**Revising Science Investigation Questions**

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| **Category** | **Original Question** | **Things to change** | **Potential Better Question** |
| **Sea Ice** | Is there less sea ice today than in the past? | A closed question (yes or no answer).  More specific in time and space.  Define variables. | How has sea ice cover changed in the Western Antarctic Peninsula over the last 50 years?  What is relationship between air temperature (oC) and % sea ice cover on the Western Antarctic Peninsula over the past 50 years? |
| Does sea ice change throughout the year? | A closed question (yes or no answer).  More specific in time and space.  Define variables. | What is the relationship between time of year and amount of sea ice cover (%) around Palmer Research Station?  How does sea ice cover change in relation to monthly air temperature on the WAP? |
| When is Antarctica the warmest? The coldest? | Need where, what and when more specific. | What is the relationship between time of year and air temperature around Palmer Research Station? |
| What month has the greatest amount of ice cover? | Need where, what and when more specific. | What is the relationship between time of year and amount of sea ice cover (%) around Palmer Research Station?  How does sea ice cover change in relation to monthly air temperature on the WAP? |
| **Weather** | Is Antarctica getting warmer? | Need where, what and when more specific. | How has the air temperature changed around Palmer Research Station over the last 50 years? |
| Is there more precipitation when the temperature is higher or lower? | More specific in what, where and when. | What is the relationship between precipitation and air temperature over the year around Palmer Research Station? |
| What is the warmest and coldest month of the year? | More specific in what, where and when. | What is the month-to-month variation in air temperature around the Western Antarctic Peninsula? |
| How much precipitation is there in Antarctica? | Needs when, where, and variable more specified | How has the total precipitation per year changed on the West Antarctic Peninsula over the past 3 decades? |
| **Zooplankton** | What is the most abundant zooplankton? | Need to specify where and when. Also be more specific about how looking at abundance. | What was the most abundant zooplankton species around Palmer Research Station between 1990-2010? |
| Do the numbers of zooplankton change throughout the year? | Need specify where and be more specific about taxa. | How does the abundance of zooplankton [salps? Other groups?] vary over the year around Palmer Research Station? |
| Where do you find the most zooplankton? | Needs when & where specified | At what depth are the most abundant zooplankton species in the summer along the West Antarctic Peninsula found? |
| Do zooplankton follow their food? | Information on what food they mean and there is no spatial information given. | Along the West Antarctic Peninsula, over the course of one year, are the largest populations of zooplankton found at depths where the chlorophyll levels are the highest during the day? |
| Do zooplankton explode under the pressure? | Needs when, where, and variable more specified | At what depths are salps found throughout the year along the West Antarctic Peninsula? |
| **Penguins** | What do Adelie penguins eat? | Needs to be more specific about how looking at diet, when, and where. | How did the composition of the diet by weight of Adelie penguins differ between 1991-2000 and 2001-2010 on Torgesen Island? |
| Are Adelie penguin populations decreasing? | Needs where and when specified | How has the abundance of Adelie penguins changed over the past 25 years around Palmer Research Station? |
| How many baby penguins are in Antarctica? | Needs where and when specified | How has the abundance of Adelie penguin chicks changed over the past 25 years around Palmer Research Station? |
| Where do you find the most Adelie penguins? | Needs where and when specified | How did the abundance of Adelie penguins vary across the different colonies around Palmer Research Station in 2014-15? |
| How much do penguins eat? | Needs when, where, and variable more specified | How does the total weight of what Adelie penguin eat vary among the primary diet items around Palmer Research Station between 2000-2010? |
| **Bacteria** | What bacteria can you find in Antarctic waters? | Needs when, where and variable more specified | How did the composition of bacteria differ among six cruise stations in 2012? |
| Where can you find bacteria in Antarctic waters? | Needs where and when specified | How has the abundance of bacteria varied across the area around Palmer Research Station between 2003-2012? |
| How many bacteria are there over the year? | Needs where and variable more specified | How did the total abundance of bacteria change each year from 2003-2012 around Palmer Research Station? |
| How many bacteria are bad for health of the water? | Needs when, where, and variables more specified | How did the number of bacteria relate to the number of phytoplankton, zooplankton, or penguins at the ocean surface around Palmer Research Station between 2003-2012? |
| Do bacteria freeze? | Needs variables more specified | How does the total abundance of bacteria around Palmer Research Station relate to the temperature of the water at 4 locations and depths between 2003-2012? |
| **Phytoplankton** | Where can you find phytoplankton in Antarctic waters? | Needs when and variable more specified | Where were the areas of highest chlorophyll concentration between 1991 to 2015 along the West Antarctic Peninsula? |
| How much phytoplankton is there over a year? | Needs where and variable more specified | How has the chlorophyll concentration varied over a year around Palmer Research Station between 1991-2015? |
| How much phytoplankton is there in Antarctica? | Needs when and where specified | How has the annual total chlorophyll concentration from throughout the West Antarctic Peninsula changed from 1991 to 2015? |
| Do phytoplankton like warm or cold water? | Needs when and where specified | Around Palmer Research Station between 2010-2015, how does the chlorophyll concentration throughout the year relate to the water temperature at that location? |