**The Ecology of Your Skin 1: Bacteria that Live on the Skin**

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**Purpose**

To explore the diversity of normal bacterial activities on the human body.

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**Context**

*“If microbes were capable of emotion, they would celebrate each time an infant was born. At birth, a new potential host emerges from the protected environment of the uterus, providing pristine surfaces and body cavities as sites for microbial colonization.”   
G.W. Tannock, Normal Microflora*   
  
This lesson is part of the [Skin Deep Project](http://www.sciencenetlinks.com/skindeep/)3, which examines the science behind skin. Skin Deep is developed by AAAS and funded by Neutrogena. For more lessons, activities, and interactives that take a closer look at the science behind skin, be sure to check out the Skin Deep Project.   
  
This lesson is the first of a three-part series in which students explore bacteria and our relationship with them.   
  
In The Ecology of Your Skin 1: Bacteria that Live on the Skin, students explore the concept of interdependence of life in the context of our relationship with bacteria. To do this, students explore the physical parameters of the body and how those affect the bacteria that live on the body.   
  
The [Ecology of Your Skin 2: The Microbial World is an Olfactory World](http://www.sciencenetlinks.com/lessons.cfm?DocID=499)4 introduces students to the olfactory world of our bacterial symbionts. Students examine some ideas about the purposes of body odors and create some hypotheses themselves.   
  
In [The Ecology of Your Skin 3: The Body Food Connection](http://www.sciencenetlinks.com/lessons.cfm?DocID=500)5, students perform an exploration of bacteria in milk to see how they can get cheese-like results from body bacteria to gain a deeper understanding of the interactions between organisms.   
  
By the end of the eighth grade, students should have built up a collection of cases based on their own studies of organisms, readings, and film presentations. They should have moved from specific examples of the interdependency of organisms to a more systematic view of the kinds of interactions that take place among organisms. Students also should understand that two types of organisms may interact with one another in several ways: they may be in a producer/consumer, predator/prey, or parasite/host relationship. (*Benchmarks for Science Literacy*, [p. 117](http://www.project2061.org/publications/bsl/online/index.php?chapter=5#D3)6.)   
  
Middle-school students also should have had ample opportunity to examine cells from various living things with microscopes and know that all living things are composed of cells. This understanding allows them to examine cells more in depth at the high-school level.   
  
At the high-school level, students are now ready to accept the concept of an ecosystem, which should bring coherence to the complex array of relationships among organisms and environments that students have encountered. (*Benchmarks for Science Literacy*, [p. 117](http://www.project2061.org/publications/bsl/online/index.php?chapter=5#D3)6.)

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**Planning Ahead**

Be sure to read through [The Ecology of Your Skin](http://sciencenetlinks.com/pdfs/skineco1_teachsheet.pdf)7 before beginning this lesson. It provides excellent background information on our relationship with the bacteria on our skin.   
  
Get one or more of the following books from the library (school or public or interlibrary loan). These are primarily for your own background reading. However, excerpts may be appropriate for class assignment readings. Also, your students who would like to do more with skin bacteria may get ideas from perusing these books:

* *Microbial Inhabitants of Humans*. Michael Wilson. New York, NY: Cambridge University Press, 2005. (This book has a wonderful chapter on “who is who” of microbial inhabitants of the skin; lots of tables and diagrams.)
* *A Field Guide to Bacteria*. Betsey Dexter Dyer. Ithaca, NY: Cornell University Press, 2003. (This book has chapters on bacteria as symbionts of animals and as enhancers of foods.)
* *The Ecology of the Human Skin*. Mary Marples. Springfield, IL: Charles C. Thomas, 1965.

Materials:

* [Twenty-five Questions](http://www.sciencenetlinks.com/pdfs/skineco1_actsheet.pdf)8 student sheet
* [The Ecology of Your Skin](http://www.sciencenetlinks.com/pdfs/skineco1_teachsheet.pdf)9 teacher resource
* [Methods for Measuring Physical Parameters](http://www.sciencenetlinks.com/pdfs/skineco2_actsheet.pdf)10 student sheet

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**Motivation**

To get students excited about the topic, initiate a class brainstorming session on questions such as:

* Where might bacteria grow on human surfaces and why?
* Under what conditions might bacteria grow more? Grow less?

This could be a good opportunity for you to clear up students’ misconceptions of bacteria and fungus, since some students will bring up athlete’s foot and jock itch. Our bodies have fungi (molds) as well as bacteria growing on them and it is not always easy to tell the difference without a microscope. The most obvious examples of fungi are the ones that cause yeast infections, athlete’s foot, and jock itch. (You may need to remind students that fungi [molds, mushrooms] are eukaryotes and bacteria are prokaryotes. They are in completely different kingdoms.)   
  
Despite yeast infections and acne (exacerbated by bacteria), encourage students to think of most of the bacteria on our bodies as *normal* and not pathogenic. Point out that humans are covered with bacteria but (with a few exceptions) we are not all suffering from bacterial skin diseases.   
  
