silicon and carbon are close neighbors on the periodic table, and both bond easily with other elements. But silicon doesn't play well with water, which acts as the critical solvent in all forms of life we understand. "In silicon chemistry, a lot of the things we use in our biology would explode or combust in water," says Tori Hoehler, a NASA chemist and biologist.

Methane is the next best guess for a solvent, and silicon does behave better in that medium. Saturn's moon Titan is known to have lakes of ethane and methane, which is why the Cassini orbiter dropped a probe into Titan's atmosphere to study its chemistry when it arrived in the Saturnian system in 2004. And while liquid methane is cold–on the order of –258°F (–161°C)–nothing says other forms of life have to be happy at what we think of as room temperature. Maybe their rooms are just really, really cold.

11. Still, life as we know it–warm, watery and carbon-based–might remain the best model. Chemistry and evolution are both, in their own ways, lazy. They take the simplest routes to elegant solutions. Perhaps there are other ways to get the biological job done, but it's hard to come up with a better alternative.

Ultimately, as many astrobiologists argue, the question of life in space might be as simple as a three-part formula: chemistry plus energy plus time. McKay likes to cite what's known as the zero-one-infinity rule, which applies in a lot of scientific theories but especially in the search for life. We know that the number of planets in the universe with life is not zero. We know so far that it's at least one. If we do find another, it makes no chemical or mathematical sense for the total potential figure not to be unlimited.

"So what we're searching for," says McKay, "is two." That search is as big as the universe–but so is the promise it holds.

This appears in the February 22, 2016 issue of TIME.

VOCABULARY/READING COMPREHENSION

The following sentences can be found in the article that you have just read. **(i)** Without referring to a dictionary, fill in the blanks with a synonymous word or phrase. **(ii)** Explain your choice of words in relation to the context of the sentence or the article as a whole. **(iii)** In addition, adapt a definition from a dictionary so that it matches the underlined word's meaning, context, and part of speech.

1. But in recent years the science has gotten much more serious and much more **rigorous**.

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ii. ____

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2. Water, which is **indispensable** for biology as we know it, is one of the most common compounds in the cosmos.

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WRITING A SUMMARY

Summarize the numbered sections (1 to 11) in the article, "The Perfectly Sane Case for Life in Space."

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