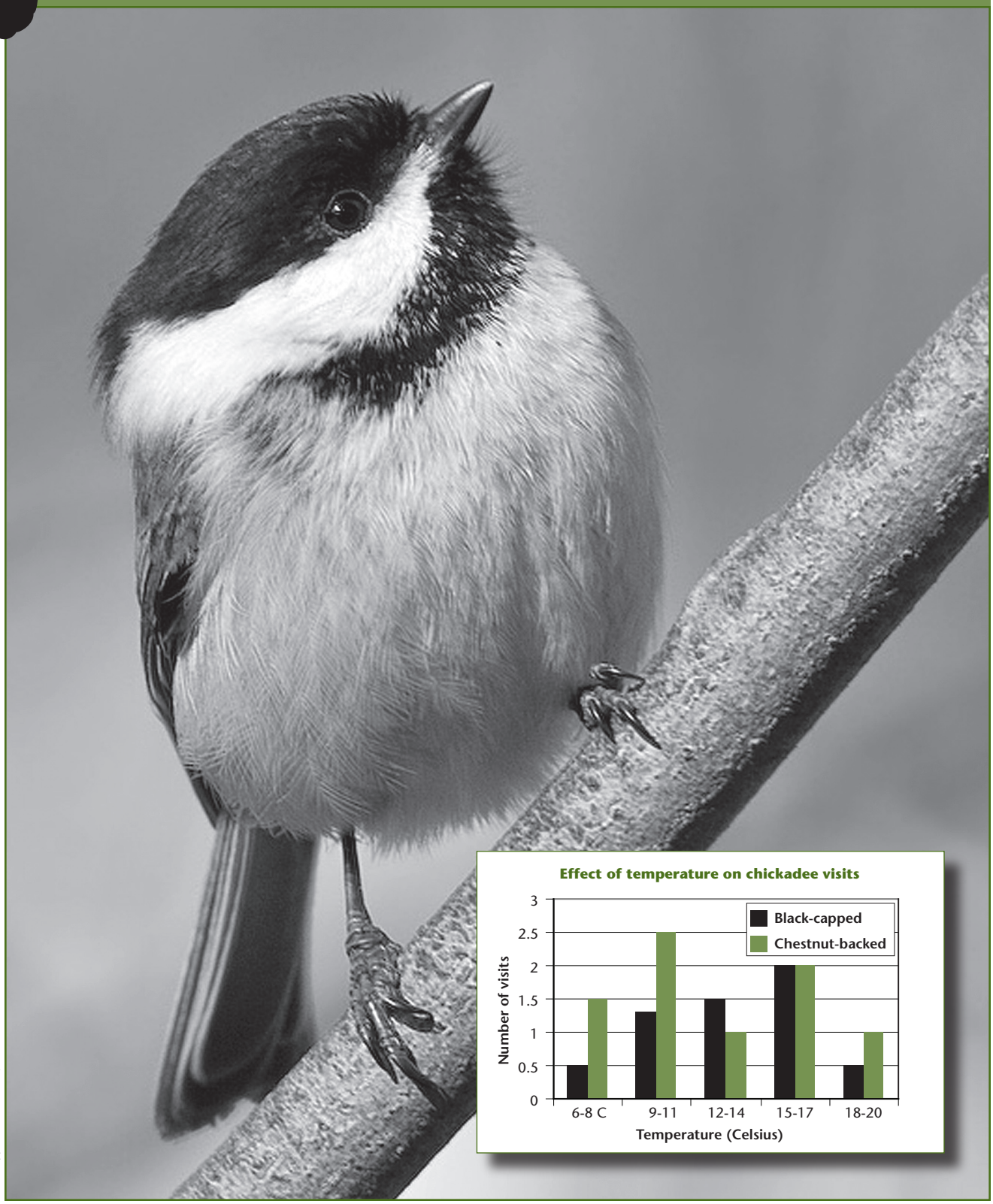
BIRD Sleuth

Investigating Evidence

RESOURCE PAGES



Black-capped Chickadee by Axel Hildebrandt

Resource Pages
Investigating Evidence

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Meet a Scientist: Kevin McGowan

BIRD Sleuth

Dr. Kevin McGowan has been interested in animal behavior, especially bird behavior, since kindergarten. At the Cornell Lab of Ornithology, he's been studying social behavior in American Crows. He follows crows because he wants to find out where they go, who they hang out with, and what kinds of things they do.

