Student Worksheet Day 2-3: Identifying freshwater and saltwater diatoms in the Hudson Estuary

Introduction:

The Hudson Estuary contains floating communities of **phytoplankton**, comprised of algae and other tiny photosynthetic organisms, as well as **benthic** communities, which are attached to rocks and other surfaces in the water. Diatoms are one type of algae from the class Bacillariophyta that are very common in all aquatic habitats, and are especially easy to find in winter when other phytoplankton populations are low (Stanne, 2007).

Diatoms are unique from other algae because they have transparent silica cell walls, called **frustules**, formed in two pieces which fit together like a pillbox. Silica is the main component of glass, and diatoms are often referred to as "algae in glass houses." Some **taxa** (or types) of diatoms including *Paralia sulcata* are marine, preferring salt to brackish water, while others including *Asterionella formosa* prefer brackish to freshwater.

Because most diatoms are very sensitive to abiotic factors such as salinity, dissolved oxygen, pH, and temperature, they are often used as environmental indicators. Frustules do not decompose so they can be found in freshwater and saltwater sediments, providing information about historical conditions of the river (Diatoms of North America). Changes in their population size can reflect a change in a food web, as is the case with the boom and bust cycles of zebra mussels and diatom depletion and resurgence (Strayer, 2016). Salinity levels are known to impact phytoplankton growth and distribution in brackish waters, and may be particularly altered as a result of climate change (Floder, 2010). We will make predictions about where certain diatom species will be found in the Hudson, and collect and identify diatom taxa and evaluate whether their abundance is related to salinity.

Questions:
1. What makes diatoms unique from other algae?

   _____

2. Which taxa of diatoms prefer salty to brackish water? _____

3. Which prefer brackish to freshwater*?* _____

Using the map you created on the first day of this lesson, place post-it notes with the names of the five diatom taxa from the Diatom ID Cards where you might expect to find them on the map. Identify the location of your school on the map as well, and where you will be sampling for diatoms.

Focusing on the five taxa on the Diatom ID Cards, write a question in the space below about the diatom community at your sampling location.
There are two variables you can consider in your question:
- Salinity of the habitat
- Type of habitat (planktonic or benthic)

Question about diatom community:

_____

_____

_____

Next, write a hypothesis about the **relative abundance** (the percent of the diatom community that each taxa makes up) of these five diatoms at your sampling site.
Hypothesis about diatom relative abundance in your sample:

_____

_____

_____

_____

Based on your question and hypothesis, create a datasheet that will allow you to collect data to support your hypothesis. A template of a datasheet is provided.

Day 3: Diatom data collection and analysis
Although diatom populations peak in early summer and fall, cyanobacteria such as *Anabena* are more abundant at that time of year. In the winter months, diatoms dominate the algal community so are much easier to find. For that reason, February is often the best month in which to collect diatoms.

Your teacher will take you out to the field site to collect diatoms using one of the following methods:
- Planktonic diatom sampling:
    - **String Method:** Secure one end of a foot long piece of string on the bank of the water body, so that the length of the string is drifting in the water. You can use rocks or other materials to secure the string. Let the string drift in the water for several days as the diatoms attach to the string. After diatoms have attached to the string, take it out of the water and put it and a small amount of Hudson River water in a jar labeled with the collection date and location.
    - **2 liter bottle:** fill the bottle with water from the surface of the water body.
    - **Microplankton net:** Use a specially designed net that filters out all but phytoplankton to collect planktonic diatoms. Drag the net back and forth just

below the surface of the water for a few minutes. A net with a mesh size of no more than 25 micrometers (*um*) would collect diatoms. Place contents in a jar and label it with the collection date and location.
- Benthic diatom sampling:
  - **Toothbrush Technique:** Collect golden brown- black layers from rocks and plants close to shore with a toothbrush, and store in airtight glass jar with a little Hudson River water. Try to avoid collecting sand with the samples. Label each jar with date and location of sample.

Preparing diatom samples

Living diatoms, especially freshwater diatoms, are interesting to view under the compound light microscope, however, it is easier to identify and count the samples when they are not alive. Collected samples can be divided so that some are observed as living samples and others can be further processed for viewing to identify them by their distinct frustules.
- Separate a small amount of the collected sample and use for viewing under the microscope alive.
- Add Lugol's iodine solution (a preservative) to remaining collected samples until it is "weak tea colored" and allow the organisms to settle to the bottom over 16-24 hours (Taylor, 2007).
- If you are going to digest the organic material from the diatoms, your teacher will give you additional lab instructions.

