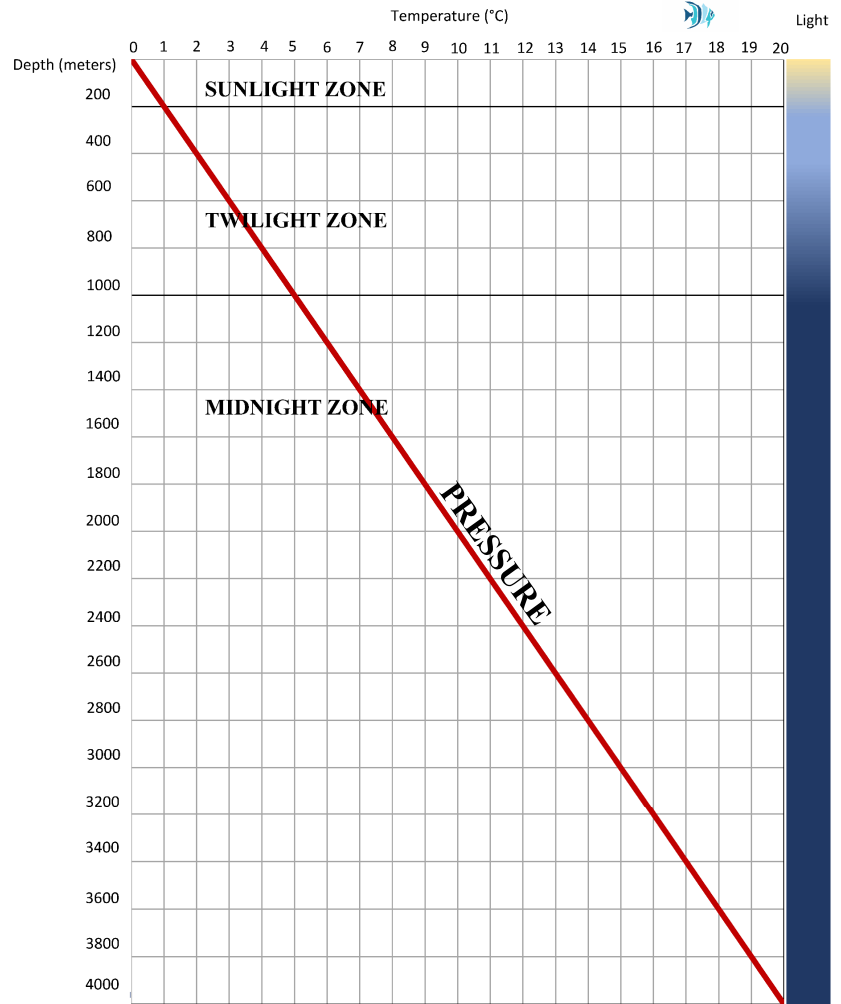


Killer from the Deep – Worksheet A

Name: _____

Ocean Zone	Depth (m)	Temp (°C)
Sunlight	0	20
	200	16
Twilight	400	10
	800	6.5
	1000	5
Midnight	2000	4.5
	4000	4



Directions: Plot the following temperature data on the depth profile graph on the right. The axes, depth zones and other environmental variables are already provided on the graph. After you have plotted the data, draw a line to connect your data points and complete the following discussion questions.

Discussion Questions

- What is your independent variable? What are your dependent variables?

- Photosynthetic plants, known as phytoplankton, are the base of the food web in the open ocean. Phytoplankton need sunlight to photosynthesize. Describe where photosynthesis occurs in the open ocean. If photosynthesis can only occur in the presence of light, how are food webs different in areas of no light? Hint: if you are struggling with this question, check out this article: <https://www.nytimes.com/2017/12/19/science/deep-sea-food-web.html>

Discussion Questions Continued

3. Describe how each variable (temperature, pressure and light) changes as depth from surface increases. What environmental conditions do organisms living in the Twilight and Midnight Zones experience?
4. Can you think of any adaptations that these populations of deep sea animals may have evolved to be better suited to living in these harsh environments? Hint: if you are struggling with this question, check out this interactive article: <https://www.nytimes.com/interactive/2017/08/21/science/the-deep-seas-are-alive-with-light.html>

Killer from the Deep – Worksheet B

Names: _____

Directions: Open your “nets” (baggies containing beads or candies) and sort and count the “captured animals” (beads or candies). Record your results in the table below. Take care to keep the contents of each “net” separate (you will compare the contents of each net). You should have 6 different nets (representing three depth habitats and two time periods, the day and the night).