Kevin needs to be able to recognize individual crows to answer his questions. For example, he wants to know if brother and sister crows hang out together when they are adults. To recognize the crows, Kevin marks them. He climbs up a tree that holds a crow nest, borrows the nestlings long enough to put colored bands around their legs or tags on their wings, and puts them safely back in their nest. He also attaches radio transmitters to some of the birds, which signal him where the birds have gone even when they're out of sight.

Kevin has been collecting data about the crows for nearly 20 years. He records who is mating with whom, how long the crows live, and who hangs out together throughout the year. By following the birds he's tagged, Kevin has discovered that crows are very social creatures. Crow parents mate for life, and crow children usually stay with their parents for several years, helping take care of their younger siblings. This behavior might not be odd for humans, but it is pretty unusual in birds; most bird families don't stay together for long after the fledglings leave the nest. Crows are also very protective of each other, and a crow's distress call will gather other crows to help scare off intruders.

Kevin has recently been curious about a virus affecting crows called West Nile virus. Because he knows individual birds, he can learn a lot about who is affected and who isn't. Because getting the virus is usually fatal for the crows, it is important for Kevin to try to understand what happens to crow social structure when crow populations are decreasing and there are not as many helpers in crow families.

Lots of people are interested in the effects of the virus, so Kevin has shared what he's learned about crow families by publishing his research in scientific journals, magazines, and newspaper articles.

One of the American Crows that Dr. Kevin McGowan has tagged and banded. The crows don't seem to be bothered by the tags, and treat them like feathers!

Kevin McGowan (2)

Kevin discovers a nest of baby crows. He'll tag them, take their temperature, and then put them back in the nest before their parents have a fit.

Meet a Scientist: Mari Kimura

iStockPhoto.com

Mosquitos don't just bite people; they bite birds and other animals too, and can make them sick as well!

Mari Kimura grew up in a big city and says she didn't know very much about birds. But once she held a wild bird in her hand, she was hooked! Mari came to the Cornell Lab of Ornithology to study a disease called avian malaria. Avian malaria makes birds very weak, and they may not recover. Birds catch the disease when they are bitten by an infected mosquito.

So, in order to understand more about avian malaria, you have to study mosquitoes. Mari says she probably spends as much time looking at mosquitoes as she does looking at birds! She often works with entomologists—scientists who study insects. Mari says, "There are more than 30 species of mosquitoes in my small study area and about 40 percent of the birds we catch are infected with avian malaria. But we don't yet know which species of mosquitoes transmit the disease. One of the goals of my research is to answer that question."

In order for a mosquito to infect a bird, the mosquito has to be able to catch the disease in the first place. Mari is doing tests to see which mosquito species are more likely to become infected. First she collects mosquito eggs from pools of water and then raises them to adulthood in a lab. Mari lets the lab mosquitoes bite a bird she knows has malaria. Then she tests the mosquitoes to find out if they caught the disease from the bird.

Mari describes the process: "I extract DNA from the lab mosquitoes and use a technique called PCR, or Polymerase Chain Reaction, to determine whether or not there's avian malaria DNA present. If I find it, it means the mosquito is infected." Determining which species are easily infected might help Mari understand which mosquitoes transmit the disease in the wild.

Mari learns a lot from working with other scientists. She also shares what she finds by publishing articles about her research and speaking at scientific conferences. Most of all, she's happy to be doing something to help the birds.

Eric Liner

Mari extracts DNA from mosquito salivary glands to see if she can recover parasite DNA using a method called PCR, which can produce billions of copies of DNA from even a single DNA fragment.

Meet a Scientist: Chris Jennelle

Chris Jennelle has always loved to explore nature and now he's doing it for a living! He studies House Finch eye disease. It's caused by bacteria and infected birds have red, swollen, runny, or crusty eyes. It can be so bad the birds cannot see, which makes it hard for them to find food or avoid predators. The disease first showed up in 1993 and has now spread across North America. Although it mostly affects House Finches, the disease has also been found in other birds, such as the American Goldfinch and the Purple Finch.

