# MICROBIAL ECOLOGICAL ROLES

Genes can give us important information about the specific role an organism plays in its environment. Each microbe's ecological role is closely related to what they do. Some common functions of marine microbes are nitrogen fixation, photosynthesis, and heterotrophy.

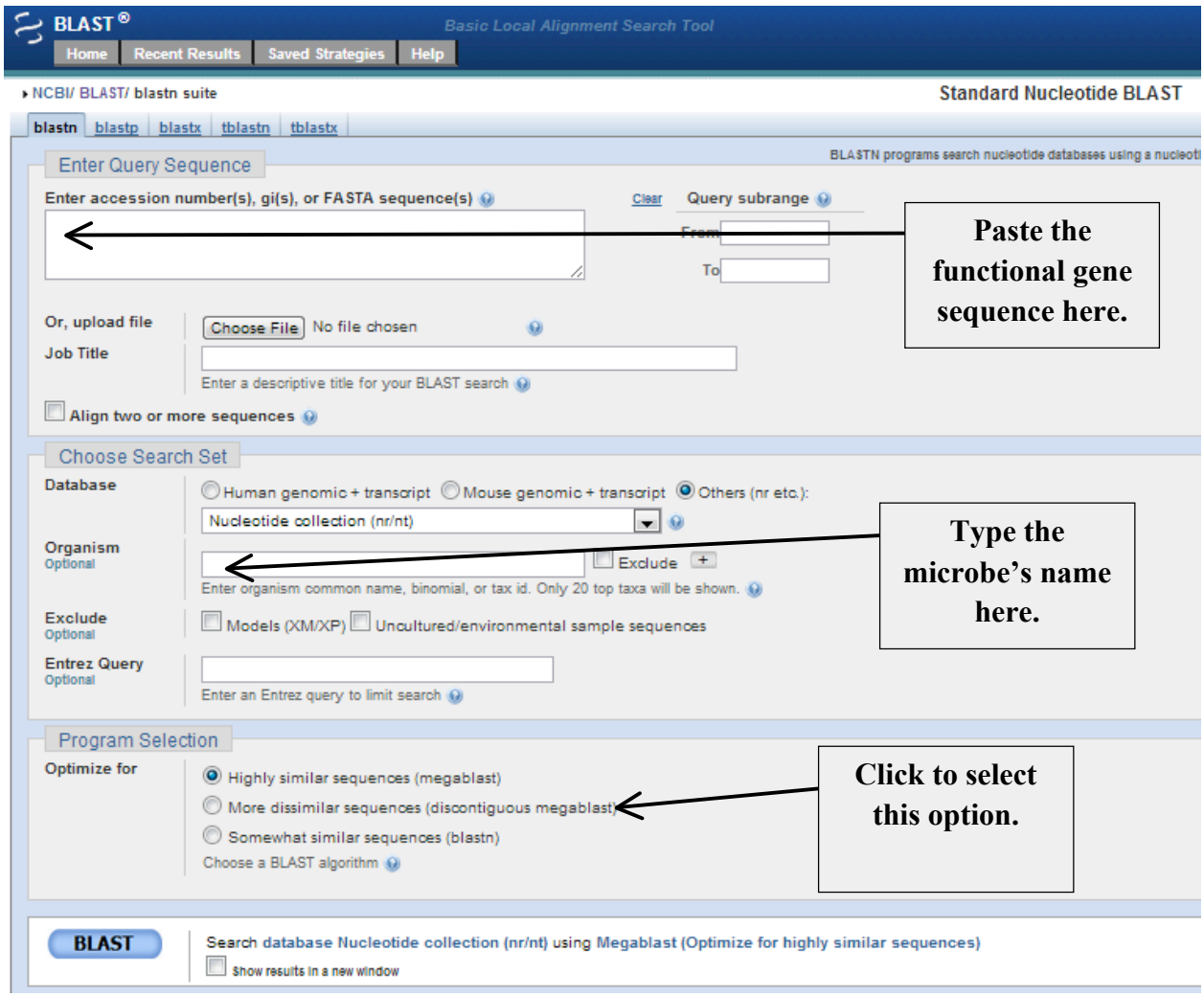
Complete each part below. Record your answers and a detailed explanation/rationale for parts 2 to 4. *You will need to conduct some research to supplement your background knowledge. You should use a minimum of 3 sources. You may use sources from the list provided and/or find your own.*

**PART ONE: Functional Genes**

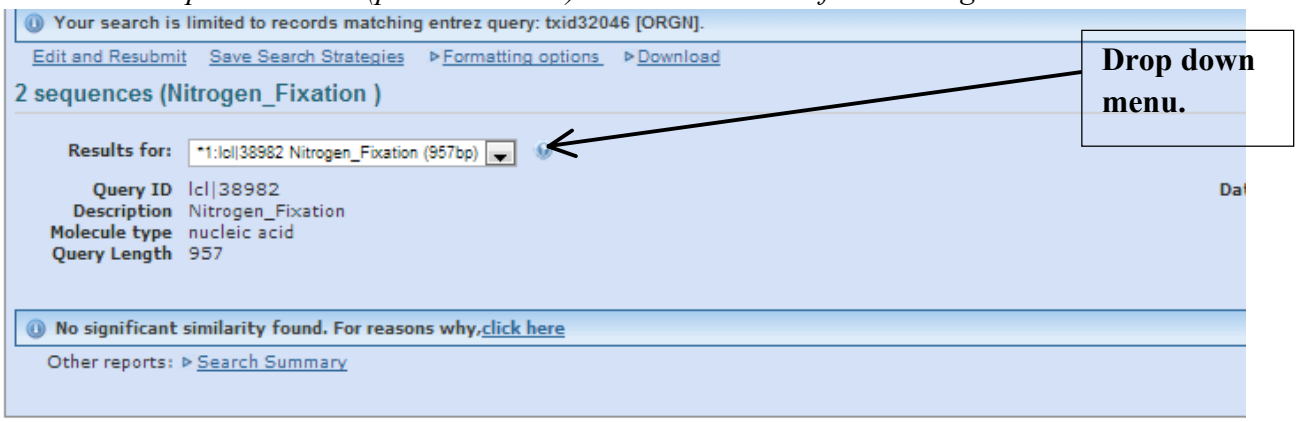
We will take a closer look at three different microbes by searching each of their genomes for functional genes for nitrogen fixation and photosynthesis.

