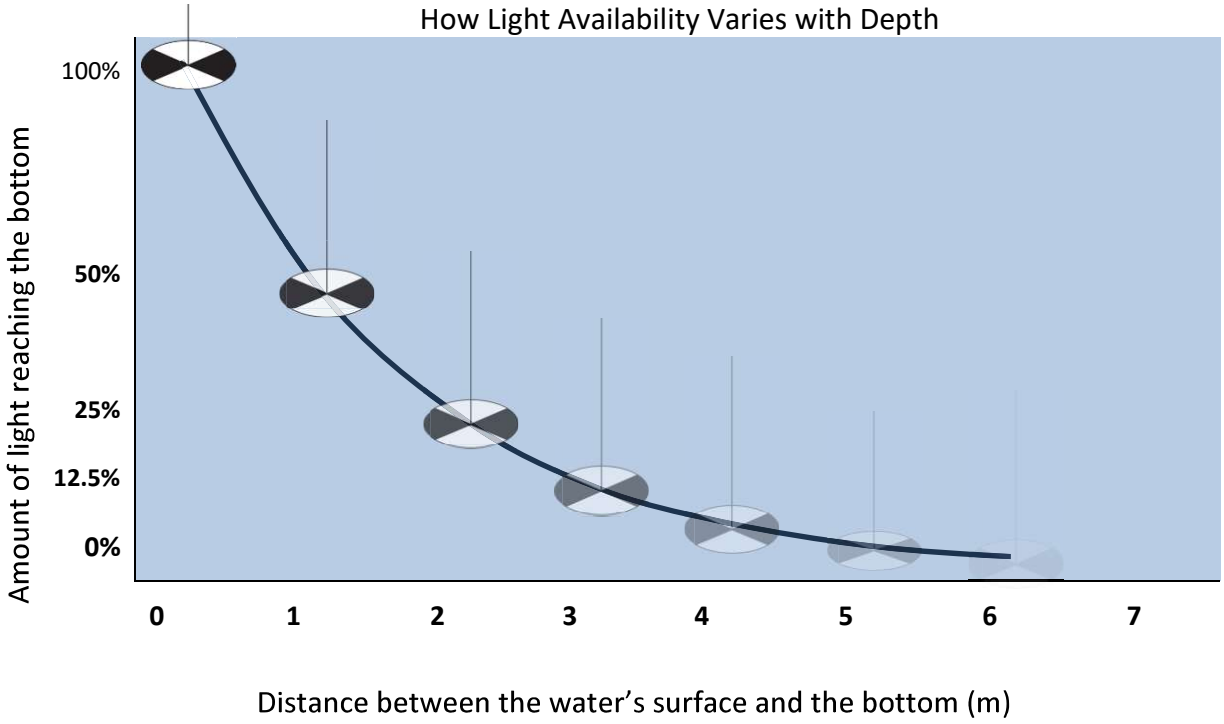
Name: _____

Seagrass Restoration Planning in the York River

Warm-up Question:

This graph depicts the general trend of the amount of light available at increasing depths in the water column. Secchi disk visibility decreases with decreasing light availability. Please use it to answer the following questions.



a. How does the water depth affect the amount of light reaching the bottom (where seagrasses grow)? (Hint: what kind of trendline does this graph have?)

b. How would this impact your decision as a restoration manager on what depth to plant eelgrass?

Background: Your grandparents remember a time when the York River was covered in seagrass meadows, but today, there are several locations in the river that have lost their seagrass coverage. They talk longingly about how clear the water was and how many crabs and fish there were to catch. As a coastal scientist, you set out to restore these areas to their former glory. You are particularly fond of eelgrass and have access to 20,000 seeds from another project. Like many other species, it needs the right conditions to grow. Too little light, extreme temperatures, or the wrong salinity can make it hard for it to survive. Your job is to review data from several possible planting sites and decide how to use your limited resources wisely.