Raymond Belhumeur

House Finch eye disease causes a bad case of pink eye in the birds. Their eyes get swollen and puffy. Some birds even go blind. They might also be tired and have some breathing problems.

Chris would like to know more about how this disease is spread. House Finches gather in flocks at certain times of the year and Chris thinks that behavior might increase the chance of a sick bird passing the disease to other birds in the group. Chris tracks individual birds to see where they travel, which ones get eye disease, and which ones recover.

To identify individual birds, Chris first catches them in a soft "mist" net and puts colored bands on their legs. Each bird has a unique combination of colors. One of the things Chris has discovered is how important it is to accurately estimate the chances of seeing a banded House Finch again after it's released.

Because it's not always possible to see a bird to make an ID using leg bands, Chris has another tool for following birds: radio tracking. He says, "We attach tiny tags on some birds. The tags transmit a signal that we can pick up with a receiver. That way we can find the bird, even if we can't see it."

Eric Liner

Chris also watches House Finches at a huge aviary to see how the birds interact with each other and what they do at the feeders set up there. How the birds behave may hold the key to understanding how eye disease is spread. Tracking the many ways that a disease could be spread among birds is very complex.

Chris shares his work with other scientists by publishing the results of his research and by making presentations at scientific meetings.

Chris Jennelle

Kinds of Questions

BIRD Sleuth

You may have already come up with some questions you have about birds. For example: What would happen if we set up a birdbath? How do birds behave when a hawk flies over? Does weather affect the number of birds on our schoolyard? Does our playground noise affect birds? How does a bird find its way when it migrates? How many species has my class seen? You can find the answers to a lot of your questions, too! Different types of questions lead to different types of research projects. You can classify questions by the way you can look for the answer. Figure 1 illustrates four of ways to answer your scientific questions.

WHAT DO YOU THINK? Look at Figure 1 and read the paragraph in the box. What are the four ways to answer your scientific questions?

