Vertical Water Column Description

Objective
To determine if a water mass is mixed or stratified by acquiring and analyzing a vertical set of temperature, salinity, and dissolved oxygen measurements.

Correlations
National Science Education Standards
Grades 5-8: A, B, D, E
Grades 9-12: A, B, D, E

California State Science Education Standards
Grade 6: 3a, c, 7a-e
Grade 7: 6f, 7a, c-e
Grade 8: 8c-d *(if discussion includes how salt and temperature affect density of a water mass)*, 9e
Grades 9-12: Biology/Life Sciences: 6a, Earth Sciences: 5d, Investigation and Experimentation: 1a, b, c, d

Ocean Literacy Principles and Fundamental Concepts: 1 & 7

Background
Lakes, estuaries, and oceans all contain examples of how water masses of different densities stay separate and form layers (stratification). Scientists can determine whether or not there is a lot of mixing going on in the water column by measuring salinity, temperature, dissolved oxygen, and other parameters in a vertical transect of the water column. When scientists conduct these vertical profiles and find that the parameters they are measuring are consistent throughout the entire depth of the water column, then the water is said to be 'well mixed'. However, if there are differences in the parameters (e.g. temperature, salinity, density) at different depths, then the water column is said to be 'stratified', or not well mixed. Whether or not the water column is mixed has strong implications for the organisms living in this environment. For example, the main source of oxygen to bottom water is from mixing with surface water, which is oxygenated by direct contact with the air. If there is no mixing, oxygen is depleted from the bottom water and organisms will either move away or die.

Optional:
You can compare field data with those data from ocean observing systems in a companion web-based activity called "Density Webquest" to assess the advantages and disadvantages of the two methods of data collection.

Materials
- Boat (or it may be possible to sample off of a pier)
- an instrument that records the measurements for parameters in which you are interested (there are many types of instrument packages that will work for this, some companies include YSI and Seabird)
- Datasheet

Procedure
1. Select a station in a body of water with a depth of at least 10 meters.

2. Record latitude and longitude. Observe weather conditions and record on worksheet.

3. Using an instrument that measures conductivity (from which you can calculate salinity), temperature, and dissolved oxygen, set the instrument to collect data continuously and lower the instrument through the water column from which you want to take measurements.

4. Record your data on the worksheet provided or create your own to accommodate all of your data.

5. Plot your data. You may want to plot all of your variables as they vary with depth on the same graph so that you can compare them. Create a legend for different data sets. You will have to create different scales for the axis where you will display the variables. Ocean depth is usually graphed so that the surface or zero meters is at the top of the graph with the greater depths towards the bottom of the graph.

If you enter the data into a spreadsheet program, you can plot and compare it in different ways.

Questions
1. What is the range of values for each parameter? Are any of the values unusual or different from what you expected?

2. What patterns or shapes do you see in your graph?

3. Do any or all of your datasets have similar patterns?

4. Was the water column mixed or stratified?

5. What features (curves, shapes) of the graph helped you determine your answer?

6. Compare the datasheet and the graph. Is it easier to compare the patterns or trends in the data from the datasheet or the graph?

Glossary

thermocline: a zone in a body of water in which temperature changes rapidly with depth.

halocline: a zone in a body of water in which salinity increases rapidly with depth.

pycnocline: a zone in a body of water in which the density changes rapidly with depth. In the ocean, temperature falls and salinity rises as you descend through this zone.

oxygen minimum zone: a zone in which oxygen is depleted by animals and not replaced by phytoplankton.

