Volume 5 • Number 8 PENNSYLVANIA DEPARTMENT OF HEALTH

GET SMART

Newsletter

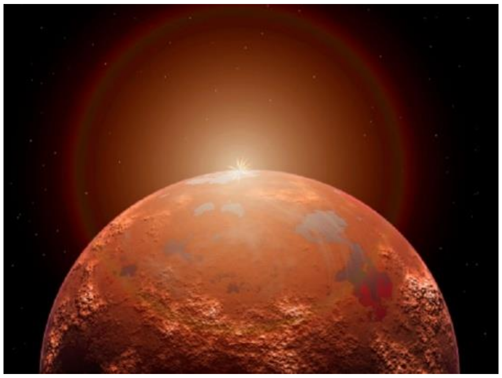
August 2017

From Looking for Life on Mars to Biological Discovery and Clinical Diagnosis on Earth

By: Christopher E. Carr, research scientist, MIT,
and research fellow, MGH

National Aeronautics and Space Administration (NASA) is currently exploring Mars and will soon launch the Mars 2020 Rover to search for evidence of ancient life there. Future missions will also explore Saturn's moon Enceladus and Jupiter's moon Europa. Both are ice-covered worlds that harbor sub-surface oceans and both could be habitable. But what does the search for life beyond Earth have to do with human health here on our planet? Our journey begins half a century ago.

Life has properties such as metabolism, movement, replication and evolution. In the 1970s, the Viking Landers visited Mars and searched for evidence of metabolism by micro-organisms like bacteria. Due to negative and inconclusive results, for a long time there was doubt about whether Mars could support life. NASA pursued a "follow the water" strategy, which revealed the activity of water on the surface of Mars in the ancient past, a probable ancient northern ocean and the remains of water today in the form of ground ice. We now know Mars was once habitable, and certain regions, mainly underground, are habitable today.



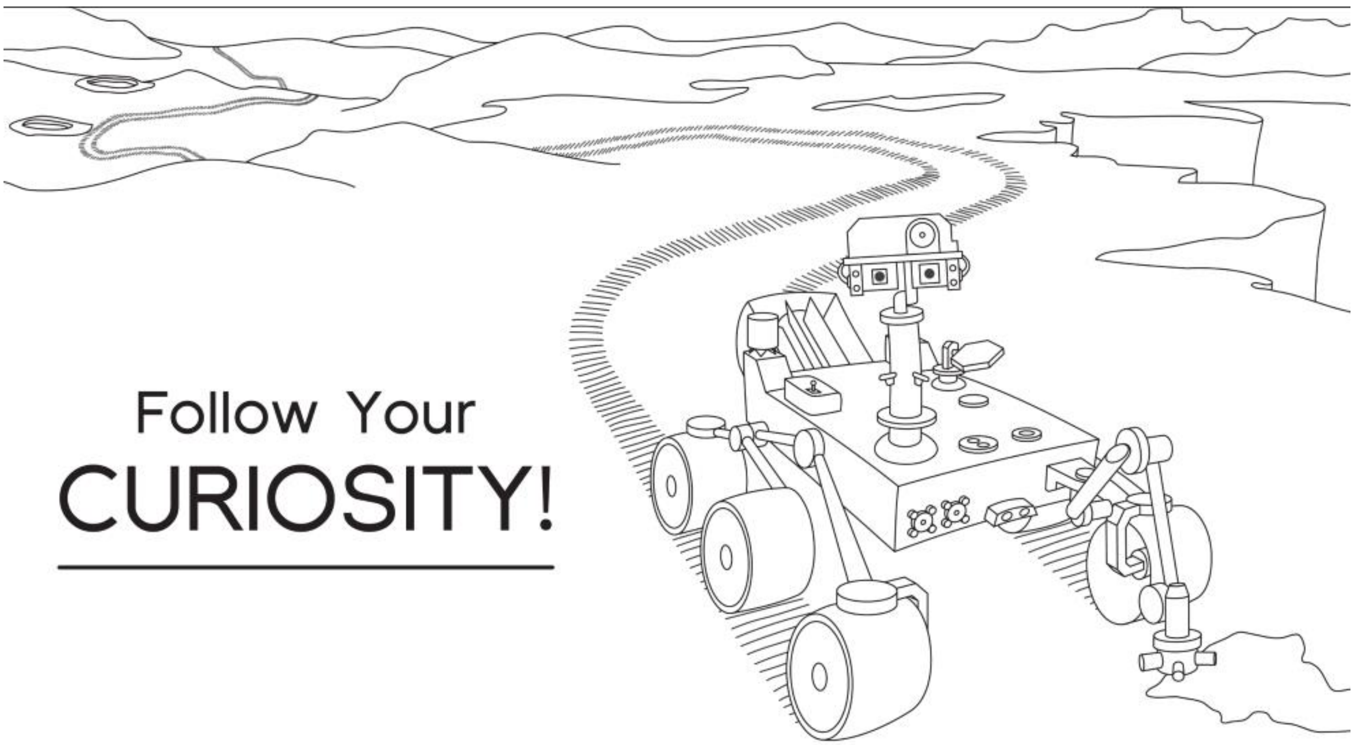
If life exists there, how can we find it? Most general methods of searching for life are not very specific; organic material such as simple carbon compounds found on Mars could have arrived from space by a comet or asteroid or been carried to Earth as contaminants onboard a spacecraft. Thus, we need ways to detect life on Mars that are highly sensitive and specific.

