Institute

Inquiry Based Learning
Educational Consultants

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We hope the lesson plans add value incorporating inquiry into your classroom and they become part of your teaching arsenal.

We would appreciate feedback. We would also appreciate a $20 contribution which helps us maintain the website so we can continue distributing these lesson plans to other educators.

Mail your feedback and contribution to:
IBL Institute
Attention: John Hoffman
1101 N. Cole St., Lima, Ohio 45805

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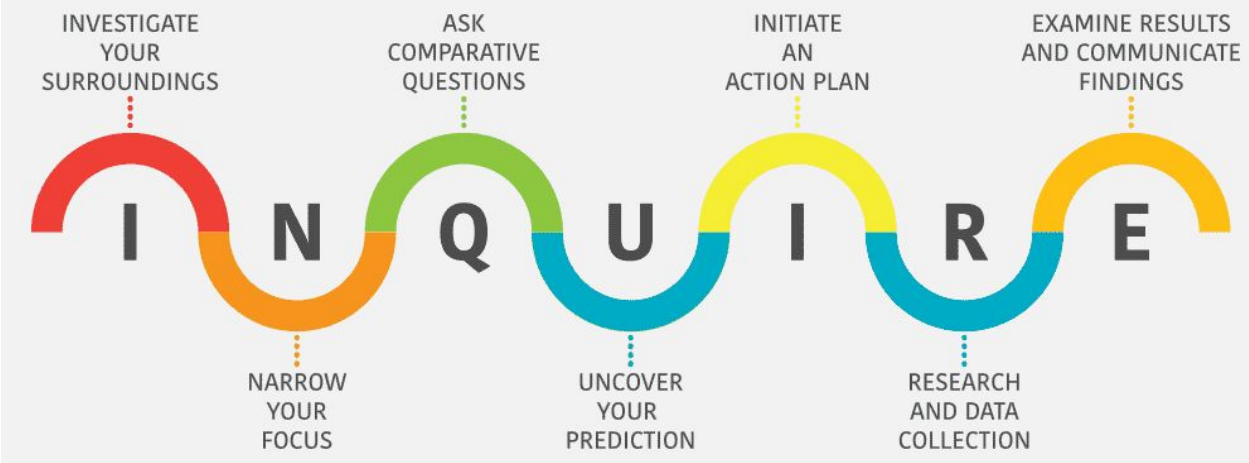
Exploring Correlations With our Environment

An inquiry-based lesson plan designed to promote critical thinking by integrating content with traditional and inquiry-based learning.



All Hands-On Learning is NOT Inquiry-Based Learning

Inquiry based learning is process-oriented and does not focus on a single correct answer, but rather emphasizes the process of gathering information and forming a conclusion. Traditional hands-on learning tends to be product-oriented and has students follow a pre-planned procedure to come to a single, specified answer.

Key Terms

Process Skills (PS)

Skills that students will engage in while thinking critically. These include observing, questioning, predicting, planning, investigating, interpreting, and communicating. These skills are found in each step of the inquiry process.

Investigating Surroundings

Observing the overall surroundings. What do I see? What is understood about the topic? What still needs to be understood?

Narrowing Focus

Observing student needs and interests, as well as academic content. Find the balance between natural curiosity and standards-based concepts. What area can be concentrated on to best promote growth and learning?

Questioning

Forming questions about what is not fully understood. Comparative questions can be investigated. They need to be able to lead into an action plan. What can be found out?

Uncover Prediction

Logically thinking to form a prediction about what could happen. What do I expect to happen based on my experiences and knowledge?

Initiate Plan

Figure out the action plan. Design an experiment which will answer the comparative question. What can I do to answer this question? How can I find this out?

Research and Collect Data

Investigating the elements of the experiment. Researching and collecting data that applies to the action plan.

Examine Results

Interpreting the data collected. What does this data mean? What else do I want to find out?

Communicating

Communicating the information that was found to someone else. The way the data is presented. What will the audience want to know? What will the audience be able to understand about this?

Table of Contents

Overview

This is an inquiry-based learning lesson in which students learn about precipitation, temperature, and humidity, as well as how a local animal species reacts to these types of weather. Students will be engaged in hands-on activities to collect data and set-up a scatter plot to answer a comparative question regarding the different types of weather. They will analyze their findings and present to the class. The project will link IBL with traditional teaching by giving teachers options to best suit the class needs. More questions will emerge to continue scientific investigations and further the learning process.