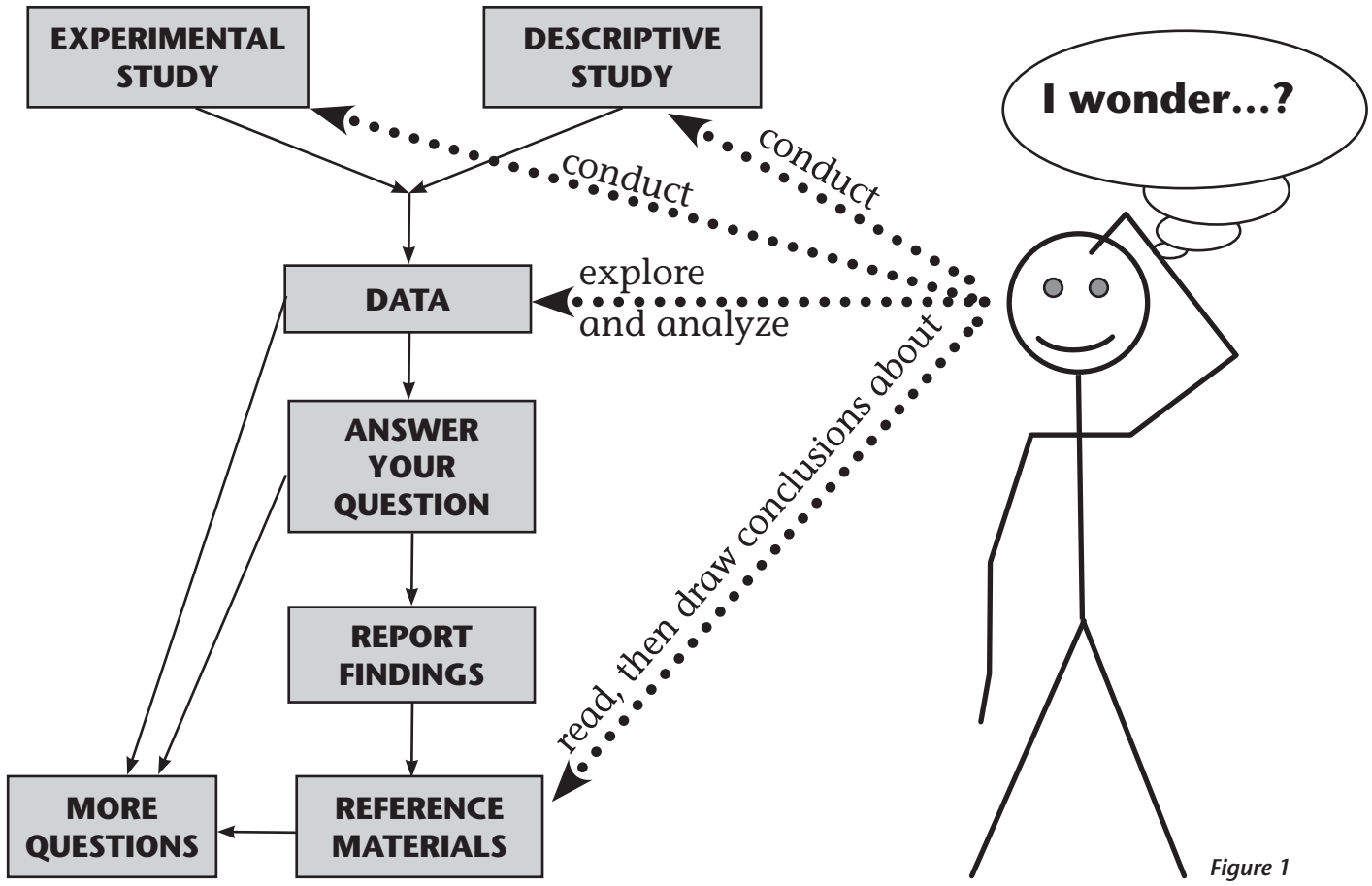


Figure 1

Where will you jump into the process?

Depending on your question, you can enter the process of science at different stages. Look at the dotted arrows to see where this student scientist could jump into the scientific process. Some conduct their investigations through **experimental** *or* **descriptive** *studies, some start by* **exploring and analyzing data** *from a database (like eBird, for example), and still others find answers by* **pulling together information** *they find in reference materials such as books or web sites.*

BIRD Sleuth Hypothesis Help

Hypothesis:

A testable statement or prediction about the natural world which can be supported or rejected by experiments or observations.

How do we turn a QUESTION into a HYPOTHESIS?

What do I wonder?	Suppose you are curious about what time of day American Robins feed their young the most.
What do I already know?	Before you turn your question into a **hypothesis**, you need some background knowledge about this topic. You do some research and discover that most songbirds, including robins, sleep at night.
How do I turn my idea into a hypothesis?	Knowing this information might lead you to think that parents feed their nestlings most often early in the morning because they are hungry after a night with no food. Therefore, your **stated hypothesis** could be, "Feeding rates of American Robins may be highest in the morning."
How do I test my hypothesis?	Although there is more than one way to **test this hypothesis**, you might design a study that would involve watching at least one active robin nest for several days and recording the number of times a parent brings food to the young during specified time intervals during each day.
How do I know if my hypothesis was supported?	The data you collect can be used as evidence to either **support or reject** your hypothesis. Are feeding rates much higher in the morning as you expected? If so, you would support your stated hypothesis.
What if I didn't find any differences?	If your results show that robins feed their young about the same time throughout the day, you would conclude that time of day had no effect on feeding rates. We call this a **null hypothesis**, which means that you could not find a pattern or relationship for the things you were testing. You would therefore reject your stated hypothesis and support your null hypothesis.
What if I found something other than what I expected?	If your results show that robins fed their young the most right before sunset, you would reject your stated hypothesis, in favor of an **alternative hypothesis**. You might wonder if feeding rates are highest right before sunset because the young need a lot of food to get through the night. An alternative hypothesis to test might be "American Robins feed their young the most right before sunset."