Instructions:

Measure and Record Depth: Use your ruler to measure the water depth at low tide by measuring vertically from the water surface (top of the blue box) to the sediment (top of brown box). Record it on your data sheet as meters with this scale: 10 cm on the ruler = 1 m of water depth. These scaled numbers are biologically accurate for the depth range of eelgrass

Estimate Light Availability: Use the Secchi disk key to determine if light availability is **High**, **Moderate**, or **Low** at each site based on how visible the lowest Secchi disk is

Analyze Site Conditions: Compare temperature and salinity to the ideal range for eelgrass

Temp: **5-28°C (tolerable); 10-20°C (optimal)** Salinity: **10-35 PPT (tolerable); 20-35 (optimal)**

Rank Each Site: After filling out the table with these four measurements for all six sites, decide whether each site is comparably **Good**, **Good-Intermediate**, **Intermediate**, **Intermediate-Poor**, or **Poor** for eelgrass restoration.

Allocate Your Seeds: Remember, you have **20,000 seeds total**. Distribute them among the six sites based on your rankings and reasoning. Each site can only hold a maximum of **6,500** seeds.

	Depth (m)	Light Availability	Temp (˚C)	Salinity (PPT)	Rank	# of Seeds
Site 1						
Site 2						
Site 3						
Site 4						
Site 5						
Site 6						

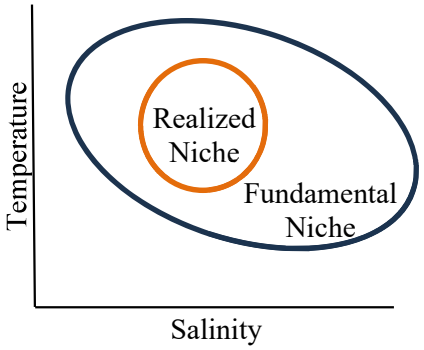
Questions:

1. Which site had the **best overall conditions** for eelgrass growth?

2. Which site had the **worst conditions** for eelgrass growth?

3. Did any sites have both good and bad qualities? How did you decide whether to plant there?

4. A fundamental niche of an organism is the full range of conditions in which an organism can survive. A realized niche is a smaller subgroup of those conditions where you actually find that organism, usually due to other limiting factors (competition, predation, etc.). **Why might this concept be important in eelgrass restoration planning? Please give one specific example of a factor that might limit the realized niche for eelgrass.**



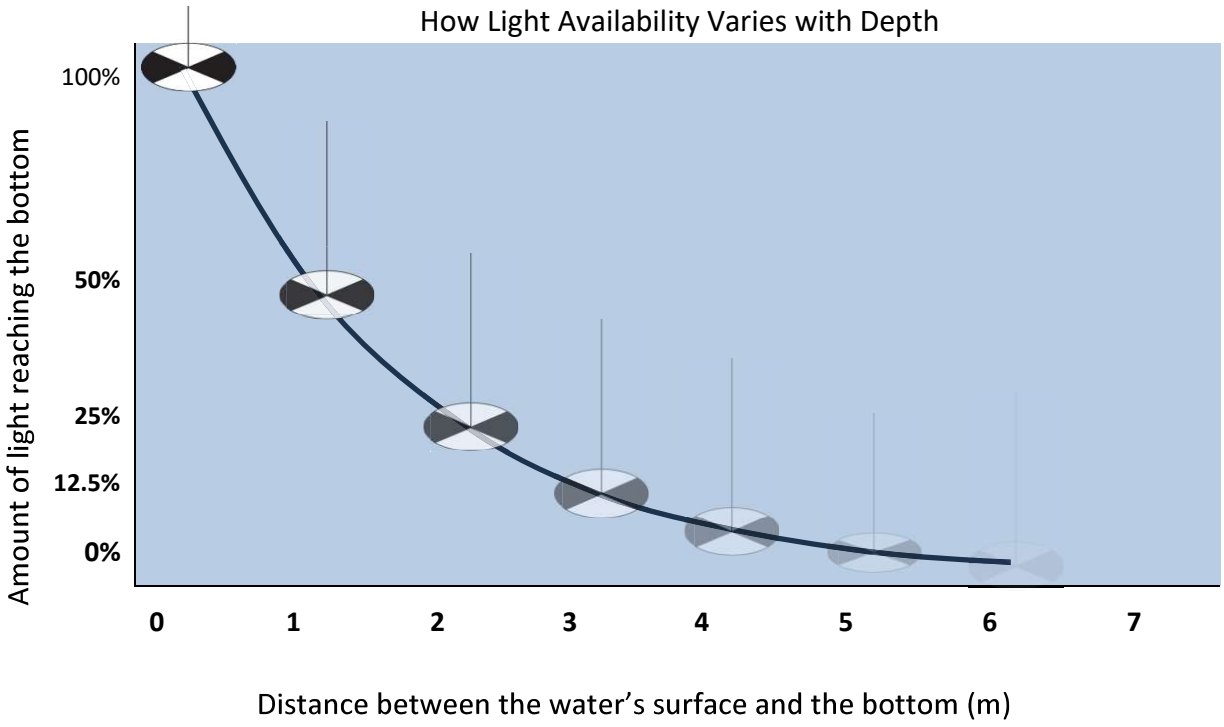
5. What environmental factors most influenced your decisions (e.g., depth, light, salinity, temperature)? Please provide evidence to support your claim.

