### Student Directions

**Virtual Teachers:** Make a copy of the Google Form of your choice so that you may assign it directly from your Google Drive into your Learning Management System (e.g., Google Classroom, Canvas, Schoology, etc.). Do you need help incorporating these Google Forms into your Learning Management System? If so, read this [Guide to Using Google Forms with My NASA Data](#).

**Directions:**

1. Review the Chlorophyll Concentration map below.
The chlorophyll concentration data shown here were obtained from global satellite measurements by the SeaWiFS and MODIS-Aqua projects of the National Aeronautics and Space Administration (NASA). Credit: NASA, NOAA, GlobalChange.gov

2. Students analyze locations 1-6 to determine how the chlorophyll values for these locations have changed over the last 20 years. Do not spend time analyzing the mapped image here; only focus on the location of these sites.

3. Select one location site to analyze to maximize time. Students may use the Graph Cube to help with data analysis.

- 1 Cube per group/student
  - Consider using Virtual Dice in place of dice/cubes
- 1 matching Question Sheet per group/student

4. Students analyze their graph and report their findings to the class using the Identify and Interpret (I²) strategy:
   1. Students work together to:
      1. **Identify** changes, trends, or differences of the chlorophyll concentrations on their graph and draw an arrow to each observation with a "What I See" comment.
      2. Next, students **interpret** their observations by drafting a "What It Means" comment for each.
      3. Next they write a caption under the graph to help remind them of their interpretation of the graph as a whole.
   2. If you have copies of the graphs for the students, direct them to draw arrows and draft comments on and around the graph in order to create connections to the graph they are analyzing.

5. Present the graphs individually or collectively as the graph below shows. Individual graphs
6. Share your findings and $I^2$.
7. Answer the following questions:
   1. What similarities do you observe among the different locations? What differences?
   2. What inferences can you make about the causes of these differences?
   3. Why are these data important?

Note: NASA satellites measure large areas of the world's ocean and have the ability to make these observations frequently, which is useful for evaluating long-term changes. There is one limitation that students should be made aware of is the trade-off of being only able to measure chlorophyll concentrations near the ocean's surface. This could potentially underestimate the total amount of phytoplankton found in all water depths.

Teachers, these mini lessons/student activities are perfect "warm up" tasks that can be used as a hook, bellringer, exit slip, etc.

Teachers who are interested in receiving the answer key, please contact MND from your school email address at larc-mynasadata@mail.nasa.gov. We verify that requestors are teachers prior to sending access to the answer keys as we've had many students try to pass as teachers to gain access. To receive the keys please provide the following:

1. The link to the school/institution's teacher directory where you are employed so we can verify that you are a teacher
2. Ensure that the school email address is provided in your response as we are unable to send to personal email accounts

Access and Explore Data

- Chlorophyll Concentration (milligrams per cubic meter)