Variables in Your Experiment

If you want to do an experiment, you'll have to consider variables. A variable is a characteristic that has two or more different values—it varies! For example, you might count three Turkey Vultures one day, eight the next day, and none on the third day. The number of Turkey Vultures is a variable.

When you do an experiment, always consider these three types of variables: Independent Variables, Dependent Variables, and Control Variables:

Independent Variable (IV)

- The experimenter (you) changes this variable, or looks at a variable that naturally changes, such as temperature.
- Graph it on the x-axis.

Dependent Variable (DV)

- This variable that might be affected by the change in the IV (you might remember: it DEPENDS on the change in the IV).
- This is what you measure.
- Graph it on the y-axis.

Control Variables

- These are all the things that you try to keep constant, or control.

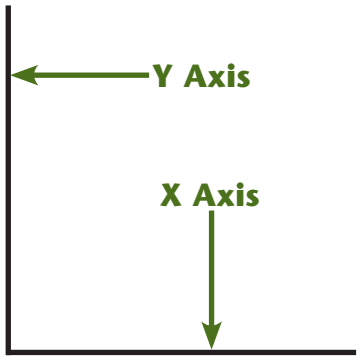


Figure 1

Let's look at these variables in an actual study. Allison wanted to know if birds preferred to eat at a bird feeder located in an area that was protected by trees and bushes. Allison considered three variables before she began: Independent, Dependent, and Control Variables.

Variables in Your Experiment

Independent Variable: Feeder Protectedness

- Whether the feeder is protected or unprotected is what Allison changed. These are also called the treatment groups.
- She put one feeder on a pole out in the open. She hung another nearby on a pole surrounded by trees and bushes.

Dependent Variable: Total Number of Bird Visits

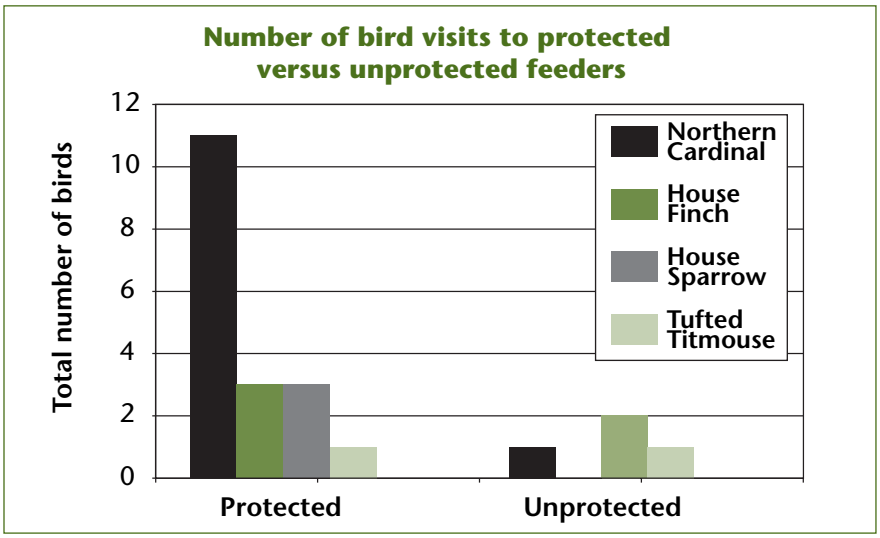
- Allison measured the number of Northern Cardinals, House Finches, House Sparrows, and Tufted Titmice that visited.

Control Variables

- Allison tried to make only one change: how protected the feeder was. She kept these things the same:
  - o The feeder type
  - o The kind of seed she used
  - o The distance between feeders
  - o She counted birds at both feeders at the same time (so things like the time of day, temperature, and wind speed were all the same)

  These things need to be controlled, or held constant so that Allison would know that any differences she saw in the number of birds that visited were due to how protected the feeder was, not something like the type of feeder or the kind of seed.

When her study was complete, Allison graphed her results. Note that her Independent Variable is on the x-axis and her Dependent Variable is on the y-axis.



What do you think? Do the results of Allison's study indicate that birds prefer to feed at a protected or unprotected feeder? Or does it depend on the kind of bird?