Name: _____

Seagrass Restoration Planning in the York River: Answer Key

Warm-up Question:

This graph depicts the general trend of the amount of light available at increasing depths in the water column. Please use it to answer the following questions.



a. How does the water depth affect the amount of light reaching the bottom (where seagrasses grow)? (Hint: what kind of trendline does this graph have?)

Light becomes increasingly less available with increasing water depth. Bonus points if they talk about there being an exponential decay!

Optional: As a class you could discuss what makes light less available. Water by itself deflects a certain amount of light, so just by nature of having more water in between the seagrass and their light source, they will be receiving less light at deeper depths. This is magnified by the fact that most water has things in it (sediment, phytoplankton, suspended particles) that further deflect the light and compound with more water.

b. How would this impact your decision as a restoration manager on what depth to plant eelgrass?

I would choose a site that is shallow enough where enough light can get down to the bottom for seagrass to be able to conduct photosynthesis.

Background: Your grandparents remember a time when the York River was covered in seagrass meadows, but today, there are several locations in the river that have lost their seagrass coverage. They talk longingly about how clear the water was and how many crabs and fish there were to catch. As a coastal scientist, you set out to restore these areas to their former glory. You are particularly fond of eelgrass and have access to 20,000 seeds from another project. Like many other species, it needs the right conditions to grow. Too little light, extreme temperatures, or the wrong salinity can make it hard for it to survive. Your job is to review data from several possible planting sites and decide how to use your limited resources wisely.

Instructions:

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Rank Each Site: After filling out the table with these four measurements for all six sites, decide whether each site is comparably **Good**, **Good-Intermediate**, **Intermediate**, **Intermediate-Poor**, or **Poor** for eelgrass restoration.

Allocate Your Seeds: Remember, you have **20,000 seeds total**. Distribute them among the six sites based on your rankings and reasoning. Each site can only hold a maximum of **6,500** seeds.

	Depth (m)	Light	Temp (C)	Sal (PPT)	Rank	# of Seeds
Site 1	1.04	high	25	10	int	3,500
Site 2	0.41	high	21	21	Int-good	6,500
Site 3	1.13	high	17	23	good	6,500
Site 4	1.12	medium	28	33	Int-poor	0
Site 5	1.18	medium	21	22	int	3,500
Site 6	1.02	Low	29	33	poor	0

Questions:

Please answer the following questions:

1. Which site had the **best overall conditions** for eelgrass growth?

   Site 3

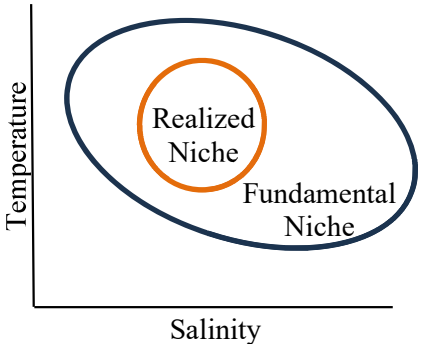
2. Which site had the **worst conditions** for eelgrass growth?

