Managing Microbes in Space

Background

Has anyone ever reminded you to wash your hands, cough into your elbow or cover your sneeze? Why do we do that? You probably know it’s because we want to help control the spread of microbes, or germs. Since the discovery of microorganisms in the 1675 scientists have been anxious to understand what microbes are and how they can be managed or controlled. Over the years scientists have learned much about how germs spread, become stronger (more virulent), and what can be done to counteract them here on Earth. But does what we’ve learned about microbes on Earth apply to living in space?

During the last decade scientists working with NASA studying germs in space have made some important discoveries that may help future astronauts who will spend months and even years in space. Discoveries that could also prove to be beneficial to all of us here on Earth.

Researchers have found that germs, or pathogens (microbes that cause disease), seem to become more virulent in the microgravity environment of space compared to those on Earth. That means that when a pathogen infects a host (organism in which a pathogen lives) like a human, they are likely to cause a more severe infection or disease. This was demonstrated several years ago in an experiment where human intestinal cells (host) were infected with Salmonella bacteria (pathogen) while in space.

In other studies conducted in space, researchers found that the immune systems of astronauts become weaker which means they may have a higher risk of getting sick from infections. If it is true that germs become stronger and astronaut immune systems become weaker that is not good news for humans living in space for long periods of time.

The experiment that is the focus of this mission is called Micro-5 by NASA and designated as PHOENIX by Principle Investigator Dr. Cheryl Nickerson at the Biodesign Institute at Arizona State University. It is designed to explore ways to counteract the effects of Salmonella to help astronauts fight infections while in space and gain knowledge that will help people on Earth in the same way. PHOENIX will be the first experiment to infect and monitor in real-time the infection of a whole organism in space to assess the effect of the pathogen on a host.

To conduct the experiment scientists will use the model organism, Cenorhabditis elegans or C. elegans as the host. This microscopic roundworm is among the most widely studied organisms in medical and scientific laboratories around the world and survives well in space living in media (liquid nutrients in which the bacteria grow). C. elegans have muscles, a digestive system, a nervous system and a life span of only a few days. Because it has an intestinal track similar to humans it is useful for studying the effects of Salmonella bacteria.
The experiment package was flown to the International Space Station (ISS) onboard a SpaceX rocket in January of 2015. Once the experiment payload was transferred to the ISS it was activated to allow one group of the *C. elegans* to feed on media containing a non-infectious bacteria called *E. coli* and a second group to feed on media containing infectious bacteria, *Salmonella*.

In this experiment scientists are studying the effects of several media types with different chemical compositions, including phosphate. Previous studies by Nickerson’s team seem to indicate that the addition of phosphate can turn down the increased virulence of *Salmonella*. If the experiment is successful in reducing the rate of death in the *C. elegans* population scientists hope it will lead to the discovery of ways to prevent or counteract illness in astronauts.

During the experiment video cameras capture and record what happens to the colony of *C. elegans* living in each media type. With the large volume of video sent back from space and from the ground-based experiments Dr. Nickerson and her team will have a lot of work to do to determine if their hypothesis is supported. That’s where you come in! Dr. Nickerson has asked you to help her count the worms in the videos to determine what percentage of the worms are living and dead, as explained on the mission dashboard page.

By helping to analyze these videos you will be contributing to Dr. Nickerson’s scientific databases. Your work will allow her to gather large amounts of data that may eventually lead to protecting future astronauts in space and protecting people from getting sick from food poisoning here on Earth!

**VOCABULARY:**

**Host** – an animal or plant that nourishes and supports a parasite; it doesn’t benefit and is often harmed by the association  
**Immune system** – complex network of interacting cells, cell-forming tissues and organs that protect the body from infections, diseases and other foreign substances  
**Media** – a liquid or gel designed to support the growth of microorganisms or cells  
**Microbes** – any microscopic organisms  
**Model organism** – a species that has been widely studied is easy to maintain and breed in a laboratory has a short generation time and a characterized genome or similarity to humans  
**Pathogen** – a microorganism, that causes disease in its host  
**Virulent** – the relative capacity of a pathogen to overcome body defenses

**ADDITIONAL REFERENCES:**

**PHOENIX**  
http://youtu.be/df1ck6RjdYc

**C. elegans**  
http://wormclassroom.org/meet-worm-caenorhabditis-elegans

**C. elegans**  
https://www.youtube.com/watch?v=zjqLwPgLnV0

**Salmonella**  
http://www.cdc.gov/salmonella/

**Salmonella**  

**Microgravity**  
http://www.nasa.gov/audience/forstudents/5-8/features/what-is-microgravity-58.html#.VGzP__nF_uK

http://www.dvidshub.net/video/172345/nasa-connect-watmtg-microgravity#.VGzP5FnF_uK