Practical Application

This experiment allows students to understand an animal species in their environment and how it reacts with different weather, such as precipitation, humidity, and temperature. Each student will have practice with the scientific process, including documenting and interpreting data.

Lesson Plan

Grade Level: 5th, 6th

Class:

Teacher:

Time Required/Duration:

One Class Period at the Beginning of the sequence
10 minutes at the beginning of each class period for ~2 Weeks
One class period at the end of the sequence

Objectives

1. Incorporate the process of inquiry-based learning into a traditional direct instruction classroom setting.
2. Students will be able to identify and explain precipitation, humidity, and temperature.
3. Students will be able to observe animals in their environment and record what they see.
4. Students will be able to gather and analyze data over an extended time.
5. Students will be able to present scientific data as well as journal their process.
6. Students will be able to use data to form a logical analysis of the correlation between weather and animal behavior.
7. Students will be able to uncover additional questions and think critically about the data found.

Educational Standards

<u>Scientific Inquiry, Practices and Applications</u>

–All students must use these scientific processes with appropriate laboratory safety techniques to construct their knowledge and understanding in all science content areas.

–During the years of grades 5 through 8, all students must have developed the ability to: Identify questions that can be answered through scientific investigations; Design and conduct a scientific investigation; Use appropriate mathematics, tools and techniques to gather data and information; Analyze and interpret data; Develop descriptions, models, explanations and predictions; Think critically and logically to connect evidence and explanations; Recognize and analyze alternative explanations and predictions; and Communicate scientific procedures and explanations.

5.LS.1 Organisms perform a variety of roles in an ecosystem.

CCSS.MATH.CONTENT.5.OA.B.3 Generate two numerical patterns using two given rules. Identify apparent relationships between corresponding terms. Form ordered pairs consisting of corresponding terms from the two patterns, and graph the ordered pairs on a coordinate plane.

CCSS.MATH.CONTENT.6.SP.A.2 Understand that a set of data collected to answer a statistical question has a distribution which can be described by its center, spread, and overall shape.

Materials

Needed:

1. Computer for each group
2. Paper and pencils

May be available for grant funding:

1. Weather station

To find out about possible grant funded supplies, please contact Jessica Begonia at 419-223-1362.

Vocabulary

(See Appendix 3 for the vocabulary defined)

Correlation
Positive correlation
Negative correlation
No correlation
Scatter plot
Relative Humidity
Temperature
Precipitation
Skew

Instructional Plan

First Day:

1. Lead students in a brief discussion about correlation. Ask students to define the word, if they have used this term before. Use examples for students to determine whether correlations exist or not. There should be at least one example of a strong positive correlation, a weak positive correlation, a strong negative correlation, a weak negative correlation, and zero correlation. Possible examples include:
    a. Strong Positive- the more time you spend exercising the more calories you burn
    b. Weak Positive- as the amount of rain increases, the amount of umbrellas sold increases
    c. Strong Negative- as temperature increases, hot chocolate sales decrease
    d. Weak Negative- as snowfall totals increase, the amount of people driving decreases
    e. Zero Correlation- ice cream sales in the United States and the amount of precipitation in Brazil
2. Ask students to brainstorm ways in which we measure the weather (e.g., temperature, amount of precipitation, humidity, wind chill, UV index, etc.). Give students 1 minute to brainstorm individually. Give students 1-2 minutes to talk with a partner. Then ask the class for their responses and list their answers on the board. **(Investigate Surroundings)**
3. Highlight precipitation, humidity, and temperature, and give them the background science to read and think about. Have a short class discussion about how these factors might affect animals in the area.
4. Take the class outside to observe animals in the area. Especially, certain types of birds, squirrels, or even insects may be common in the area. Discuss what the weather is at the moment, and how the animals are reacting to it. **(Investigate Surroundings)**
5. As a class, choose an animal to study that is common throughout the area and can be easily observed. **(Narrow Focus)**
6. After going back inside, split the class into groups of 4 or 5.
7. Instruct each group to pick which of the three (temperature, precipitation, or humidity) they would like to explore and create their own comparative question. **(Ask Comparative Questions) (Narrow Focus)**
8. Have students spend 10 minutes researching the animal's typical behavior.
    a. This can be done on computers or using books that the library may have about the animal.
9. Have students discuss within their groups each of their predictions for the correlation of the data. **(Uncover Prediction)**
    a. Encourage them each to share their *own* predictions about the correlation.
10. Each group should create a spreadsheet, with sections for the date, weather data, and the number of animals observed, as well as an area for observations. This can be done on paper, using Microsoft Excel, or a similar program to record their data. There are sample data sheets in the student journal, but students can create their own if that works best for the class. **(Initiate Action Plan)**

