

# Tagging A Microbe

## Background

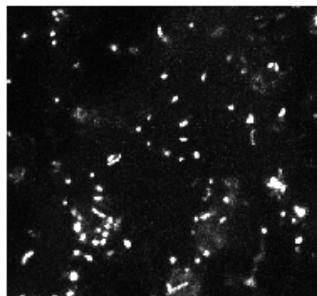
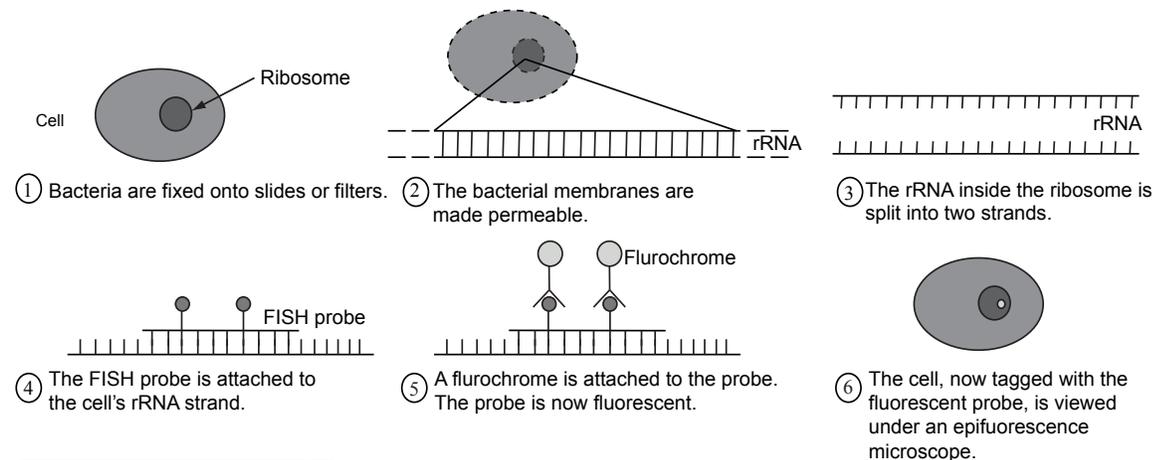
Microbes are too small to see with the naked eye, but they are everywhere: in your body, on your chair, hanging out in forests, and even in the ocean. There are millions of different kinds and each kind has its own story to tell. One of the missions of the *JOIDES Resolution* (JR) and her scientists is to study microbes, in this case bacteria, living in hard to reach places below the ocean floor. By doing so, they hope to better understand the role microbes play in the food web, how they influence Earth's geochemical cycles and climate, and even learn more about the origins of life.

Scientists can learn about microbes by studying their genetic material (DNA and RNA). This activity will help you understand one such method, called Fluorescence **In-Situ Hybridization** or **FISH**. The process helps microbiologists who work on the JR investigate two big questions:

1. What types of bacteria are living below the seafloor?
2. How abundant is each type of bacteria?

## The FISH process

On the ship, scientists take rock and sediment samples from the cores that come up from the ocean floor. The samples are placed in a freezer to preserve them. When ready, the microbiologists use FISH to "tag" microbes with a probe and fluorescent dye called fluorescent fluorochrome. The fluorochrome attaches to the ribosomal RNA (rRNA) in the bacteria of interest. When viewed under a special microscope the bacteria that have been "tagged" light up. Different colored fluorescent tags are used to identify different types of bacteria.



The microbes in this image are living on a basaltic rock extracted from the ocean floor. The bright spots are microbes tagged with the FISH probe. The dull spots are other bacteria. From this data, the scientists were able to distinguish between two different types of bacteria in situ without disturbing the cells or destroying their environment. Turner, A., unpubl. data.

## What to do

In this activity, you will use Lego blocks to learn how the FISH process works.

1. Place all Lego pieces on your table. Use the **Key** to identify and separate the pieces.
2. Create the following **bacteria strands** by placing the appropriate base bricks onto each rRNA backbone. These will represent the unknown bacteria collected from the sub-seafloor.

Bacteria 1: **UAGAAACC**

Bacteria 2: **AACCAUCC**

Bacteria 3: **ACAGGUCA**

Bacteria 4: **AUAUCACC**

3. Use the remaining Lego pieces to make two of the following **probes**. These represent the probes designed by scientists to identify specific types of bacteria;  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\delta$ . There should be an empty space at the end of the backbone.

PROBE  $\alpha$ : **CCU**

PROBE  $\gamma$ : **CUA**

PROBE  $\beta$ : **AUA**

PROBE  $\delta$ : **AUG**

4. Follow the **FISH** process to tag the bacteria: Connect each probe to the bacteria with the complimentary base sequence. Each probe will match only one strand.

Adenine binds with = Uracil (**A=U**)

Guanine binds with Cytosine (**G=C**)

Add the brick with a painted symbol to the end of your probe. This Lego piece represents the fluorescent fluorochrome that will make your bacteria glow. You have now “tagged” the bacteria.

5. View the bacteria: Place all four bacterial sequences, painted side up, in the viewing box, which represents the special fluorescent microscope microbiologists use. Identify which bacteria are “fluorescing” or glowing.
6. Collect the bacteria from a number of student groups. Put them all in the viewing box and estimate the abundance of each kind.

### Tell What You Know:

1. How do scientists figure out which bacteria and how many live below the seafloor? Why is this information important?
2. How is the *JOIDES Resolution* an important tool for this kind of research?
3. What questions do you have about deep-sea microbes and/or how they are studied?

### Key

Adenine (**A**) = **red brick**

Uracil (**U**) = **green brick**

Cytosine (**C**) = **blue brick**

Guanine (**G**) = **black brick**

rRNA backbone = long Lego

probe backbone = medium Lego

fluorescent fluorochrome = painted brick

