WATER DROP
PLANKTON STUDY

Educational Activity

Grade Level: Grade 5 - 12

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Ocean Literacy Standards:

#4: *The ocean made the Earth habitable.*
#5: *The ocean supports a great diversity of life and ecosystems.*
#6: *The ocean and humans are inextricably interconnected.*

This Water Drop Plankton Study activity allows students grades 5-12 experience how scientists record the plankton found in a water sample.

KEY CONCEPTS

- Phytoplankton and zooplankton identification
- Collect, record, and analyze observational data
- Scientific thinking

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Background:

The word plankton is derived from the Greek word "planktos'" which means drifter or wanderer. Planktonic organisms cannot move against a water current, so they like to go with the flow. When you hear the word "plankton," what are some words that come to mind? Aquatic? Tiny organisms? Microscopic, or only visible under a microscope? These characteristics are all correct descriptions of many planktonic organisms; however, some planktonic organisms, like jellyfish, are large and visible with the naked eye.

This activity will cover the two different types of plankton - **phyto**plankton and **zoo**plankton. Phytoplankton are the plant-like organisms that use sunlight to photosynthesize to create their own energy. Through this process of photosynthesis, phytoplankton produce over half of the oxygen that we need to breath (NOAA). To demonstrate this, take in three deep breaths. Now, give a big thank you to phytoplankton for two of those breaths. Zooplankton are animals that include the larval (baby) stages of crabs, fish, and other small organisms. Both phytoplankton and zooplankton can be found in the **photic zone**, which is the upper part of the water column that receives sunlight.

Depending on their life cycle, plankton are identified as either **holo**plankton or **mero**plankton. Holoplankton are organisms that are planktonic their whole life cycle, such as jellyfish, krill, and copepods. Meroplankton, on the other hand, are only planktonic for part of their life cycle. The blue crab is an example of an animal with a meroplankton larval form called zoea. They are in this planktonic form for about a month before they enter their juvenile stage, enabling them to crawl around.

Why do scientists care about plankton? Why should you care about plankton? Not only do phytoplankton produce a majority of the oxygen on the planet, but phytoplankton and zooplankton also play an important role in their ecosystems as the base of many food webs. A lot of the seafood we eat would not be available if plankton did not exist. For example, larval fish and shellfish that we eat and rely on as commercial fisheries begin their life as zooplankton.

Scientists are constantly learning more about planktonic behavior patterns and lifestyles, which is beneficial for monitoring **Harmful Algal Blooms (HAB)**. HABs are rapid algae growths that lower oxygen levels and cause toxins that are dangerous to animals, people, and even the ecosystem. Have you ever heard of red tides or blue-green algae? Both of those are harmful algal blooms.

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The University of Georgia Marine Extension and Georgia Sea Grant participates in a nationwide volunteer citizen science project organized by the National Oceanic and Atmosphere Administration (NOAA) called the Phytoplankton Monitoring Network or PMN. The purpose of PMN is to monitor coastal waters and identify trends that could help scientists better understand HABs. Volunteers collect weekly water samples and analyze them for **target species**, or any plankton that may cause HABs. In Atlantic coastal waters, there are 12 different target species:

Akashiwo sanguinea	*Karenia*
Alexandrium monilatum	*Karlodinium*
Ceratium furca	*Lingulodinium polyedrum*
Chaetoceros	*Prorocentrum*
Cochlodinium	*Pseudo-nitzschia*
Dinophysis	*Pyrodinium bahamense*

If there is an abundance of any target species, that water sample is sent to a member of the NOAA PMN Team for further investigation. Volunteer citizen science projects like this are meant to help people be involved with science, so anyone can join! If you want to better understand how PMN works, go to the Appendix on pages and read “How to collect plankton samples by pulling a plankton net” on page 16.

Sources:
NOAA, n.d. National Oceanic and Atmospheric Administration. How Has the Ocean Made Life on Land Possible? https://oceanexplorer.noaa.gov/facts/oceanproduction.html. Accessed 2020.

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Water drop plankton study directions:

The following activity will help you learn how to analyze plankton samples under a microscope.