Instructional Plan Continued

Data Collection:

1. Each day for roughly 2 weeks[1] at the beginning of class, project a weather application on the board for students to record their data. **(Research and Collect Data)**
2. After the information is recorded on their data sheets, go outside as a class and have each group count how many of the animal they see active at this time. **(Research and Collect Data)**
    a. If weather is not permitting, going to a window to observe the animals will work as well.
3. Students can note any observations they notice about this animal on their data sheet.
4. Each day students will write in their journals.

Final Days:

1. Once ready to move on to analyzing the data, model creating a scatter plot for the students with data from the classroom (this data can be anything that would be meaningful to the students, such as age and height. The data will need to be collected ahead of time.)
2. Each group will create a scatter plot for their data. **(Examine Results)**
3. Then, students will individually fill out the worksheet (Appendix 6, page 32). Students should be encouraged to discuss with their group as they complete this, but answers should be in their own words.
4. Groups will use their worksheets to create a presentation for the class, using either of the options listed in the Post Assessment section (page 9). **(Examine Results and Communicate Findings)**

[1] There is no amount of data that *has* to be taken for this experiment to work. The more data, the better, but 2 weeks will be sufficient. Longer than a month may take away from a student's engagement.

Instructional Overview

1. The teacher will introduce the students to the concepts of the lesson.
2. The teacher will provide background information to the students about the math and science concepts that will be investigated.
3. The teacher will instruct and provide assistance in student creation of data sheets.
4. Students will collect and record data each day at the beginning of class.
5. Students will write responses to prompts in a journal format daily.
6. The teacher will model plotting points onto a scatter plot.
7. The students will complete the post assessment worksheet and present their findings to the class.
8. The students will complete the student feedback forms.

Post-Assessment

1. Working with their group, have students create a scatter plot for the data they collected.
2. Have each student answer the questions on the worksheet.
   -Discussion about the material during this time could be encouraged, but the answers should be in their own words and what they individually think.
3. Each group will prepare an explanation to the class about their findings. It should cover the data they collected for their chosen animal, the scatter plot created, and what they concluded based on that information. **(Examine Results and Communicate Findings)**

   There are two options for the class to do this:

Option a.

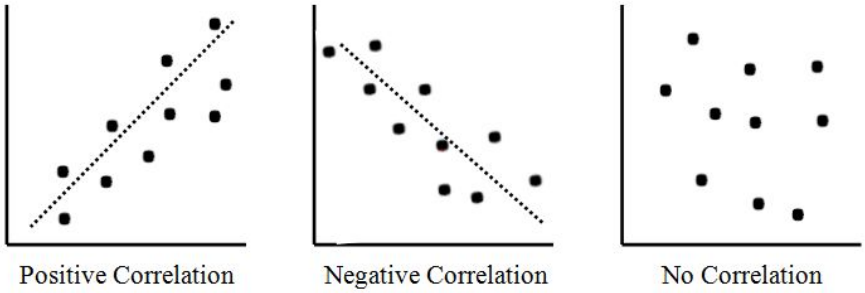
Take all but 10 minutes of the rest of the class period for the students to gather their thoughts and get ready to present their findings to the class. Each group should have up to two minutes to stand up from their seats and present their information. They should focus on getting across the information in an understandable and effective way.