To address this problem, we are developing the Search for Extra-Terrestrial Genomes (SETG; setg.mit.edu), to search for life that is similar to life on Earth, such as forms based on nucleic acids (DNA), which serves as the genetic code of all known life. Our team includes the Massachusetts Institute of Technology, the Massachusetts General Hospital and Claremont BioSolutions LLC, a company specializing in point of care diagnostics, among others.

We hypothesize that life on Mars, if it exists, could be based on DNA due to shared ancestry with Earth. But how could this happen? If we look at the moon or Mars, we see large craters caused by large meteorite impacts. These impacts are so large that they can knock material off one planet and eject it into space, where some of it can end up on another planet. Earth and Mars may have shared up to 1 billion tons of rock, mostly several billion years ago. In addition, some of this rock is transported in a way such that microbes in the ejected rock could survive the journey. Thus, one planet might have infected the other with life.

Our SETG instrument is intended to operate independently on a future rover mission to Mars. A Mars sample will be processed by SETG and analyzed using single molecule nanopore sequencing. The same technologies that are allowing us to automate this process are being applied to detecting infectious diseases such as *Mycobacterium tuberculosis* and *Clostridium defficile*. Single molecule nanopore sequencing, epitomized by Oxford Nanopore Technologies' tiny MinION device, are enabling rapid portable sequencing and are being used to map outbreaks such as Ebola and Zika virus. This technology is also being used to directly detect genetic markers of antibiotic resistance. Thus, the search for life beyond Earth is closely related to biological discovery and diagnostics relevant to human health. Given future plans to send humans to Mars, one thing is clear: if there isn't life on Mars already, there will be.

Kid's Corner:
Coloring fun!



For more fun activities, visit https://mars.nasa.gov/participate/funzone/.

Countdown to Get Smart Competition 2017!

96 days

Enter at:
www.KnowWhenToSayNo.org

School Year Checklist:

Make sure you're ready for a new school year staying germ free!

- ✓ To-go tissues in bookbag
- ✓ Hand sanitizer
- ✓ Get Smart knowledge
- ✓ Singing 'Happy Birthday' when hand washing
- ✓ Teaching your friends
- ✓ Covering mouth when sneezing or coughing

If you would like more information, please contact us at knowwhentosayno@pa.gov.
To unsubscribe, email knowwhentosayno@pa.gov.