1. Print off the 3 plankton slides and the data sheet (3 copies) on pages 9-12. You will need to fill out a data sheet for each slide. Printing off the ID guides on pages 5-8 is not required, but you will need to be able to refer to these guides during this activity.

2. Cut along the dotted lines across the plankton slide sheet in order to separate the eyepiece from the plankton slide.

3. Take the eyepiece and cut out the inside of the circle along the dotted lines.

4. Start with plankton slide 1. Place your eyepiece over A1 and locate any visible plankton. If you spot one, identify it using the ID guide, and put a tally mark beside the organism's name on the data collection sheet. Repeat this process for each grid block.

- You will move in a zig zag pattern until you have completed the slide. For example, on plankton slide 1 move from A1 to F1 then go down to F2. Move from F2 to A2 then go down to A3. Continue this pattern.

5. Compare your answers to the answer keys on pages 13-15 and see if you were able to correctly identify all of the plankton in your sample.

6. *BONUS:* Applying what you've learned about Harmful Algal Blooms (HAB), determine if you would send this sample to the PMN Team for further investigation. Remember, you only send a sample if you see an abundance of a target species.

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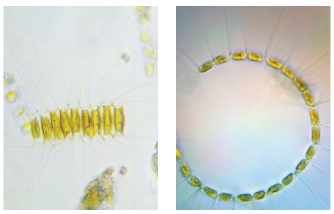
Phytoplankton

IDENTIFICATION GUIDE

Prepared by Andrew Bigham and Deanna Frankowski (2007) (Rev. 2020)

* Potentially hazardous algal bloom (HAB) and Phytoplankton Monitoring Network target.

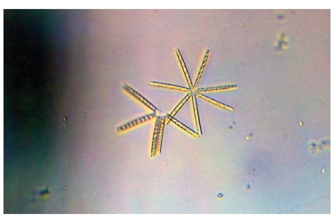
DIATOMS



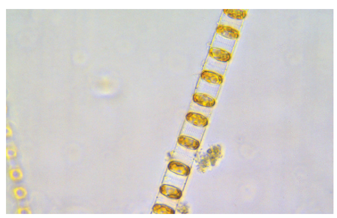
Chaetoceros sp.*
Square shaped cells with spines at each corner; often seen in chains

Odontella sp.
Rectangular shaped cell with projections off each corner; may form chains

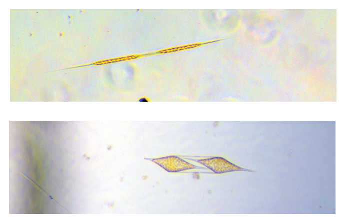
Pleurosigma sp.
Elongated cell, tapered at ends; normally orange or clear; often seen moving



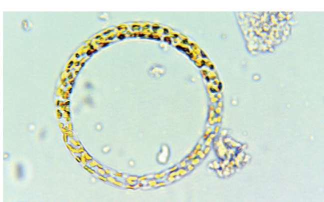
Thalassionema sp.
Single, rod-like cells that may form chains



Skeletonema sp.
Small cells evenly spaced in chains

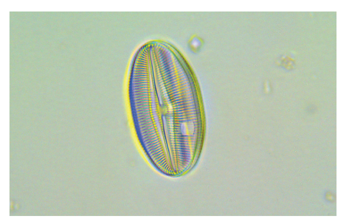


Rhizosolenia sp.
Elongated cell with projections at each end; may have multiple chloroplasts



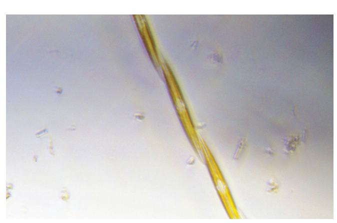
Guinardia sp.
Chain of cells that can be arched; each cell has multiple chloroplasts

Ditylum sp.
Cell has multiple chloroplasts and a long spine at each end

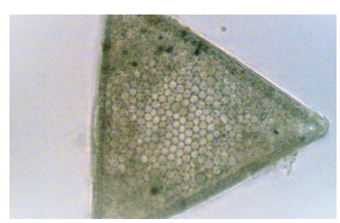


Navicula sp.
Related to Pleurosigma but much smaller; often seen moving

Prorocentrum*
"bean shaped" or rounded, flattened cell with dent on the top, with or without an apical spine.