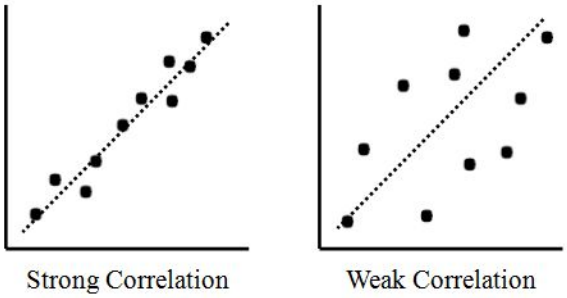
Option b.

The students will take the whole class period to come with a way to present the information in a way they see fit. This can be a slideshow presentation, a speech, a handmade demonstration, or any way of effectively communicating their information. For this option, there is a sample rubric in Appendix 3, but teachers can alter it to best fit the class. Students should have access to this while creating their presentation.

Background Information

Math Information:





Science Information:

Precipitation is water that is made in the atmosphere through condensation, which then falls to Earth. Rain, hail, snow, and sleet are all forms of precipitation. To measure precipitation, a rain gauge is used. It is a tube which has one end open and usually has a measuring scale on the side. It is left outside, with the open side up, so that water can collect inside.

Air temperature is how warm or cold the air is. The gases that make up the air are moving, so those particles have kinetic energy. The more they move, the warmer the air gets. Temperature is measured using a thermometer. It is shaped like a thin tube, and has a liquid inside, which is either mercury or alcohol. When the liquid heats up, it expands at a predictable rate. The tube is marked with a measuring scale in degrees Fahrenheit, so that the temperature can be measured.

Humidity is the amount of water vapor that is in the air. There are different types of humidity, which measure the amount of water vapor in different ways. We will be using relative humidity, which is measured as a percentage. It is done using a psychrometer which consists of two thermometers. One thermometer measures the air temperature. The other thermometer has a wet cloth at the top, which water evaporates from, lowering the temperature reading. After calculating these into a percentage, the relative humidity can be found.

Journaling

Students will document their data, thoughts, and questions each day for the duration of this lesson. This can be done with technology such as Google Docs or Word, with pencil and paper, using the Investigation Book, or any other method that best fits the class. During each class, the students will respond to prompts provided by the teacher, as well as anything they would like to make a note of for later. The prompts can be modified to best suit the class. For the class period covering the anticipatory set, students will respond to prompts at the end of class. These prompts will allow students to respond to the material covered and write their own inquiries. For class periods where a short time is spent collecting data, students will respond to prompts about the data after it is recorded. On the final day, students will respond to prompts at the end of class, these can be used as an exit slip to assess learning.

Introduction prompts:
What made you excited about today's lesson?
What is one thing that you learned today?
What is one thing you are curious about?

Do you think there will be a correlation with the data?
What do you expect the scatter plot to look like?

Data collection prompts:
Do you think there will be a correlation?
    If this answer is different than before, what changed your mind?
Did you expect the data collected today to be what it was?
Did the animals do anything differently today? Why do you think they did that?

Final day prompts:
What did the data tell you?
Did the scatter plot look how you expected it to? Why or why not?

About Inquiry-Based Learning As It Applies To This Lesson Plan

This is a project that works best when students work in small groups (4-5). Inquiry is collaborative in nature. The process takes advantage of students' strengths to contribute to the project. Some are great communicators, some are problem-solvers, and some have well-developed technical skills. In the workplace, we also work in groups. We work as part of a team. The inquiry process develops skills necessary to solve complex problems in the world.

The students will benefit from the background science of meteorological readings. Make sure the section on the background science is available to each group. Some in the group may have little interest in the material provided whereas others will want to read it in depth, but the end result will be that everyone in the group will know more about the types of weather and the way we measure them. Connect the relevance of the group working with the scatter plots as it relates to the comparative question. Students can discuss whether the scatter plot is strong, weak, or has no correlation. If there is a correlation, they can delve deeper into the information to discuss if there is a strong or weak correlation. Engage the class in a discussion about what the scatter plot means after they have completed one for their data.

Investigate your surroundings and narrow your focus: Encourage each group to think about the ways we measure weather. Have them get familiar with tools used to measure weather. Encourage them to ask questions about the way each device works. Along with how the species they are investigating behaves during different types of weather. Have them discuss differences in the tools and how they work. Why would one tool be designed differently than the other? What benefits might one design have for what it is measuring? Why might an animal be more active during a certain type of weather? This is a good time for students to write down questions. We suggest having them write individual questions on individual pieces of paper so the questions can later be sorted. It's not important to sort those now, but this can be revisited once the students are more in tune with the inquiry process.