Identifying and recording diatom populations

Diatoms are ubiquitous in marine, brackish and freshwaters---there are 20,000 to 2 million species on Earth--- but they are not so easy to see with the naked eye. By using the compound light microscope and the Diatom ID Cards, the collected diatoms can be identified by *Genus* and possibly *species.*
- Use a pipette to put a droplet of the sample on the center of the slide and gently place a coverslip on top of the sample. For living samples,use concave slides so pennate diatoms may be seen moving For non-living samples, standard slides are fine.

- View at low power magnification (10x eyepiece lens X 4x objective lens)

- Center diatom(s) of interest and increase to medium or high power magnification

- Using the microscope drawing worksheet to draw what you see. Use pencil to record a detailed drawing for each type of diatom you observe. Be sure to write down the eyepiece, objective and total magnifications that you are using to view the diatom.

- Use the Diatom ID Cards to identify your algae, and record the count in your datasheet. If you cannot identify it, count it in the "unknown" column.

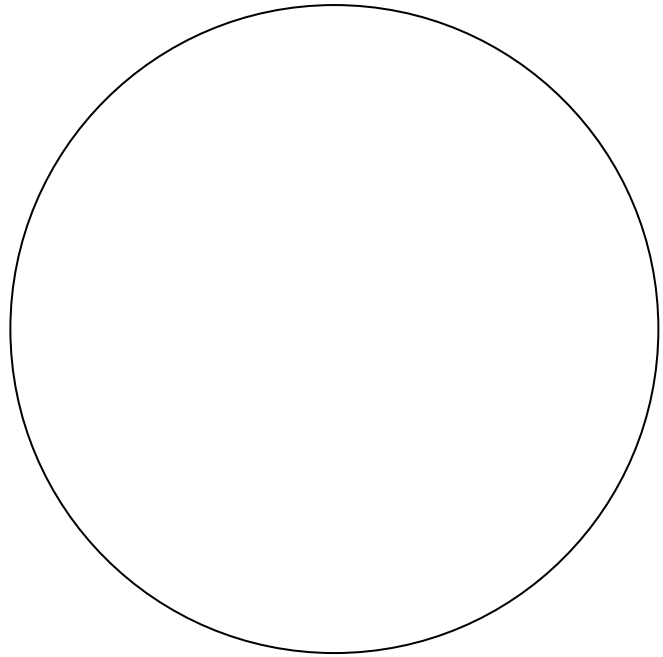*"To see what others have seen and to know what no one else has known…"*
--Szent-Gyorgi

Specimen name_____

Eyepiece (ocular) magnification: _____

Objective magnification: _____

TOTAL magnification: _____

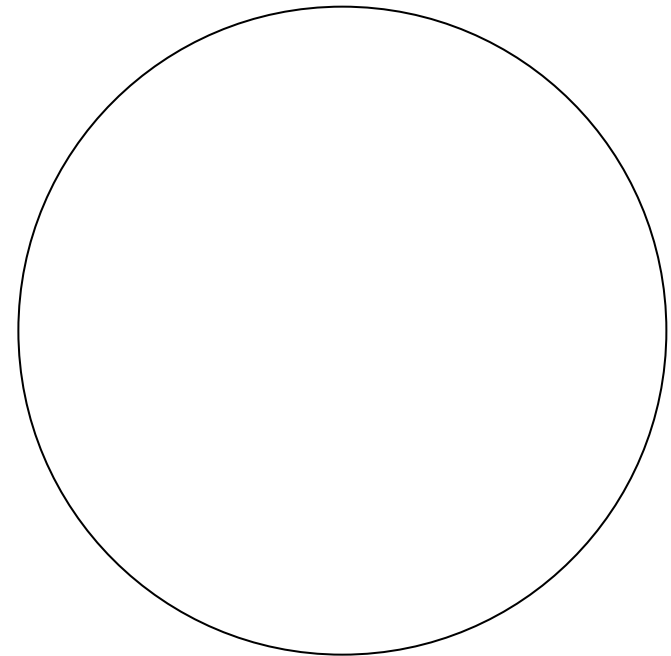**Stained/unstained (circle one)**

COMMENTS:

"In the field of observation, chance favors the prepared mind."
---Louis Pasteur

Specimen name_____

Eyepiece (ocular) magnification: _____

Objective magnification: _____

TOTAL magnification: _____

Stained/unstained (circle one)

COMMENTS:

(Optional) Sometimes the size of the diatom is helpful in identifying it. By measuring the diameter of the field of view at low power and using the following formula, specific cell dimensions seen at hp, can be determined.

$$\frac{\text{Low power magnification}}{\text{High power magnification}} = \frac{\text{High power field of view diameter}}{\text{Low power field of view diameter}}$$

$$\frac{40}{400} = \frac{X}{\text{low power field of view diameter (in mm.)}}$$

Questions:

Review your results in your data table of diatom counts in relation to your hypothesis about diatom relative abundance.

Do you accept or refute your hypothesis?

_____

If so, why? If not, why not?

_____

_____

_____