Pseudo-nitzschia sp.*
Cells look like grains of rice; cells form a rigid chain that looks like inclining stairs



Triceratium
rigid triangular shaped diatom with well defined pores.

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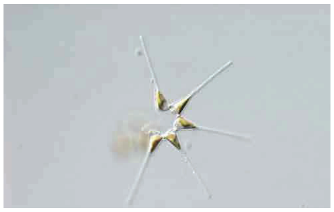
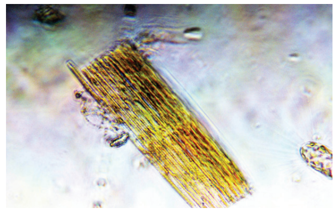
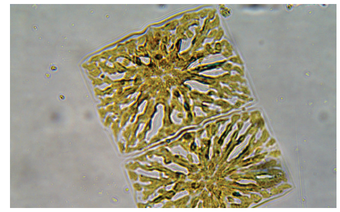


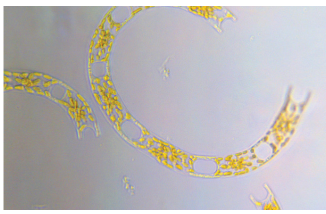
Asterionellopsis
Single cells, or cells may form star-shaped colonies by uniting at base



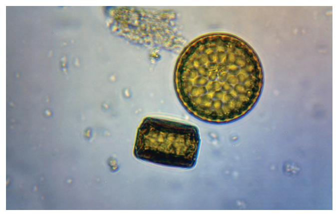
Bacillaria sp.
Rectangular cells in inclining chains; moves in and out like an accordion



Striatella sp
Rectangular shape and starburst patterned chloroplasts. Found as single cells or small groups.



Eucampia sp.
Arched elliptical chains of cells connected by two projections

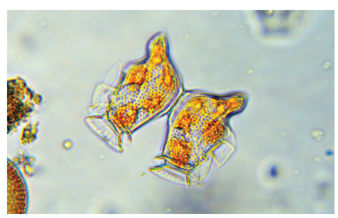


Coscinodiscus sp.
Spherical cell; may have a dark band around the edge and a dark center

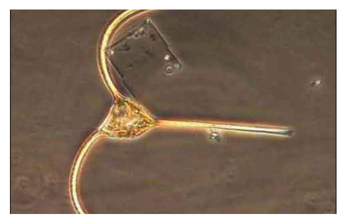
Nitzschia sp.
Long, oval cell with two projections; very small cells that move in straight line

DINOFLAGELLATES

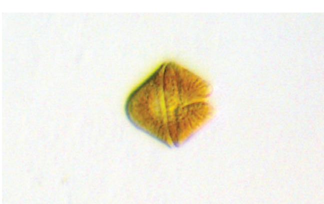
Ceratium furca (phenotype)*
"Forked Horns" Three horns: one elongated anterior and two unequal posterior horns.



Dinophysis spp.*
"The evil princess" wide round-ed bottom, a handle-like wing on one side and flared "crown"



Ceratium longipes
Cell with three long pipes radiating from a central disc



Akashiwo sanguinea*
Flat, tooth-like shape, often orangish in color

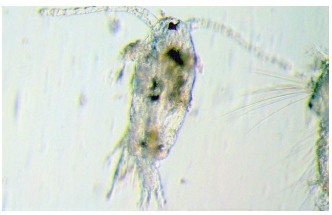
Protoperidinium sp.
Turnip-shaped cell that moves like a spinning top

Grade Level: Grades 5 - 12

Zooplankton

IDENTIFICATION GUIDE

Prepared by Emi Yamaguchi and Caitlin Bell (2007) (Rev. 2020)



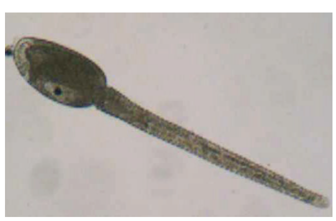

Adult Copepod
Copepods are the most common zooplankton worldwide. They are an integral part of the food web as both predator and prey

Copepod Nauplius
The nauplius is a common early larval stage of crustaceans. Some nauplii have spines.