   Site 6

3. Did any sites have both good and bad qualities? How did you decide whether to plant there?

   Many sites had both good and bad qualities. It was important to check to see if these conditions were just on the edge of eelgrass' tolerance range, or fully outside of it. The combination of how many good versus bad environmental conditions is also important.

4. A fundamental niche of an organism is the full range of conditions in which an organism can survive. A realized niche is a smaller subgroup of those conditions where you actually find that organism, usually due to other limiting factors (competition, predation, etc.). **Why might this concept be important in eelgrass restoration planning? Please give one specific example of a factor that might limit the realized niche.**



   There are biological factors that also influence habitat suitability, not just chemical and physical conditions

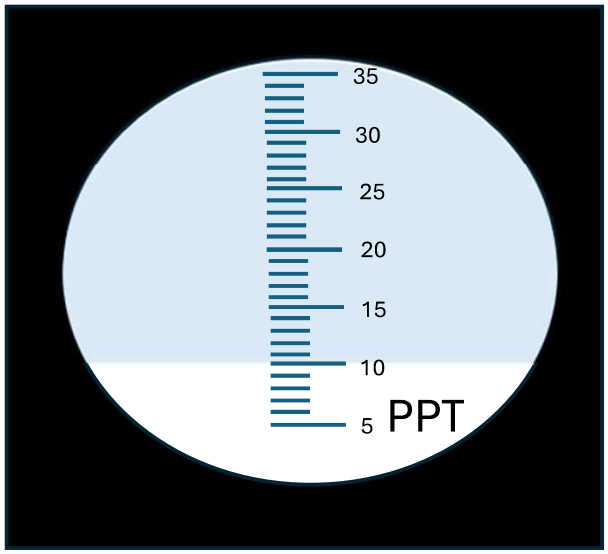
   Competition with other seagrass species; herbivores eating the eelgrass in those locations; disease in that area; heavy boat traffic that disturbs the bottom; many right answers

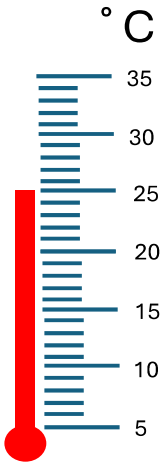
5. What environmental factors most influenced your decisions (e.g., depth, light, salinity, temperature)? Please provide evidence to support your claim.

   Light and temperature. Eelgrass has a smaller range of temperature tolerances than salinity, and the sites are more often outside of the optimal range. Light is important for photosynthesis and plant growth, and it is also medium/low at more sites.

Restoration Sites to Print

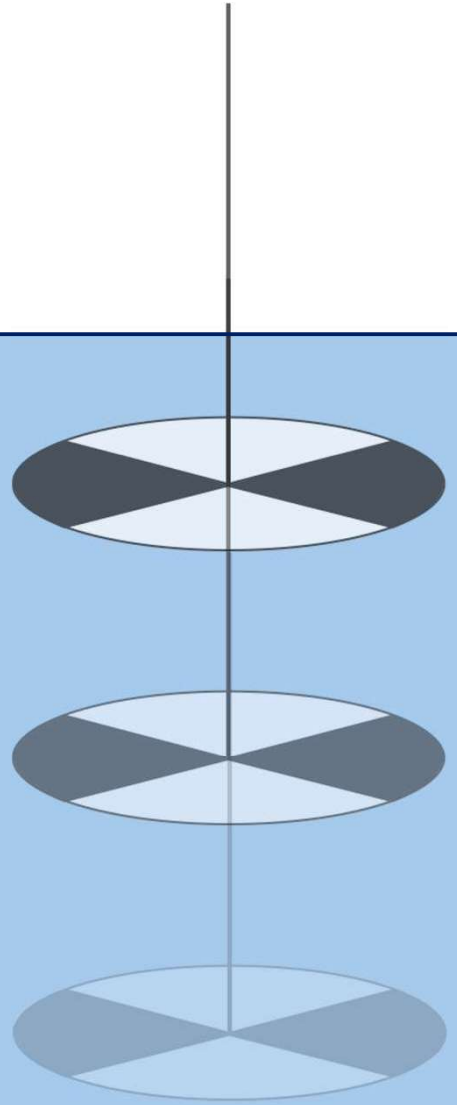
- Print one set of sites (6) per group of students
- Ideally print in color
- Option to laminate for future use