1. Go to: blast.ncbi.nlm.nih.gov/Blast.cgi
2. Under "**Basic BLAST**," click on "**nucleotide blast**."
3. Download the "***Functional Genes***" file from the EARTH lesson plan page.
4. Open the ***Functional Genes*** file, copy all the text, and paste it into the box at the top of the page (under the heading "Enter Query Sequence).
5. Under the heading "Choose Search Set," enter the name of one of the three microbes below (be sure to select the one that exactly matches the names listed):
    a. *Synechococcus elongatus* (taxid: 32046)
    b. *Canidatus pelagibacter* (taxid: 198251)
    c. *Trichodesmium erythraeum* (taxid: 1206)

6. Under the heading "Program Selection," select the option "More dissimilar sequences."
7. At the bottom of the page, click on the blue button that says "BLAST."
   ***(Refer to the picture on the next page)***




**8.** Look through the results to determine whether the microbe has the functional gene you searched for. *NOTE: You are searching for **both** functional genes at once. You will need to use the drop down menu (pictured below) to select the other functional gene.*




**9.** If the functional gene sequence is found in the microbe's genome, record a "+" in the corresponding box in the data table below. If the functional gene sequence is not found in the microbe's genome, record a "–" in the corresponding box in the data table.

**10.** Return to the nucleotide blast page and repeat steps 4-9 until you have searched *each* microbe for *each* functional gene.

**11.** Classify each microbe as a nitrogen-fixer, photosynthesizer, or heterotroph, and record your classification in the corresponding box in the data table.

**DATA TABLE:**

| MICROBE | N-FIX GENE | PHOTO GENE | CLASSIFICATION |
|---|---|---|---|
| *Synechococcus elongatus* (taxid: 32046) | | | |
| *Canidatus pelagibacter* (taxid: 198251) | | | |
| *Trichodesmium erythraeum* (taxid: 1206) | | | |

**PART TWO: Microbe locations**

Now that you know what each microbe does, use this information to determine where in the ocean the microbe is likely to be found. *Think about what type of conditions the microbe needs in order to perform its function and where those conditions can be found in the ocean.*

**PART THREE: Big Picture**

Given the location and function of each microbe, where do they fit into the ocean food web or biogeochemical cycles. *For example: What consumes each microbe? Where does the nitrogen compound that the microbe "fixes" come from? Where does the nitrogen compound that the microbe produces go?*

**PART FOUR: Ecological Role**

Now put it all together to explain what each microbe's individual role is in the ocean. *A good way to approach this is to think about what would happen if this microbe disappeared. Some microbes also have beneficial uses to humans!*

**THE PRODUCT**

Create a product to communicate your conclusions. Your product can be a poster (virtual or paper), a Prezi, a PowerPoint, or a brochure. Whichever form you choose, your product must include each of the following:

- A diagram of the ocean with labeled layers/areas
- Each microbe's location labeled within the appropriate layer/area
- The basics about each organism:
  - Function
  - Place in the food web or biogeochemical cycle
  - Overall role (what the microbe does or how it is used by humans)
- Sources—at least 3 *(any sources consulted must be credited – if you create a poster, this can be on the back; if you create a presentation or brochure, this can be at the end)*

# Assessment Rubric

*All products (regardless of form) will be graded based on the following rubric:*

| CRITERIA | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Diagram** | Diagram is not neat and 1 or less layer/area is labeled. | Diagram is fairly neat and 2 or less layers/areas are labeled. | Diagram is neat and 2 appropriate layers/areas are clearly labeled. | Diagram is neat and all 3 appropriate layers/areas are clearly labeled. |
| **Microbe Locations** | Microbes are not labeled, or labels are unclear. | Location of 1 microbe is clearly labeled. | Locations of 2 microbes are clearly labeled. | Locations of all 3 microbes are clearly labeled. |
| **Function** | Functions are not listed or unclear. | One microbes' function is clearly listed. | Two microbes' functions are clearly listed. | All 3 microbes' functions are clearly listed. |
| **Place in food web/biogeochemical cycle** | Places in food web or biogeochemical cycle are not explained or unclear. | One microbe's place in the food web or biogeochemical cycle is clearly explained. | Two microbes' places in the food web or biogeochemical cycle are clearly explained. | All 3 microbes' places in the food web or a biogeochemical cycle are clearly explained. |
| **Overall role** | Overall roles are not explained or unclear. | The overall role of 1 microbe is clearly explained. | The overall roles of 2 microbes are clearly explained. | The overall roles of all 3 microbes are clearly explained. |
| **Sources** | One source is credited at the end of the presentation. | Two sources are credited at the end of the presentation. | Three sources are credited at the end of the presentation. | More than 3 sources are credited at the end of the presentation. |
| **Overall appearance & organization** | The product is not aesthetically pleasing, shows no planning, and no organization. | The product is not aesthetically pleasing, shows some thought in planning, and is somewhat organized. | The product is aesthetically pleasing, shows thought in planning, and is somewhat organized. | The product is aesthetically pleasing, well-planned, and well-organized. |