Megalops
Final larval stage of a crab. During this stage, the abdomen is extended. It folds under the body as an adult.


Polychaete Worm Larvae
These are the marine relative of earthworms. The larvae are found in the plankton. The adult form is benthic

Zoea
Larval stage of a crab or shrimp. They have two large spines used for protection and flotation.




Tunicate (sea squirt) larva
Early life stage of a tunicate. Related to humans because they have a notochord, although it disappears in adults. Adult forms are called sea squirts.

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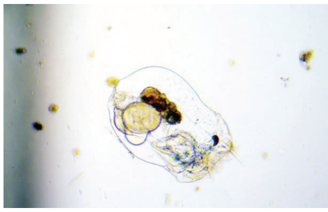
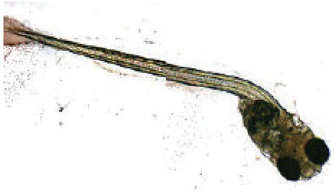
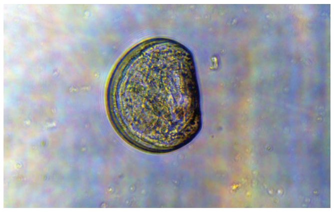


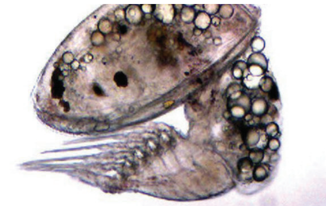
Rotifer
Rotifer cilia are in constant motion. Only a few species are found in marine or brackish water.



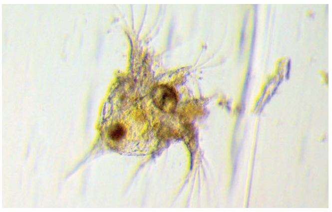
Fish Larvae
This juvenile fish will develop into a nektonic or benthic adult form. It is planktonic at this young stage.



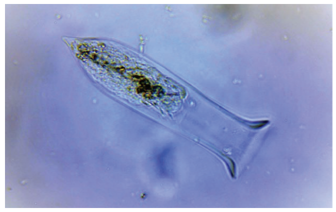
Veliger Larva
A free-swimming larval stage of a mollusk. They have the beginnings of a foot, shell and mantle. This is a veliger of a clam.



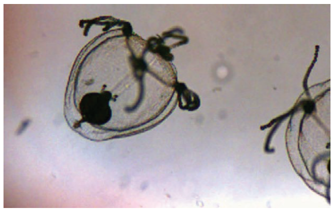
Cypris Larva
Final larval stage of a barnacle. It must find a suitable attachment site to beome an adult.



Barnacle Nauplius
Distinguished from crab larvae by "spikes" on their heads. This stage comes before cypris stage.



Tintinnid
Often referred to as a "tintinnid cup," it is a ciliate with a hard outer covering.



Hydroid Medusa
Medusa stage of a hydroid. It has stinging cells for defense and food capture. This stage reprosuces sexually to form polyps. Polyps then reproduce asexually to produce the medusa form.

Adult *Oikopleura* sp.
Actually an adult tunicate with notochord and tail. The tail waves food to the mouth.