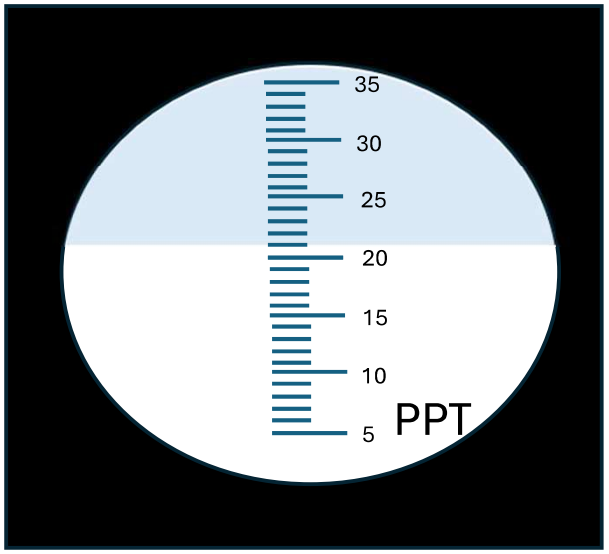


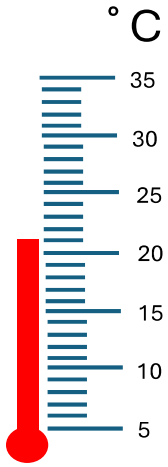


Site 1

Temperature: 25 C
Salinity: 10 ppt

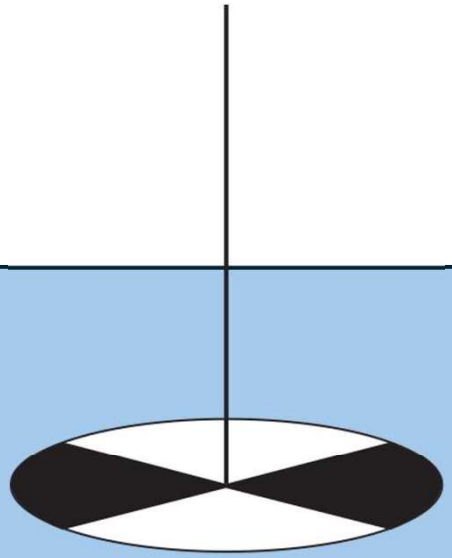


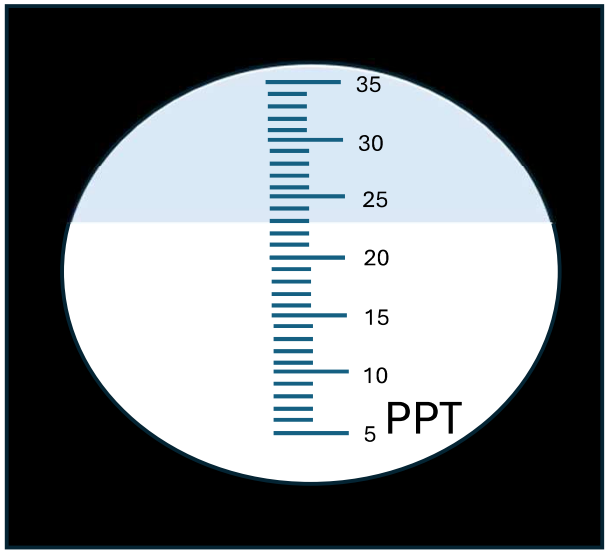


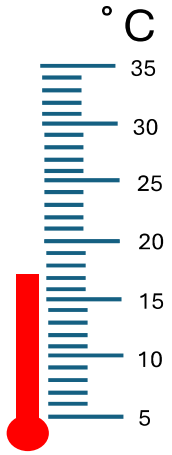


Site 2

Temperature: 21 C
Salinity: 21 ppt



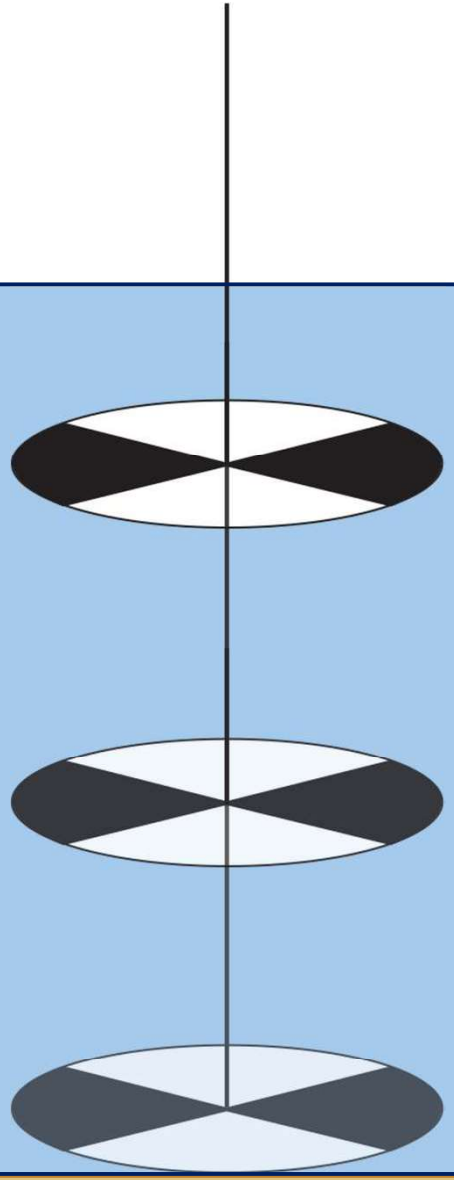