You could then make a transition into the idea of an ecological classification of the human body surfaces. After you introduce a few examples from the list below, such as “arid desert,” students could be encouraged to come up with their own ecosystem metaphors. (This idea is originally from *The Ecology of the Human Skin* by Mary Marples and is elaborated on in *A Field Guide to Bacteria* by Betsey Dyer.) Examples might include:

* The “arid desert” of your forearm
* The “rocky, wave battered shoreline” of your teeth
* The "nutrient-rich terrain" of your face
* The “moist rain forest” of your underarms
* The “dark, damp cave-like crevices” between your toes

If there is time, however, allow students to come up with their own metaphors.

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**Development**

Now have students do the “Twenty-five Questions” exercise to help generate ideas for research. The exercise is written out in detail on the [Twenty-five Questions](http://sciencenetlinks.com/pdfs/skineco1_actsheet.pdf)11 student sheet.   
  
Read the sheet yourself and even try the exercise ahead of time. Then decide whether you ought to print the sheet for each student, or simply give the instructions orally. The latter is recommended. Spontaneity and creativity (rather than laborious reading of directions) are preferable for this exercise.   
  
Depending on the size of your class, you might break up students into groups of four or five and have students take turns reading their questions to each other. Then they might choose several of the most interesting to present to the rest of the class or to write up on the board.   
  
Encourage all students to complete it, no mater how laborious it might be to generate the last few questions. Award some “points” for getting all twenty-five! You could point out that when you tried the exercise, you found it challenging too. The expectation is NOT that any of the twenty-five questions will be “right” or “wrong.” Have students winnow out some of the most intriguing questions and get them up onto the board. Although many of the questions generated may pertain to pathogens, try to keep an even balance of considering skin bacteria as normal, by making sure that plenty of normal bacteria questions get discussed and written on the board. A good outcome for this exercise is enthusiastic class discussion and excitement about the possibility of investigating bacteria further. Remind the students that simple curiosity is what motivates many scientists.

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**Assessment**

The “Twenty-five Questions” exercise may be used for assessment. Encourage all students to complete it, no mater how laborious it might be to generate the last few questions. Award some points for getting all twenty-five. You could point out that when you tried the exercise, you found it challenging too.   
  
Producing and then discussing the twenty-five questions is a good generator of ideas and will lead into a research project by your students. Have students choose four or five of the most interesting questions for their starting point for inquiry and research. They can then use Internet resources, the library, or interviews to try to answer those questions in a report form.   
  
If students decide to explore questions that involve the distribution of bacteria on the skin, they could make use of the [Methods for Measuring Physical Parameters](http://www.sciencenetlinks.com/pdfs/skineco2_actsheet.pdf)10 student sheet.

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**Extensions**

Follow this lesson with the next two lessons in The Ecology of Your Skin series:

* [The Ecology of Your Skin 2: The Microbial World is an Olfactory World](http://www.sciencenetlinks.com/lessons.cfm?DocID=499)4
* [The Ecology of Your Skin 3: The Body Food Connection](http://www.sciencenetlinks.com/lessons.cfm?DocID=500)5

A little biographical information about Bruce Russell himself and his other activities is at [Bruce Russell](http://www.afana.org/russellb.htm)12, on the Academic Film Archive of North America website.

You may wish to purchase Bruce Russell’s DVD (or video) [The Biology of Bacteria](http://scctv.net/biomedia/default.aspx?DepartmentID=1&SeriesID=6&SeriesIndex=2)13 from the BioMedia Associates website. The bacteria section uses compelling microscopy of living bacteria to examine their structure, physiology, behavior, and the vital roles these microbes play in the biosphere, including oxygen production (cyanobacteria), decomposition, nitrogen fixation, and as parasites as well as helpful symbionts.

Students could look into the use of “probiotics” (which are tablets of freeze-dried beneficial bacteria) sold in pharmacies (near nutritional supplements). They could work to answer these types of questions: What are they used for? Do they work? Does my doctor recommend them? (Interview the doctor!) Can I get some to experiment with? (Yes, buy some!) For example, if I dissolve a probiotic tablet in water, can I revive the bacteria and look at them? What are some folk medicine traditions that are probiotic, such as eating yogurt to prevent some infections? Do they work? Does my doctor recommend it? Etc., etc.

Read magazine and newspaper accounts of the over-use of antibiotics and the potential consequences. This is a complex topic and not likely to be resolved in simple classroom discussions. However, you could use it to introduce the idea of selection for resistant strains of bacteria. One consequence is that some antibiotics are no longer as effective because of the prevalence of resistance. This topic might be interesting if compared and contrasted with the investigation on probiotics.

Have students compare and contrast bacteria and fungi. This exercise could be a good review of information about the differences between bacteria and fungi in typical biology text books. We have both on our bodies and the vast majority are not pathogens.

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