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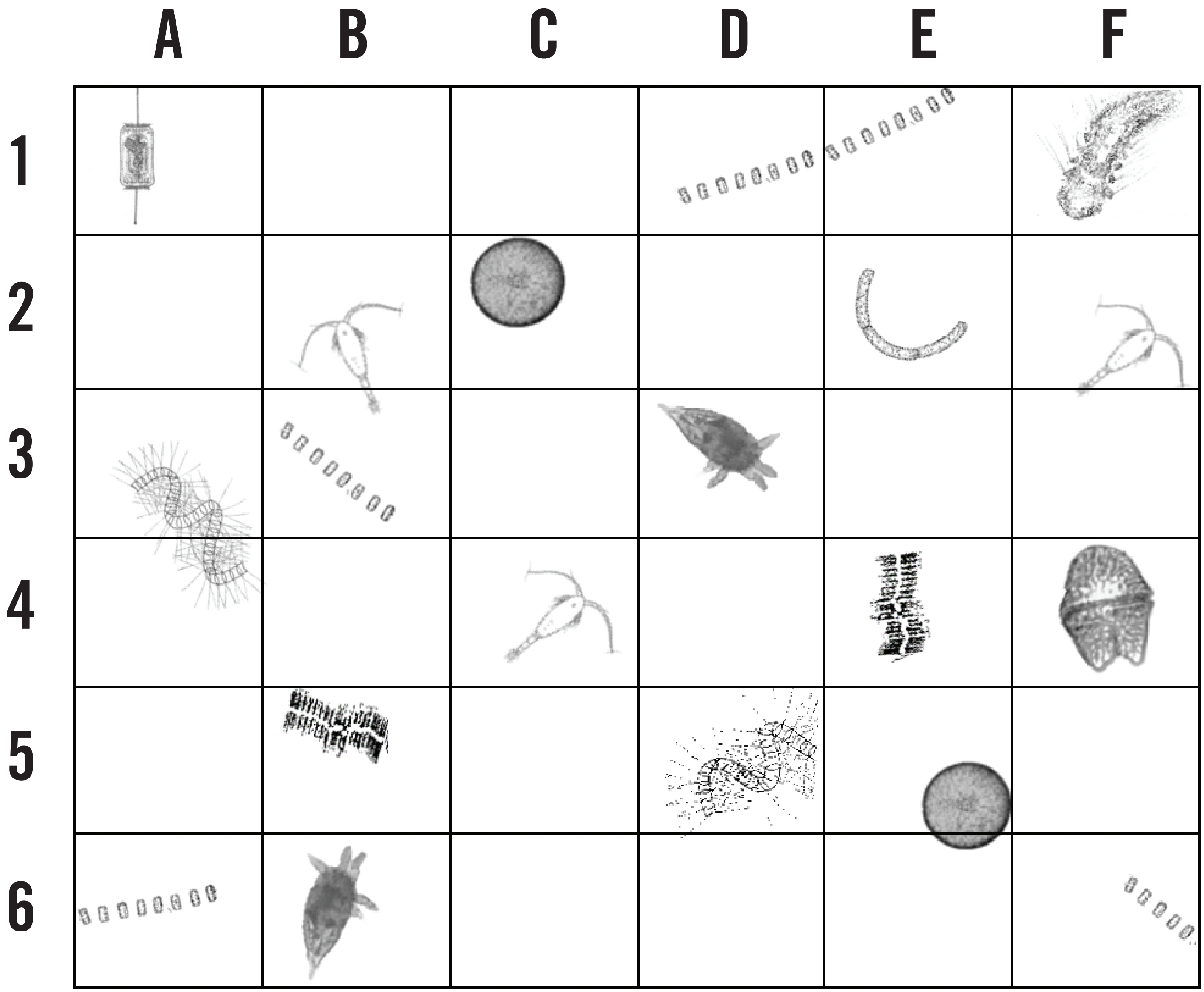
Plankton slide 1



Cut this circle to make your microscope eyepiece!