Animal	Abundance (Counts)					
	Day			Night		
	0-200 m	200-1000 m	1000-4000 m	0-200 m	200-1000 m	1000-4000 m
Flyingfish (yellow)						
Lanternfish (green)						
Hatchetfish (blue)						
Fangtooth (red)						
Pelican Eel (black)						

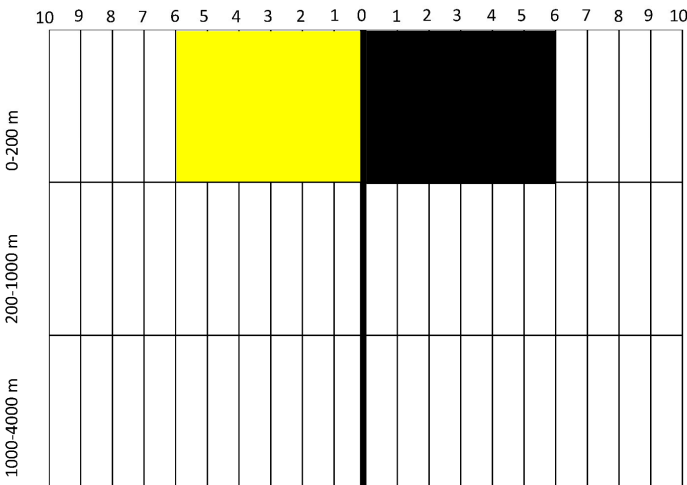
Graphing: Plot the abundance data from above on the following depth profile as a horizontal bar graph. Use a yellow marker to shade the bars of abundance data for the daytime and brown/black marker for shading the bars of abundance data for the nighttime. An example is shown below for the Fanfish.

Example: Fanfish



Daytime Abundance

Nighttime Abundance

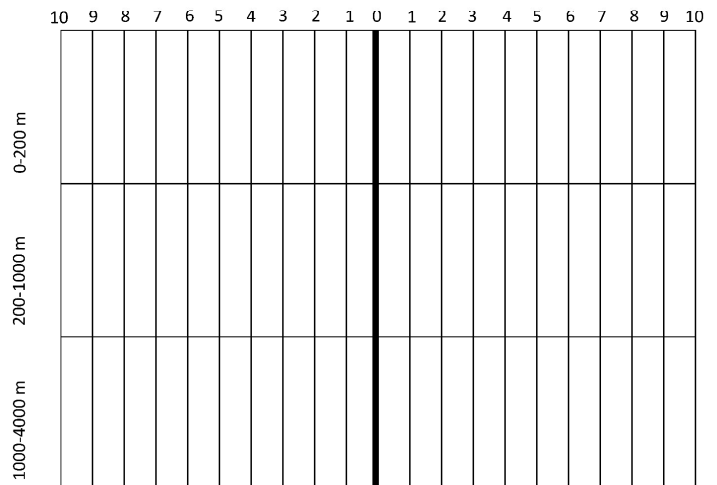


Flyingfish



Daytime Abundance

Nighttime Abundance



Names: _____

Killer from the Deep – Worksheet B

Discussion Questions

1. Which animals are migratory on a diel (day/night) cycle? What zones do migratory animal(s) inhabit in the day versus night? Which animals had a uniform distribution (non-migratory)? Complete the chart below to answer.

Animal	What zone do they live in during the day? (circle one)	What zone do they live in during the night? (circle one)	Diel Vertical Migrator to Sunlight Zone?
Flyingfish	Sunlight / Twilight / Midnight	Sunlight / Twilight / Midnight	Yes / No
Lanternfish	Sunlight / Twilight / Midnight	Sunlight / Twilight / Midnight	Yes / No
Hatchetfish	Sunlight / Twilight / Midnight	Sunlight / Twilight / Midnight	Yes / No
Fangtooth	Sunlight / Twilight / Midnight	Sunlight / Twilight / Midnight	Yes / No
Pelican Eel	Sunlight / Twilight / Midnight	Sunlight / Twilight / Midnight	Yes / No