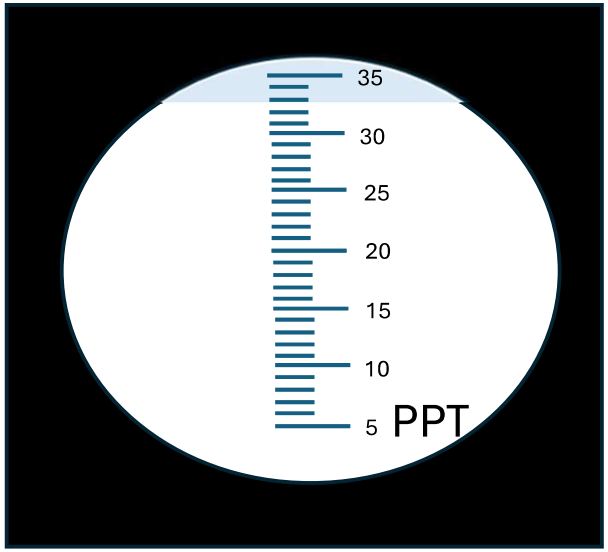


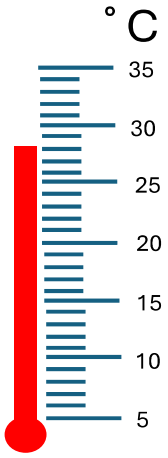
Site 3

0.5 m

Temperature: 17 C
Salinity: 23 ppt

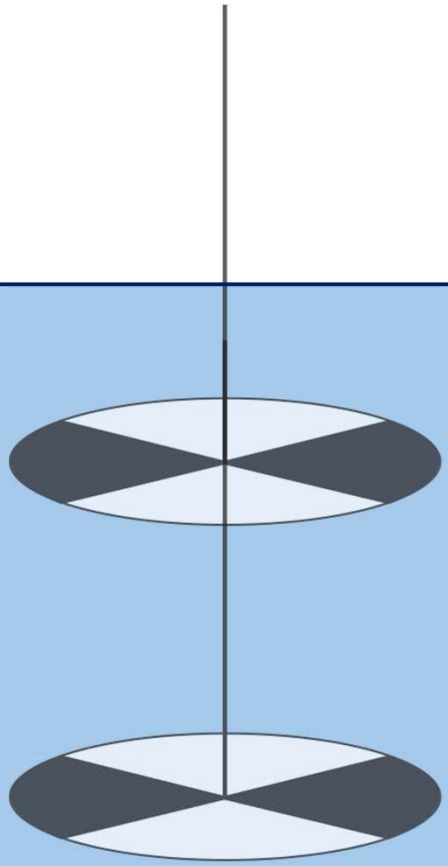


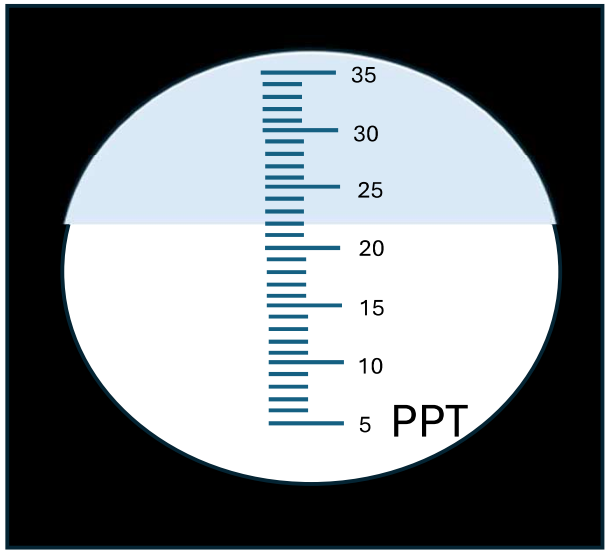


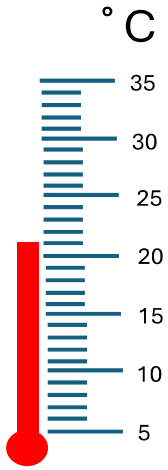


Site 4

Temperature: 28 C
Salinity: 33 ppt

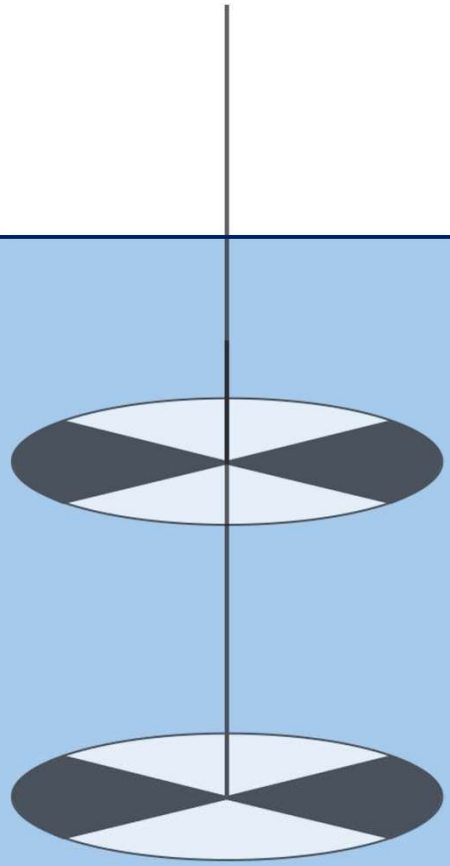


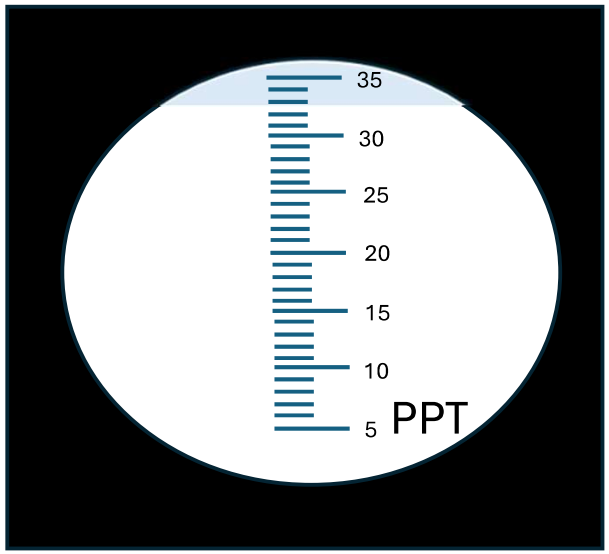