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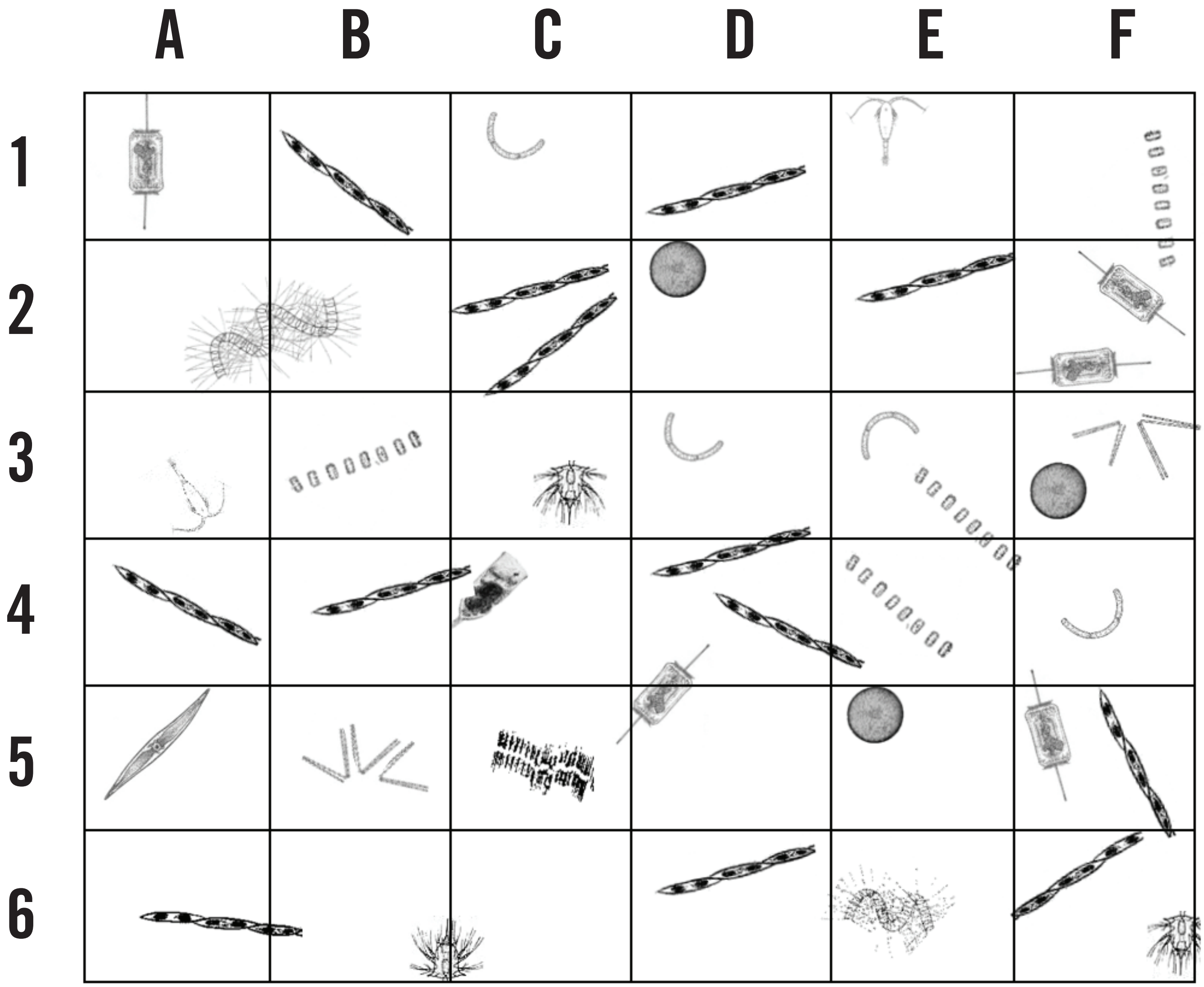
Plankton slide 2



Cut this circle to make your microscope eyepiece!