2. In this activity, depth zones were defined for you. What if we didn't know the depth of the net? What variable has a consistent, predictable relationship with depth and can be used as a proxy (substitute) for depth? (Hint: refer to graph of environmental variables in Activity A).
3. Scientists have discussed several theories on the predominant (most important) variable that organisms undergoing diel vertical migration track to know when to migrate. While many scientists agree that light is a primary cue for organisms, scientists believe that daily, internal circadian rhythms (part of an organism's "biological clock") may also help animals know when to migrate. How could you test the importance of light versus biological clocks as migration cues?
4. Light penetration into the ocean differs in different parts of the world because of the Earth's tilt on its axis. For example, near the Equator, light reaches a greater depth in the water column than near the poles. Diel vertical migrators live in the Twilight Zone during the daytime because they are evading visually cued predators (that need light to see) in the Sunlight Zone. How would you expect the migration distance (difference between starting depth and end depth) to differ between the tropics and the poles? If migration distance is greater, how would you expect the speed of the migration to change (assuming that the time animals have to complete the migration stays the same)?
5. Due to climate change, the oceans are projected to become warmer and more stratified (less exchange/mixing between depth layers). Across large swaths of the oceans, fewer phytoplankton (aquatic plants) are expected to bloom in the surface zone because nutrients will be "trapped" in deeper water column layers, inaccessible to these surface-living photosynthetic plants. If there are fewer phytoplankton, the base of the ocean food web, how do you predict that the number of animals undergoing diel vertical migration to the Sunlight Zone will change?

Killer from the Deep – Worksheet B

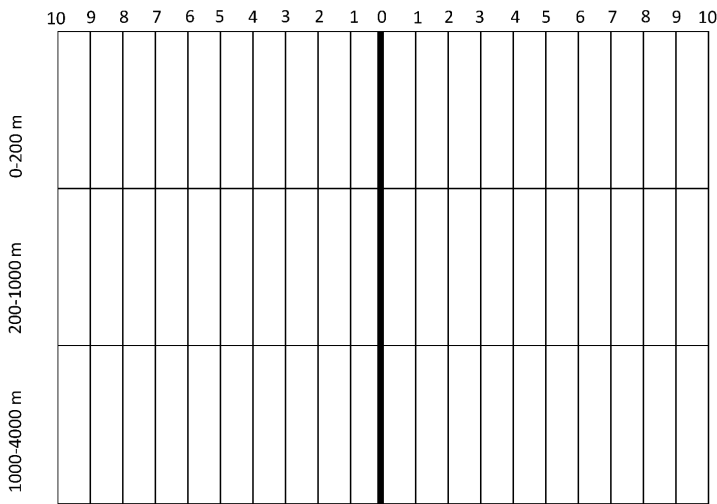
Names: _____

Graphing: Plot the abundance data for from above on the following depth profile as a horizontal bar graph. Use a yellow marker to shade the bars of abundance data for the daytime and brown/black marker for shading the bars of abundance data for the nighttime. See the Fanfish graph as an example.

