



MASSACHUSETTS INSTITUTE OF Technology  
Department of Biology  
2011 Teachers' Workshop



10th Annual HHMI Summer Workshop for  
High School Science Teachers  
July 25-29

Omaphalos!

Why Bacteria Should be the Center of Everyone's World.  
By Thomas Danko, Lincoln-Sudbury Regional High school

This activity seeks to engage the student directly by collecting bacteria directly from the belly button, making them more aware of the fascinating microbial biota not only on this planet, but also on ourselves.

Rob Dunn, along with Jiri Hulcr have made a splash in the science world this past July with their belly diversity project:

“Researchers from the Belly Button Biodiversity project, led by Jiri Hulcr from North Carolina State University, have revealed their first round of DNA results and reveal the discovery of some 1,400 strains of bacteria living inside volunteer’ belly buttons, and 662 of those are unrecognized strains.”

<http://www.physorg.com/news/2011-07-multiple-strains-bacteria-human-belly.html>

Additional references to the belly button project are below

<http://www.yourwildlife.org/>

<http://www.yourwildlife.org/bellybutton-biodiversity/>

<http://www.npr.org/blogs/krulwich/2011/07/09/137653646/venus-has-a-crowded-belly-button>

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\* Omaphalos: navel in Greek

Here are some numbers and descriptions that will get students to think about the various ecosystems of bacteria that live on and in the human body.

1. Ask students which number represents the number of microbes found in the human body

10 to the 14th power ( $10^{14}$ )

10 to the 13th power ( $10^{13}$ )

A: *1st number is the number of bacteria on the human body.  
The second number is the number of human cells in the body.*

2. Ask students where one might expect to find 500 different Microbial species including sulfur producing and acid-producing bacteria??

A: *In the mouth*

*Streptococcus mutans* produces lactic acid- (lives in the mouth)

*Sulfur producing bacteria Porphyromonas Gingivitis* is found in plaques and gums causes bad breath – it produces  $H_2S$

Both form microfilms in the mouth

3. Ask students what can cause body odor?

A: Body odors are the result of chemicals produced by microorganisms living in and on our body. For example some *Corynebacteria* live in the armpit and metabolize lipids found in sweat, producing characteristic body odor.

4. Ask students where they would expect to find two pounds of bacteria in the body?

A: In the colon. Most of human feces is composed of bacteria.

5. Ask students where they might find bacteria that consume the amino acid leucine found in sweat and produce isovaleric acid, a smelly gas?

A: On feet

With your students now thinking about all the organisms living in and on their bodies, and why there are different microbes in different places, let's move to the belly button.

The belly button is an ideal location. It's isolated, well protected and seems to harbor little to no fungi.

Sampling:

1. Prepare agar plates (basic recipe is at the end of the activity)
2. Use sterile cotton swabs - NOT toothpicks.
3. Swab the belly button, then lightly swab the agar plate in a back and forth manner across the plate. You can separate the bacteria further by using a new sterile cotton swab, gently touching the previous streaks and rubbing back and forth again after turning the plate 90 degree. Self-conscious students can turn around in their chairs or to a corner of the classroom.
4. Cover plates and tape shut. Use a marker to initialize, date and label the back of the plate (not the cover).
5. Let sit at room temperature (or incubate at 30 degree Celsius) for up to 4 days.

Possibilities:

Compare

- Males versus females
- Athletes versus non athletes
- Teacher versus students
- Different classrooms
- if you are connected with a sister school, in another state or country well....

It is remarkably easy to take pictures of these dishes: Use a macro setting if available, point and shoot.

Perhaps a wall display of the pictures from your class, maybe for back to school night ?

There are many possibilities that can turn this into a fun and informative activity.

## Data Collection and Going Further:

Observe the bacterial colonies that have grown on the plate and record color and shape using the following chart:

<http://www.microbelibrary.org/component/resource/laboratory-test/3136-colony-morphology-protocol>

Students can create a table and record the changes they see based on the above protocol.

Single isolated colonies can be further cultured and examined.

Protocols for:

- Gram Staining
- Oxidase tests
- Catalase tests

can be found at: <http://www.usi.edu/Science/biology/ceseeley/lab10.html>

RECEPIES to make agar plates ([http://www.sciencestuff.com/playground/agar\\_powder.shtml](http://www.sciencestuff.com/playground/agar_powder.shtml))