Ask comparative questions: At the heart of inquiry is the comparative question. Comparative questions are ones that can be investigated. Some questions are very good questions, but they are very difficult to investigate. For example: Why are butterflies attracted to my flower garden? Good question, but difficult to investigate. However, we can take that question and change it to: Are butterflies attracted more to red flowers or white flowers? Do you see where we are going with this? You can now design an experiment to count how many butterflies visited each of the colors and compare the results. What will come of this will be more questions. Do the findings hold up for different kinds of butterflies? Another experiment can be designed. In the case of meteorological readings, the comparative question, at least somewhat, is being provided by you. This makes the lesson plan a guided inquiry. An open inquiry is one in which the students pick the topic, create the questions, create the action plan, etc. The comparative question for this lesson plan is: Is the species _____ more active during periods of _____ (high/low) _____ (humidity/precipitation/temperature)? Later, we will revisit the questions the students asked above and have them separate those questions that can be investigated and those that cannot. Often, questions that would be difficult to investigate can be made investigable by turning them into comparative questions.

Uncover your prediction: We are not talking about group-think here. What do you individually think? Each group will be collecting data about a specific species. Will the data they find show a correlation between the amount of the species active and the weather measurement? Each student will have a prediction and they should record that prediction.

A prediction is not the same thing as a hypothesis. A hypothesis might be: All swans are white. A prediction would be: I think the next swan I see will be white. A prediction is based upon the individual's experiences, observations, opinions, knowledge, and instincts.

Initiate an action plan: The experiment has been provided. The action plan was designed to help students answer the comparative question. Students will take the data and logically find an answer to the comparative question. It's not one of those "do the experiment and I will let you know the right answer." There is no right answer. Ask the students to record their data on the data sheet provided. To make future lesson plans or repeats of this one more inquiry-based, simply ask them to make a data sheet and record their findings. Perhaps have half the groups use the data sheet provided and then let the other half come up with their own. Part of inquiry requires you to give up some control to allow your students to figure it out.

Examine results and communicate findings: Each group will present their findings to the class. Typically, each group would prepare a graph, data table, chart, pictures or whatever they want to communicate their findings to the class. A poster or section of white board is helpful. The group goes to the front and each member usually participates. As a group, they share the data collected and the scatter plot created with the class. They share their individual predictions. They share their analysis of the scatter plot, giving their reasoning as to why they came to that logical conclusion. How do they answer the comparative question? What did they learn from the experience? Classmates then have an opportunity to ask questions to the presenting group.

Student/Teacher Roles for Each Step:

Investigate your surroundings:	The teacher and students are doing this
Narrow your focus:	The teacher and students doing this
Ask comparative question:	The students are doing this
Uncover your prediction:	Each student is doing this
Initiate an action plan:	The students are doing this
Research and data collection:	The students are doing this*
Examine results and communicate findings:	The students are doing this

*You may use the data sheet provided or the student may create their own

Group Procedures

First day:

1. After your class decides on the species of animal to investigate, spend time researching information about this animal's behavior.
2. With your group, choose which type of weather you want to investigate.
3. Write this on your data sheet in the second column labeled "weather".
4. Write the species of animal the group chose in the third column, on the blank line in "Number of _____ observed".
5. Think about your prediction for what you will find after collecting the data. Share these predictions with your group. Some questions to think about while making your prediction are:
    a. Will there be a correlation with the data?
    b. Will the weather affect the amount of animals you see outside?
    c. Will the weather affect how the animals are behaving?

Daily:

1. Record the weather reading in the data sheet.
2. Get together with your group as you head outside (or to a window) to observe the animals, bringing at least one data sheet to record data on.
3. Count how many of the animal you see. Be careful not to count one individual animal twice, as that will skew the data.
4. Record this number on the data sheet, noting any observations your group has made about the animals behavior, and any thoughts on how it relates to the weather reading.
5. After going back inside, make sure every member of the group has the data recorded on their own data sheet.