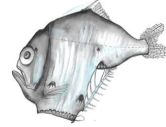
Lanternfish



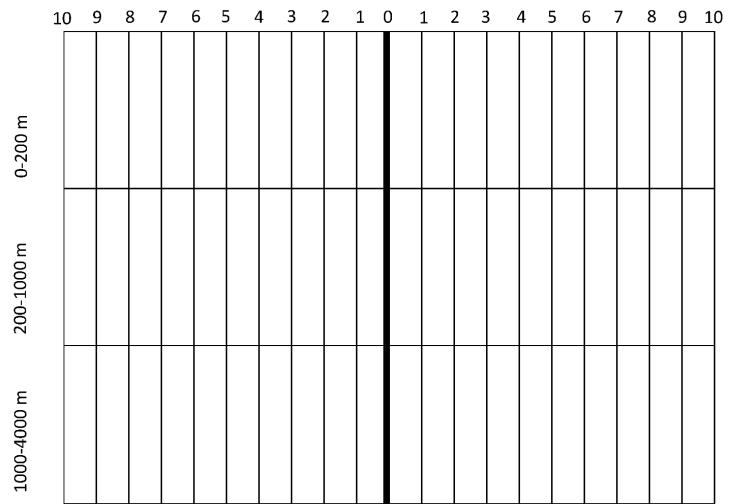
Nighttime Abundance



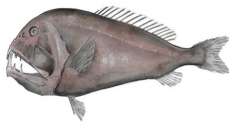
Hatchetfish



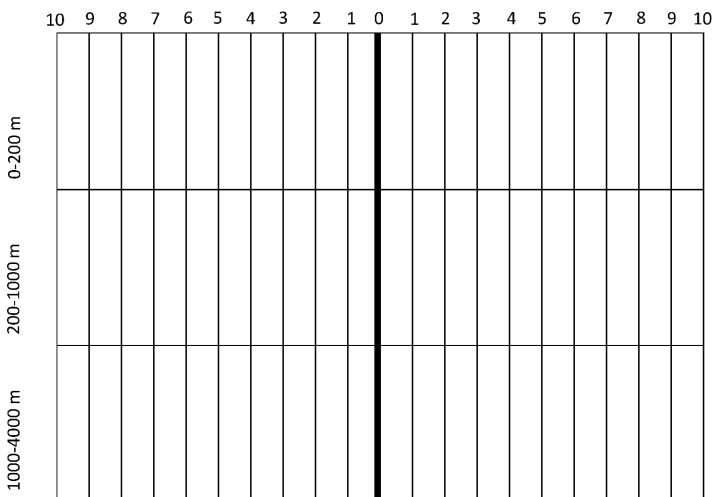
Daytime Abundance Nighttime Abundance



Fangtooth



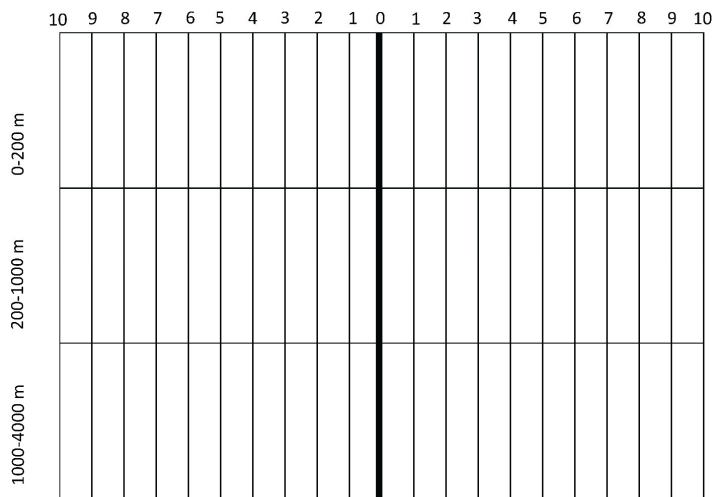
Daytime Abundance Nighttime Abundance



Pelican eel



Daytime Abundance Nighttime Abundance



Killer from the Deep – Worksheet C

Names: _____

Assignment: Solve the Murder Mystery

Cyclops the copepod (pictured right) was killed (and eaten!) while in the surface Sunlight Zone under cover of darkness. Luckily, there was a witness and the authorities have provided you with a list of suspects. Use the clues from the witness’s statement to authorities and the accompanying flash cards to fill in the provided table of suspects and solve the crime.



Victim



Witness

1/20/2022
Detective's Notes – Witness Statement
<ul style="list-style-type: none"> Crime occurred during nighttime in the Sunlight Zone
<ul style="list-style-type: none"> Witness reports “flash of light” emanating from murderer
<ul style="list-style-type: none"> Witness reports murderer had slender, elongate body

In order to identify the killer, consider the following questions for each suspect and complete the table below.

Motive: Does the suspect have motive? Because the victim was eaten, consider the suspect’s dietary preferences that could motivate them to kill the victim.

Means: Does the suspect have the means, including ability, to commit the crime? What are the suspect’s unique characteristics (e.g., adaptations) that could allow them to subdue the victim?

Opportunity: Did the suspect have an opportunity to commit the crime? Or do they have an alibi? Were the suspect and the victim in the same place at the same time?

SUSPECTS

Name	Motive (Dietary preference?)	Means (Biological adaptations?)	Opportunity (Zone they live in?)	Diel Vertical Migrator? (Y or N)
Lanternfish				
Hatchetfish				
Fangtooth				
Pelican Eel				

KILLER: _____