# Lab 5 – Investigating density and stratification in the ocean

Name: Section number \_\_\_\_\_\_\_\_\_\_\_\_\_

Complete the lab and use this form as your answer sheet. Type answers in the Text boxes which will expand as you type in them

## 5.0 Introduction

1. Describe the basic characteristics of a temperature-versus-depth profile at a temperate or mid-latitude location like that shown in Figure 5.0.2.

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1. Based on Figure 5.0.2, where do you think you would find the most dense water and where would you find the least dense water? [Describe using depth (m)].

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1. Do you think that the density will change with seasons? If so, why?

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## Lab 5.1 – What is the relationship between temperature, salinity and density?

1. Make your density profile predictions for each month by clicking on the small blue circles on the dashed line and dragging them left or right to change the density to what you believe it should be. Describe the approach or steps you took in predicting the shape of the density profile you “drew”. [insert a screen shot of your drawing below your description of steps]:

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1. Click on “Show Density” to check your predictions. How do the density profiles you drew differ from the calculated density profile for each month?

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1. Why do you think your predictions did or did not match the calculated density profile?

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1. What is the depth range (in meters) of the pycnocline in October? How does the pycnocline relate to the thermocline and the halocline?

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# Lab 5.2 – What seawater property (temperature or salinity) is most important in determining density at different locations?

1. Does temperature or salinity have more of a controlling effect on seawater density in the Irminger Sea (sub-polar)? Explain how you came to this conclusion.

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1. Does temperature or salinity have more of a controlling effect on seawater density at the Coastal Pioneer mooring (temperate region)? Explain how you came to this conclusion.

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1. Use the density equation Density = Mass/ Volume to explain how a change in seawater temperature can increase seawater density. Do temperature and density have a direct or inverse relationship?

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1. Use the density equation above to explain how a change in seawater salinity can increase seawater density. Do salinity and density have a direct or inverse relationship?

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1. Use the density equation above to explain how a change in pressure or depth can increase seawater density. Do temperature and density have a direct or inverse relationship?

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1. Which of the three factors (temperature, salinity or pressure) is the primary control on the density of seawater in most of the surface ocean?

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1. Which of the three factors (temperature, salinity or pressure) is the primary control on the density of seawater in most of the deep ocean?

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## Lab 5.3 – Comparison of temperature, salinity, density and stratification at polar and temperate locations

1. Are surface ocean temperatures higher in January (a winter month) or July (a summer month) at Coastal Pioneer? List the temperature for each month. Is this what you would expect given the location of Coastal Pioneer?

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| January |  | *Is it what you would expect?* |
| July |  |

1. Are surface ocean temperatures higher in January (a summer month) or July (a winter month) at Global Argentine? List the temperature for each month. Is this what you would expect given the location of Global Argentine?

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| January |  | *Is it what you would expect?* |
| July |  |

1. Describe how temperature changes with depth at Coastal Pioneer in July (a summer month). Be specific.

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1. Describe how temperature changes with depth at Coastal Pioneer in July (a summer month). Be specific.

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1. Describe how salinity changes with depth at Coastal Pioneer in January (a winter month) and July (a summer month). Be specific.

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1. Describe how density changes with depth at Coastal Pioneer in January (a winter month) and July (a summer month). Be specific.

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1. Describe how temperature, salinity, and density change with depth at Global Argentine in January (a summer month) and July (a winter month). Be specific.

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1. Which ocean location is the saltiest at the surface? Freshest at the surface? Propose an explanation why one location is saltier than the other.

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| Saltiest: |  | *Why?* |
| Freshest |  |

1. During which season (summer or winter) is the stratification or change in density with water depth the strongest at each location? Recall that seasons are reversed in the Southern Hemisphere.

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| Coastal Pioneer: |  |
| Global Argentine: |  |

1. Which of the locations shows the greatest stratification or change in density with water depth to 100 m?

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1. Propose an explanation for the vertical density structure you observed at each ocean location.

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| Coastal Pioneer: |  |
| Global Argentine: |  |

1. Describe the stability of the water column at the Coastal Pioneer Array in April and October. Is overturning and mixing a possibility? Why or why not?

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## Lab 5.4 – How does salinity and temperature change with water depth over time?

1. Does the depth range of the thermocline, halocline, and surface mixed layer change throughout the year with the seasons? If so, how?

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1. Suggest an explanation for the differences in the depth of the thermocline and the surface mixed layer between the winter and summer.

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1. Describe how the seasonal thermocline changes during the year at a temperate location.

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1. Primary production in the ocean is limited to the euphotic zone - the layer of seawater that receives enough sunlight for photosynthesis to occur. The depth of the euphotic zone varies with season and location, from a few meters in coastal waters to 100s of meters in the tropical open ocean. Phytoplankton, the group of organisms responsible for most of the photosynthesis in the ocean are drifters and unable to swim against ocean currents or between strong gradients in density. These organisms can be “mixed” with seawater layers.
   1. How would you expect the depth of the thermocline to influence the ability of the phytoplankton to stay in the euphotic zone?

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* 1. During which season (summer, fall, etc.) would you expect water column stratification to be the most beneficial for phytoplankton primary production? Explain why.

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1. Global ocean conveyor belt circulation is driven by slight differences in seawater density as the density of seawater determines its tendency to move vertically. At what latitudes is water column instability great enough to result in the sinking of surface waters to thousands of meters of depth?

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1. As our planet warms, polar surface seawater is getting warmer and fresher. What impact could this have on the density structuring or stratification in the ocean? On the stability of the water column at polar latitudes and ocean conveyor belt circulation?

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