Final Days:

1. After watching your teacher model how to make a scatter plot, look at your own data and think about how to represent it on a scatter plot.
2. With your group, decide how to create a scatter plot for the data to best represent your findings.
3. Complete the worksheet by yourself. Talk with your group about the best way to answer the questions, but put the answers in your own words.
4. Using the worksheets to guide you, prepare a presentation of your findings to communicate with the rest of the class.

Appendix 1 –Rubric

	Data	Scatter plot	Analysis
3	- Includes *all* of the data collected	- Includes the scatter plot *correctly* completed	- Presented analysis of data *clearly and accurately* to the class
2	- Includes *most* of the data collected	- Includes the scatter plot completed with *one or two errors*	- Presented analysis of data to the class, *with one or two areas of confusion*
0-1	- Includes *little to none* of the data collected	- Does not include scatter plot *or* - The scatter plot is completed incorrectly	- Presented analysis of data inaccurately/ unclearly to class *or* - Did not present analysis of data to the class

Appendix 2 –Extension

To extend this lesson, students can do research as to correlation between meteorological readings. This can be done in groups, individually, or as a class. Alter the specifics to best fit the needs of the class.

1. Instruct the students to write down any questions that they might have after reflecting on the activity.
    a. These can be *any* questions that students come up with.

2. Have students share their questions with their classmates, discussing the topics that came up. If anyone knows answers to the questions, they can share them and talk about it.

3. Using computers or textbooks, have students look for answers to their questions.
    a. This may lead to more questions, which students should be encouraged to explore, if time allows.

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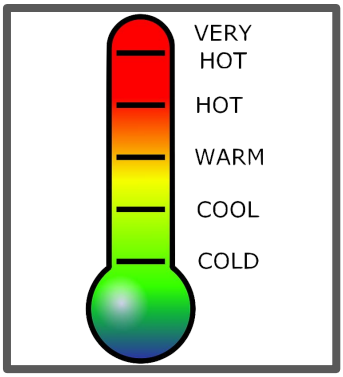
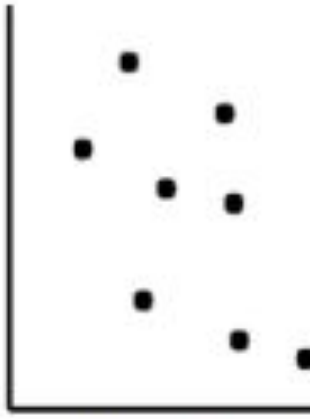


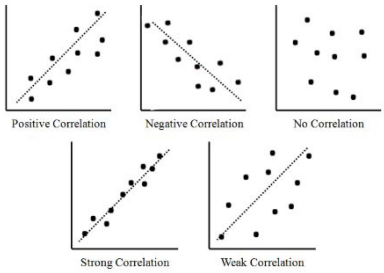
Temperature- measurement of how hot or cold an object is

Precipitation- water particles that fall from clouds and reach the ground

Relative Humidity- amount of water vapor in air compared to how much there could be

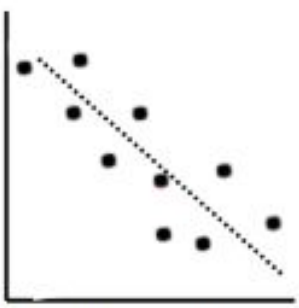


Scatter Plot-graph of plotted points showing how two sets of data are related

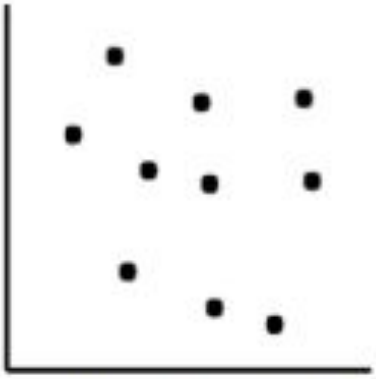


Correlation- how closely related two sets of data are

Positive Correlation- when both variables move in the same direction



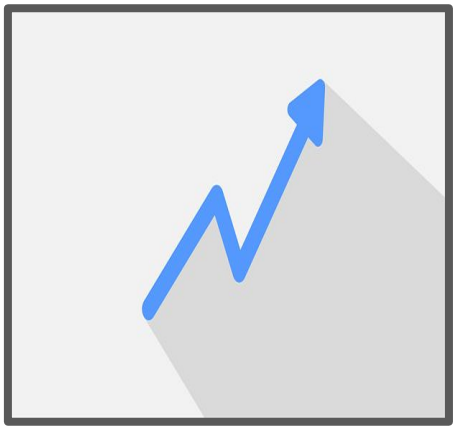
Negative Correlation- when one variable decreases, the other increases