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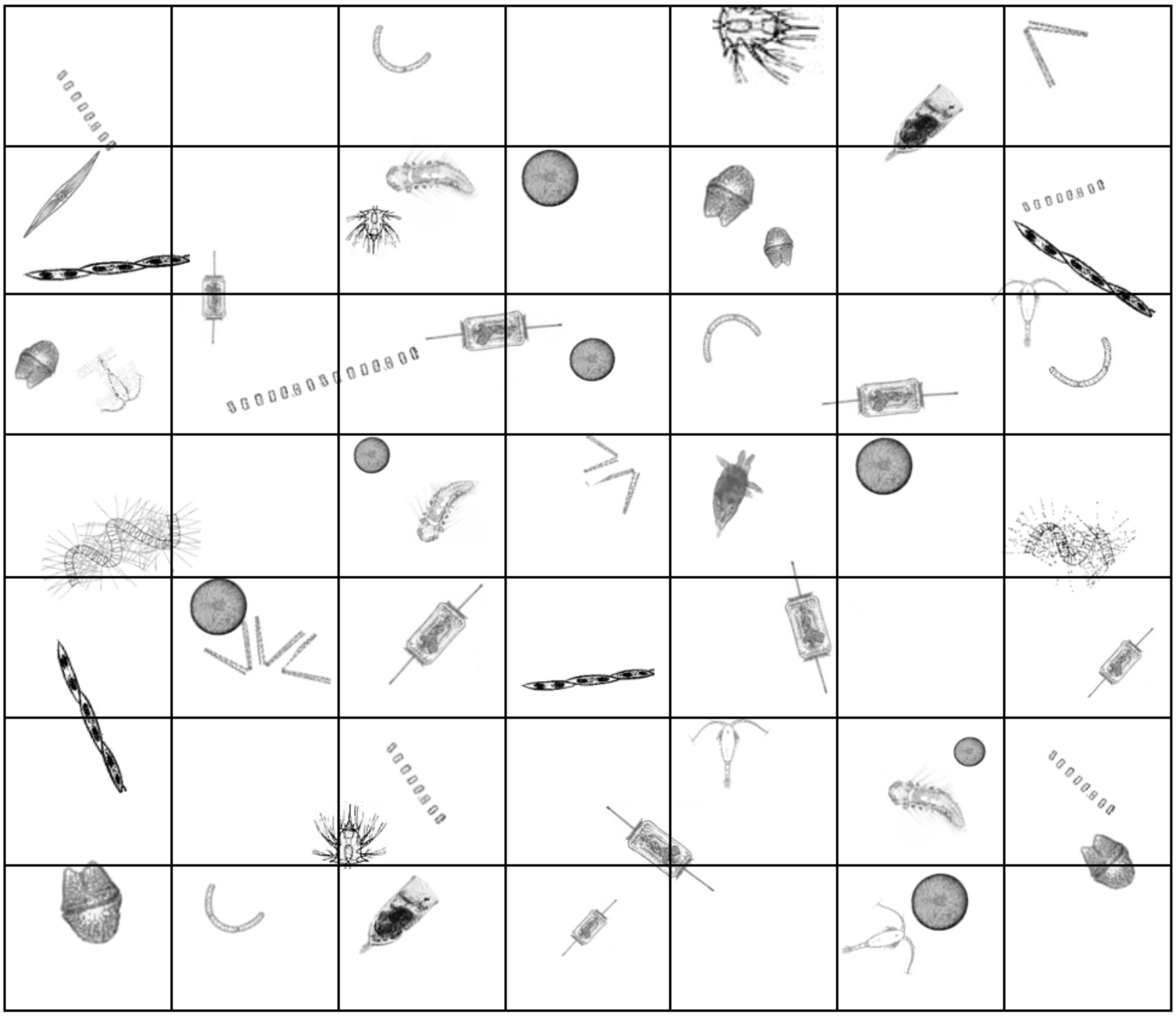
Plankton slide 3

A B C D E F G

1 2 3 4 5 6 7



Cut this circle to make your microscope eyepiece!

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Data Collection Sheet

PHYTOPLANKTON		ZOOPLANKTON	
Chaetoceros sp.	_______	Adult copepod	_______
Odontella sp.	_______	Copepod nauplius	_______
Pleurosigma sp.	_______	Megalops	_______
Thalassionema sp.	_______	Polychaete worm larva	_______
Skeletonema sp.	_______	Zoea	_______
Rhizosolinea sp.	_______	Tunicate (sea squirt) larva	_______
Guinardia sp.	_______	Rotifer	_______
Ditylum sp.	_______	Fish larva	_______
Navicula sp.	_______	Veliger larva	_______
Prorocentrum	_______	Cypris larva	_______
Pseudo-nitzschia sp.	_______	Barnacle nauplius	_______
Triceratium	_______	Tintinnid	_______
Asterionellopsis	_______	Hydroid medusa	_______
Bacillaria sp.	_______	Adult Oikopleura sp.	_______
Striatella sp.	_______		
Eucampia sp.	_______		
Coscinodiscus sp.	_______		
Nitzschia sp.	_______		
Ceratium furca	_______		
Dinophysis spp.	_______		
Ceratium longpipes	_______		
Akashiwo sanguinea	_______		
Protoperidinium sp.	_______		

Should this sample be sent to NOAA PMN for further HAB investigation?