Vertical Water Column Description Datasheet

Date: _____ Start Time: _____

Station:_____

Latitude, Longitude: _____, _____

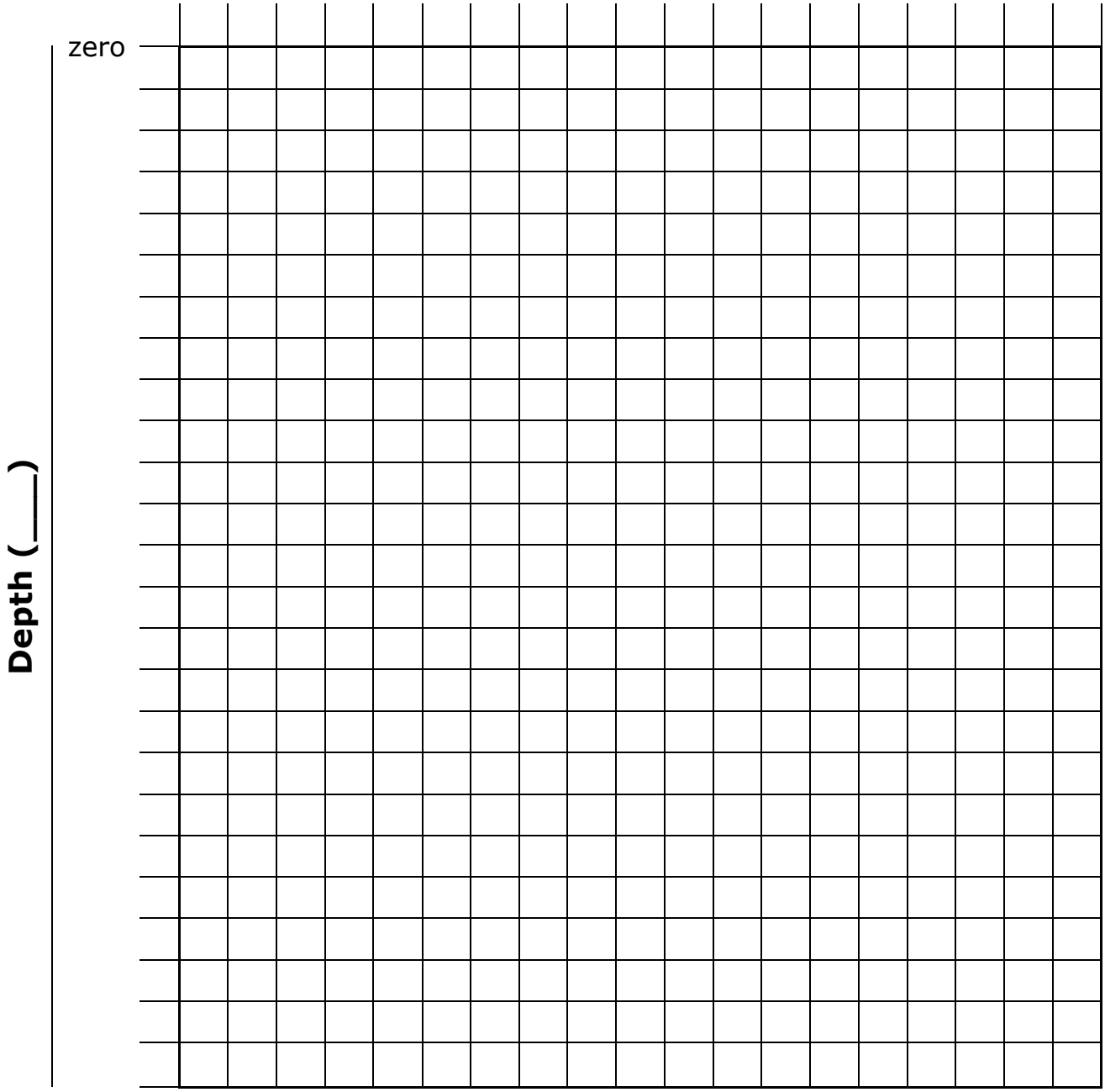
Weather: _____

Team Members: _____

Depth (m)	Time	Temperature (°C)	Oxygen (mg/L)	Salinity (PSU)

Parameters measured:

	Temperature (°C)
	Oxygen (mg/L)
	Salinity (PSU)



Describe your graphs and explain what they tell you about the water column.