No Correlation- when there is no relationship between two variables

Comparative Questions- questions we can investigate

Prediction- what you think before you investigate



Skew- to change the results making them inaccurate

Investigation Book

Investigator: _____

Things I Want to Investigate

Data Log

Location: _____

Animal Investigated: _____

Date & Time	Weather:	Number of _____ Observed:	Observations:

What made you excited about today's lesson?

What is one thing you learned about today?

Information about the species being investigated:

What is your comparative question?

Do you think there will be a correlation with the data? Why do you think this?

What do you expect the scatter plot to look like?

Why do you think this?

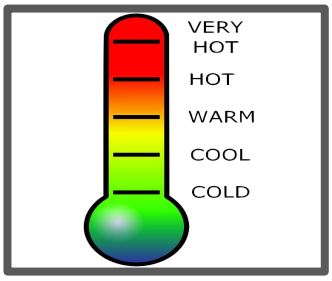
After collecting several days of data, explain your observations. Is the data supporting your prediction?

Using all of the data collected, the scatter plot looks like:

What does this data tell you?

Did the scatter plot look how you expected it to? Why or why not?

What is one thing you are taking away from your inquiry?



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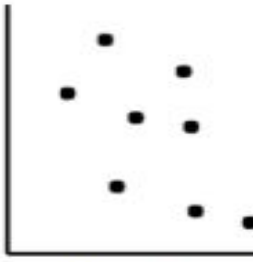

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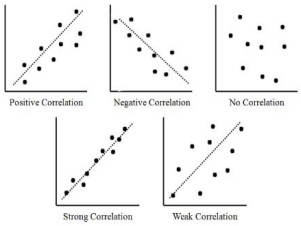
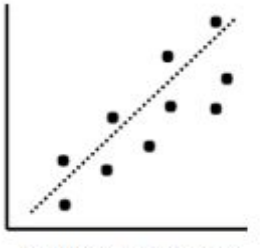
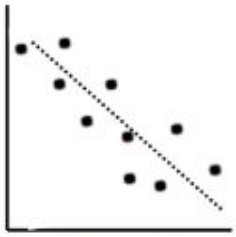


Correlation- how closely related two sets of data are



Positive Correlation- when both variables move in the same direction



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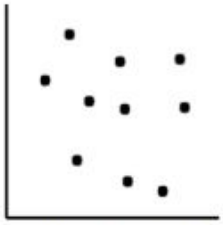


No Correlation- when there is no relationship between two variables

Skew- to change the results making them inaccurate

Comparative Questions- questions we can investigate

Prediction- what you think before you investigate

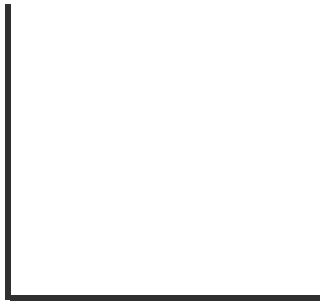
Observe- to watch carefully and notice important details

Name: _____

I was investigating the correlation between _____ and

_____ .

This shows an approximate line of correlation for the data that was collected:



The type of correlation was: _____

Using this information, I can conclude:

_____

_____

_____

_____

Thinking about this, I might like to further investigate:

_____

_____

_____

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Appendix 6 –Student Feedback

1. What did you learn from this?

2. What additional questions come to mind after having done the experiment?

3. Was it fun and/or interesting?

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Appendix 7 –Teacher Feedback

1. What evidence suggests students grasped the major themes of the experiment?

2. Do you anticipate other guided or open inquiry projects arising from this project? What questions did the students ask that suggest understanding and interest in the subject?

3. To what extent did this project fit into your curriculum and teaching agenda?

4. Would you consider doing this again?

5. What would improve this experience?

Please return completed surveys to
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