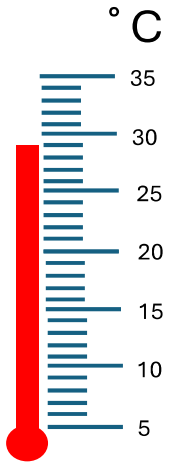


Site 5

Temperature: 21 C
Salinity: 22 ppt

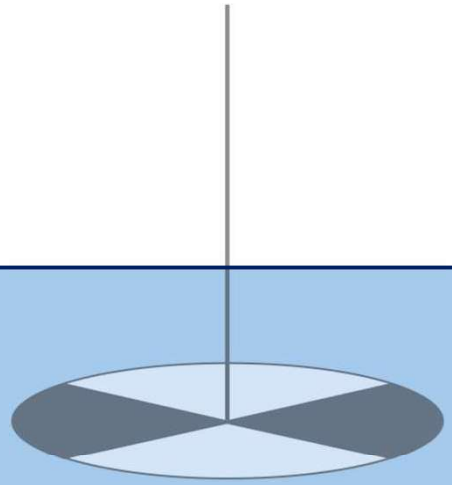






Site 6

Temperature: 29 C
Salinity: 33 ppt



Secchi key to print

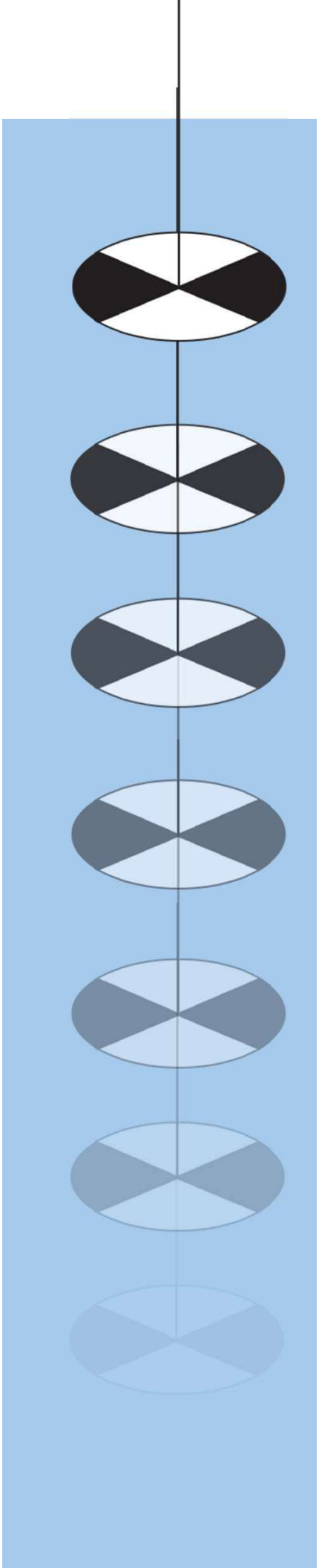
- Students will use this key to determine the light availability associated with each site
- Ideally print in color
- One key per group should be sufficient
- Option to laminate for future use

High light availability: Secchi visible on bottom

Moderate light availability: Secchi visible in middle, but not the bottom

Low light availability: Secchi only visible at the top

The more transparent the Secchi disk, the less light availability



Increasing Light Availability