Creating Testable Questions

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| **Category** | **Original Question** | **Things to Change** | **Potential Better Question** |
| ***HF Radar*** | How does current change in the canyon? | Specificity-what about current? Direction? Speed?  Need an independent variable  Time oriented | How does the current speed along the Palmer Deep Canyon change at a given time in February 2015? |
| ***Glider*** | Is there chlorophyll at the surface of the ocean? | Needs to be more specific--when and where?  Add an independent variable to examine what affects the chlorophyll present | How did the depth of the mixed layer water around Palmer Station affect the chlorophyll concentration present in 2015? |
| How does wind affect salinity? | Needs to be measurable (what about the wind--speed, direction)?)  Time and space oriented (Over what time frame? At what depth?) | How does the wind speed over Palmer Deep Canyon affect the salinity at 80-90 m during summer 2015? |
| How does water temperature change over time? | More specific in time and space. | How does the water temperature (degrees celsius) at Palmer Deep Canyon change from January 2015 to February 2015 at 80-90m? |
| ***Palmer Penguins*** | How much time do penguins spend searching for food? | Needs to be more specific (species, sex, time, location). | How does the species of penguin (Adelie vs Gentoo) affect foraging time from January 2015 to February 2015 in Palmer Deep Canyon?  How does the sex of the penguin (male or female) affect foraging time from January 2015 to February 2015 in Palmer Deep Canyon? |

**Model Data Lessons**

**Each lesson should take about 40 minutes, be assessed by worksheets/questions in each; put standards in teacher guides**

* **Lesson #1**: **Introduction and Modeling**
  + Introduce Antarctica: Identify region on map, give background information for who/what is there, meet scientists, etc.
  + Show models to introduce phenomena--have students make observations about what they see to identify things that are special about this region; why did we go here (big picture)
  + Can you “see” hotspots?
  + Each group looks at one of the models and shares out
  + Discussion questions to address for each model:
    - Model with Dye/circumpolar deep water
    - Model with salinity (surface and cross section)
    - Model with temperature (surface and cross section)
    - Model with vectors (at two depths): predict how this would affect movement of phytoplankton, krill
    - We want: CSV file with data so students can make graphs from Mike, with certain frames, at fixed Z depth
  + Show Tools of Science Video about modeling
* **Lesson #2: Abiotic Factors that help establish hotspots: Station activity**
  + Density/salinity tanks
  + Density/Temperature tanks
  + Canyons in pie pan with confetti, blow with straws (currents)
    - Eddy
  + Reynold’s number demonstration (water, oil, honey, PB)
* **Lesson #3: Biotic factors that utilize hotspots**
  + Tools for measuring: videos of gliders, CODAR, tagging, echolocation
  + Foraging activity--with beads and convergent zone
    - Introduce food web concept
    - Eat at hotspots
* **Lesson #4: Flow chart/graphic organizer/Food web**
  + Cards with organisms and measurement tools (need to add)
  + Pictures on front, blurb about organism on back
* **Lesson #5: Intro to testable questions**
* **Lesson #6: Playing with glider data**
* **Lesson #7: Revisiting testable questions by looking at data**
* **Data Jam (lessons 8 & 9): students get codar and penguin data to engage in data jam activities**
* Then into testable questions, data, videos, dataJam
  + Rubric-based assessments here
* At end: Value that models add--what sort of model would you want after asking your testable question?

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