YES _______ **NO** _______

ANSWER KEY - Plankton slide 1

PHYTOPLANKTON	
Chaetoceros sp.	2
Odontella sp.	0
Pleurosigma sp.	0
Thalassionema sp.	0
Skeletonema sp.	4
Rhizosolinea sp.	0
Guinardia sp.	1
Ditylum sp.	1
Navicula sp.	0
Prorocentrum	0
Pseudo-nitzschia sp.	0
Triceratium	0
Asterionellopsis	0
Bacillaria sp.	2
Striatella sp.	0
Eucampia sp.	0
Coscinodiscus sp.	2
Nitzschia sp.	0
Ceratium furca	0
Dinophysis spp.	0
Ceratium longpipes	0
Akashiwo sanguinea	1
Protoperidinium sp.	0

ZOOPLANKTON	
Adult copepod	3
Copepod nauplius	2
Megalops	0
Polychaete worm larva	1
Zoea	0
Tunicate (sea squirt) larva	0
Rotifer	0
Fish larva	0
Veliger larva	0
Cypris larva	0
Barnacle nauplius	0
Tintinnid	0
Hydroid medusa	0
Adult Oikopleura sp.	0

Should this sample be sent to NOAA PMN for further HAB investigation?

YES ________ NO __X__

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ANSWER KEY - Plankton slide 2

PHYTOPLANKTON		ZOOPLANKTON	
Chaetoceros sp.	2	Adult copepod	2
Odontella sp.	0	Copepod nauplius	0
Pleurosigma sp.	1	Megalops	0
Thalassionema sp.	2	Polychaete worm larva	0
Skeletonema sp.	4	Zoea	0
Rhizosolinea sp.	0	Tunicate (sea squirt) larva	0
Guinardia sp.	4	Rotifer	0
Ditylum sp.	5	Fish larva	0
Navicula sp.	0	Veliger larva	0
Prorocentrum	0	Cypris larva	0
Pseudo-nitzschia sp.	13	Barnacle nauplius	3
Triceratium	0	Tintinnid	1
Asterionellopsis	0	Hydroid medusa	0
Bacillaria sp.	1	Adult Oikopleura sp.	0
Striatella sp.	0		
Eucampia sp.	0		
Coscinodiscus sp.	3		
Nitzschia sp.	0		
Ceratium furca	0		
Dinophysis spp.	0		
Ceratium longpipes	0		
Akashiwo sanguinea	0		
Protoperidinium sp.	0		

Should this sample be sent to NOAA PMN for further HAB investigation?

YES __x__ NO ______

ANSWER KEY - Plankton slide 3

PHYTOPLANKTON	
Chaetoceros sp.	2
Odontella sp.	0
Pleurosigma sp.	1
Thalassionema sp.	3
Skeletonema sp.	5
Rhizosolinea sp.	0
Guinardia sp.	4
Ditylum sp.	8
Navicula sp.	0
Prorocentrum	0
Pseudo-nitzschia sp.	4
Triceratium	0
Asterionellopsis	0
Bacillaria sp.	0
Striatella sp.	0
Eucampia sp.	0
Coscinodiscus sp.	7
Nitzschia sp.	0
Ceratium furca	0
Dinophysis spp.	0
Ceratium longpipes	0
Akashiwo sanguinea	5
Protoperidinium sp.	0

ZOOPLANKTON	
Adult copepod	4
Copepod nauplius	1
Megalops	0
Polychaete worm larva	3
Zoea	0
Tunicate (sea squirt) larva	0
Rotifer	0
Fish larva	0
Veliger larva	0
Cypris larva	0
Barnacle nauplius	3
Tintinnid	2
Hydroid medusa	0
Adult Oikopleura sp.	0

Should this sample be sent to NOAA PMN for further HAB investigation?

YES ______ NO __x__

APPENDIX

How to collect plankton samples by pulling a plankton net

Photo credits: Rachel Wilson, Marine Education Fellow, UGA Marine Extension and Georgia Sea Grant

Attach a clear bottle to the end of the plankton net. The phytoplankton will be caught in the bottle.

Lower the entire net into the water so the bottle fills with water. Bob it up and down a few times to eliminate any air bubbles that might form.

Drag the net in the upper water column, ensuring the net never comes out of the water. Do this for 3 minutes.

Pull the plankton net out of the water, hold the net about 6 inches above the bottle, and wash down any extra plankton that might be on the net by quickly tilting the bottle upside down. Do this 2-3 times.

Here is the plankton sample! It is ready to be taken back to the lab for further investigation under a microscope.