Diving with Gliders

*Carmelina Livingston, Steve Seal, Anne McCarthy*

Summary

Students will use the Phoebe Glider to explore the concepts of scale and slope. Using real-time data from the CMOP website, students will create tables and graphs.

Key Concepts

* Students will read and interpret tables.
* Students will manipulate scale of graphs.
* Students will create tables.
* Students will calculate slope.

Objectives

Include clear, measurable statements of what students will be able to do, such as:

* ***Observe*** and ***identify***key components of data in graphs and tables.
* ***Record*** times and depth of the Phoebe glider.
* ***Demonstrate***graphing and plotting the Phoebe data.
* ***Communicate*** the meaning of slope, scale, and depth.

Materials

* Voicethread
* Data print out for each group
* Butcherblock paper for each group
* Calculators
* Meter sticks (optional, can use to bring relevance to measurements)

Before the lesson:

* If possible, complete the “Ocean Observing with Gliders” lesson to let students explore how gliders work before graphing.
* download the data, break each dive and rise into separate print outs for group.
* Go to the CMOP website, select Data>Campaign Data
* Then select *glider data*.
* Under the products tab, chose a mission.  Set the x-axis to time and y-axis to depth.  Click *Download.* This will open a file in Excel.  It has all the measurements taken. Select a few dives and print this for each group.
* Now click *Plot Data.*Keep this graph on screen for final discussion with students.
* The glider “Phoebe” collects data only on dives about every 8 seconds.  The glider does record its location, time and depth on the ascent.  Students will need to use scales of 8 secs (or a multiple) to have an accurate meter/second slope.   The maximum depth of the glider is 200m.

Procedure:

1. Introduce students to concept of gliders using voicethread with videos and graphics explaining gliders and ocean observing:
2. Use google earth to fly into Astoria, OR and the zoom to actually glider track. Then show the next animation about diving.
3. [http://planetearth.nerc.ac.uk/images/uploaded/custom/glider3.gif](https://www.google.com/url?q=http://www.google.com/url?q%3Dhttp%253A%252F%252Fplanetearth.nerc.ac.uk%252Fimages%252Fuploaded%252Fcustom%252Fglider3.gif%26sa%3DD%26sntz%3D1%26usg%3DAFQjCNETJZbLD_3Iej3oFWO9N9_YgcdDdg&sa=D&ust=1500589186259000&usg=AFQjCNGIUGyerPY5ntHRzMxJLiGgHPahOQ)
4. This could be done from home if all students have computer access and have students comment on voicethread.
5. Explore the Excel data together.
6. What data is the glider always recording?Why does some of the data have *nan*?  When does the glider collect data?
7. Break students into groups, assign each group a set of data that has one dive and one climb.
8. Have students create a table that will have 20 points.  Have students create a scale in seconds that will accommodate the entire dive, have students create a scale in meters that will accommodate the entire dive.  Make sure the data is on the poster.
9. Have students graph time points and depth.
10. What do we plot on the x-axis? Why?
11. Group 1: shallow dive, Group 2: medium dive, Group 3: deep dive
12. What is depth measuring? When the line segment is increasing which direction is the glider moving? When the line segment is decreasing which direction in the glider moving? Does the direction of the line segment match the direction of the glider’s motion in the water? why or why not?
13. Calculate slope. (Because this is real data, it is not a perfect line.)
14. Discuss the idea of a ‘best fit line’.
15. What does slope show? What is the unit of our numerator? What is the unit of our denominator? What does meters per second show?
16. Have groups post their table and graph. Have students do a gallery walk and make observations comparing the different tables and graphs.
17. Which graph do you think is the steepest dive? How can we tell? How does the scale change based on the dives? How does this affect how the graph looks?
18. Show the graph of the data.  Discuss the similarities and differences of the students graphs (note the negative on depth!)
19. Assesment: Have students write a paragraph reflecting on the glider and graphs.  Note any key discoveries, challenges and observations.

Assessment

* **Performance—**Students will work in groups using dive data to create and calculate tables, graphs and slopes.
* **Product—**Students will have a poster with the table and graph for three distinct dives. Students will also have a written reflection.
* Assessment will be informally observed through group work and discussion.
* Assessment will be collected through the poster and write up.

Additional Resources

VoiceThread [https://voicethread.com/#home](https://www.google.com/url?q=http://www.google.com/url?q%3Dhttps%253A%252F%252Fvoicethread.com%252F%2523home%26sa%3DD%26sntz%3D1%26usg%3DAFQjCNHpaNjoCuxMQ8PPalvJmM2rKBH_6w&sa=D&ust=1500589186262000&usg=AFQjCNG0iuuhsa-kJwBSnygzza1CrQ7FwA)

Center for Coastal Margin Observation and Prediction [http://www.stccmop.org/](https://www.google.com/url?q=http://www.google.com/url?q%3Dhttp%253A%252F%252Fwww.stccmop.org%252F%26sa%3DD%26sntz%3D1%26usg%3DAFQjCNG3ZlpDJA-GLwwR21mjF9FbDDjrMg&sa=D&ust=1500589186262000&usg=AFQjCNF0bqlRyeZbOaBwaIZ0ItssTZ09fA)

More resources on Gliders:[http://www.mbari.org/earth/2010/resources10.html](https://www.google.com/url?q=http://www.google.com/url?q%3Dhttp%253A%252F%252Fwww.mbari.org%252Fearth%252F2010%252Fresources10.html%26sa%3DD%26sntz%3D1%26usg%3DAFQjCNHZ3fwqAKF8yaRhLOYJs0WR77n3Rg&sa=D&ust=1500589186263000&usg=AFQjCNE1CrWQn3e3DpRlC0zdgGLclXe_zg)

Extensions:

-Graph in Excel.

-Use another glider from [http://cencoos.org/sections/data/glider/index.html](https://www.google.com/url?q=http://www.google.com/url?q%3Dhttp%253A%252F%252Fcencoos.org%252Fsections%252Fdata%252Fglider%252Findex.html%26sa%3DD%26sntz%3D1%26usg%3DAFQjCNH96PzCzvJ01Jpj89gmAHSYz6yq5g&sa=D&ust=1500589186263000&usg=AFQjCNE6VIMDhsK6Oyf4RLJP1gDEy-aKjg) and graph both together to compare.

-Graph other data from the Phoebe data (depth and temp, depth and salinity, etc.) and calculate slope.

-Create the equation for the line and see if other points fit.  Discuss the best fit line.

-Calculate slope using 2 other points, and compare.

Got time?

If you have time before your presentation, it would be helpful for me for you to provide

* National Council of Teaching Mathematics Standards:
* Analyze change in various context
* Use mathematical models to represent and understand quantitative relationships.
* Understand patterns, relations and functions.