**Data Science in Global Health**

## **Part I: Investigable Questions and Identifying Variables**

**Overview**

For this lesson, the class will be divided into groups. Each group will be assigned a city in Washington and given some data on air pollution for their city. By graphing the data, you will find out if there is a relationship between the time of year, or season, and the amount of air pollution for your city. Once all groups have determined this for their city, we will see if any trends or patterns can be observed across cities in Washington by compiling our data. You will then write a claim and support it with data to answer the investigative question.

**Investigative Question**

*Is there a relationship between the time of year/season and the amount of air pollution in Washington?*

The city our group is investigating is: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1) With your group, discuss the following questions before writing your answers.

1. What is the *changed* variable in this investigative question? (also known as the independent variable or manipulated variable). In other words, the variable that is *affecting* the other variable.
2. What is the *measured* variable? (also known as the dependent or responding variable). In other words, the variable that is *being affected* by the changed variable.
3. What are some things that you think the scientists who measured the air pollution in your city had to control, or keep constant, in order to get data that is a fair test of the time of year’s effect on the amount of air pollution?

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2) What is your hypothesis, or prediction? Do you think that the time of year/season affects the amount of air pollution in Washington? Explain your thinking.

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**Part II: Graphing Data to See Patterns**

**Overview**

It’s hard to see any patterns, or relationships, from raw data. Graphing data makes it easier to see any patterns. Discuss what type of graph you think will best represent your data in order to answer the investigative question. You might choose to make three separate graphs or one graph to represent the data for all two or three years. Once you’ve agreed as a group, use the data table to make a graph of your data on the next page. Then use your graph to answer the graph analysis questions.

Things to remember when making your graph:

* The changed variable typically goes on the x -axis
* The measured variable typically goes on the y-axis
* Label your x axis and y axis
* Use different colors to represent different years
* Include a title for your graph
* Include a legend (or a key) for your graph
* If you have missing data in your data set (labeled N/A) just leave that month blank.

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Graph Analysis

Discuss each question with your group before writing your response.

1. Which month had the highest measured air pollution in (for the years available)….

2014?\_\_\_\_\_\_\_\_

2015?\_\_\_\_\_\_\_\_

2016?\_\_\_\_\_\_\_\_

2a) Based on the data from just your city, how confident are you claiming that there is a certain month, or season, in which the air pollution tends to be the highest in Washington? Explain why you are confident or not confident.

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b) What would make you more confident that there is a pattern in the time of year and the highest amount of pollution in Washington? (HINT: what kind of additional data might make you more confident?)

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3. Which month had the lowest measured air pollution in (for the years available)….

2014?\_\_\_\_\_\_\_\_

2015?\_\_\_\_\_\_\_\_

2016?\_\_\_\_\_\_\_\_

4) Based on the data from just your city, how confident are you claiming that there is a certain month, or season, in which the air pollution tends to be the lowest? Explain why you are confident or not confident.

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**Part III: Making a Claim and Supporting it with Data**

**Overview**

You are ready to write a claim that answers the investigative question. A claim is a one sentence answer to the investigative question that you believe to be true based on evidence. Scientists always support their claims with evidence. Support your claim using the table your teacher made (which should be projected) of the compiled class data on the months with the highest and lowest air pollution in cities across Washington.

*Is there a relationship between the time of year/season and the amount of air pollution in Washington?*

**Claim** (a claim is a one sentence answer to the investigative question that you believe to be true based on any patterns observed in your data):

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Evidence** (the evidence should support your claim and should include a discussion of any patterns you observe in your data. Include quantitative details):

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Go back and read your hypothesis on page 1. Does the data support or refute your hypothesis? (It doesn’t matter if your hypothesis was correct or not. Scientists base their claims on evidence):

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## **Part IV: Generating basic statistics to answer a new investigative question**

**Overview**

In addition to graphing data, another way that scientists organize and interpret data in order to find meaning is through statistical analysis. You will find some basic statistics for your city’s air pollution and then compare those statistics with another group in order to answer investigative question #2:

*How does location (city) affect the amount of air pollution?*

1 a) In this question, what is the *changed* variable?

b) What is the *measured* variable?

In order to compare air pollution levels in different cities, you will need to first calculate a few statistics: the minimum, maximum, median and mean for your city. Write your city’s statistics in column 1. Once you’ve calculated your city’s statistics, share your results with a different group and copy their statistics into column 2.

**Definitions:**

* **Minimum** – The smallest observation.
* **Maximum** – The largest observation.
* **Median** – The middle observation in a ranked list of observations.
* **Mean** – The sum of the observations divided by the number of observations.

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| Statistic | City 1 (your city)  NAME: | City 2  NaME: |
| Minimum |  |  |
| Maximum |  |  |
| Median |  |  |
| Mean |  |  |

1. What interesting differences between cities can you identify?

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1. What might be some possible explanations for these differences?

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1. Write a claim that answers investigative question #2 and support it with statistics from both of your cities. Discuss with your group which statistics you think might be most relevant to include in your evidence statement.

**Claim**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Evidence:**

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**Part V: Observing and Asking Questions about the State of Global Air Pollution**

**Overview**

Air pollution is not just an issue in Washington; it’s a global issue. In this last part, you will explore a map that shows data on global air pollution, make some observations, and write some investigable questions that you’d like to further investigate.

1. Follow this link to State of Global Air map view: <http://www.stateofglobalair.org/air#PM>

* + Read the information on the webpage
  + Explore the map: move cursor over countries to view levels of PM2.5

2. Study the map and write down two interesting observations you have of global air pollution:

Observation #1:

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Observation #2:

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3. What are you curious about? What would you like to find out more about? Write down two investigable questions. Remember, investigable questions have a changed and a measured variable. Scientists’ questions usually come out of observations they find interesting. Your questions might come out of the observations you wrote down above.

Investigable Question #1:

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Investigable Question #2:

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