Figure 2: Number of bird visits to protected versus unprotected feeders

By Allison, 7th Grade, Bloomsburg Middle School, Bloomsburg, PA, Mr. Prosseda

Will a Fake Cat Scare Birds?

By Amy
Robert Frost School, Silverton, OR
Mrs. Rindy

Introduction

I noticed that cats in my yard had been scaring the birds away. I wondered if the birds could differentiate a fake cat from a real one. I decided to find out: does a fake cat scare birds? I measured the amount the birds ate one week and compared it to how much they ate during the next week when a stuffed cat was "guarding" the feeder. I thought that for a little while the birds would be afraid of the fake cat but that eventually the birds would figure out that the cat was fake. Therefore, my hypothesis was that during the week that the cat was not "guarding" the bird feeder I would get more birds but that there would only be a small difference in the amount of food eaten.

Courtesy of Amy

Amy wondered if a fake cat would scare away the birds. Here you can see her stuffed-animal cat "guarding" her bird feeder.

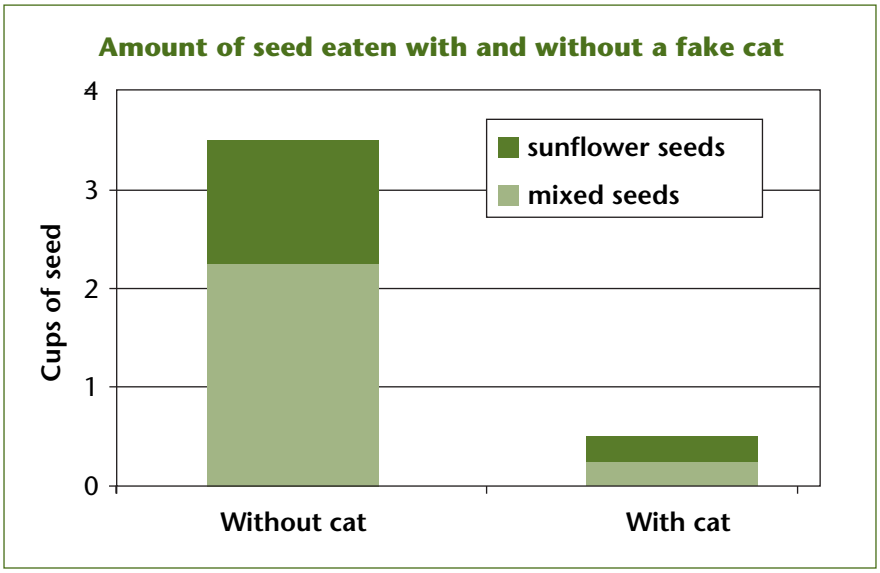
Materials and Methods

I filled two bird feeders with 2¼ cups of seed (one with mixed seed and one with sunflower seed). I hung them outside. After one week, I took the bird feeders down and measured how much seed was eaten. I got a life-size stuffed cat and propped it up in the tree close to my bird feeders (see picture). I then filled the bird feeders again with the same kinds and amounts of seed. After one week, I measured how much seed was eaten with the stuffed cat present. I compared how much seed was eaten with and without the cat.

Results and Analysis

I found out that more birds came to the bird feeders when there wasn't a "dangerous" animal around. When I didn't have the cat "guarding" the bird feeders, the birds ate all 2¼ cups of mixed seeds and 1¼ cups of the sunflower seeds (a total of 3½ cups of seed was eaten). During the week with the stuffed cat, only ¼ out of the 2¼ cups of seeds were eaten out of each of the feeders (a total of only ½ cup of seed was eaten). The birds did not eat as much birdseed when the stuffed cat was "guarding" the bird feeder. See my graph.

Will a Fake Cat Scare Birds?



My results as shown in a bar graph

Discussion and Conclusion

My hypothesis was partially correct, but I was surprised that the birds didn't seem to eventually figure out that the cat was fake. I observed that whenever a bird did find the courage to take a quick nibble of birdseed when the stuffed cat was present, it was very jumpy and cautious, and it only stayed at the bird feeder for a moment. The birds never seemed to learn the cat was not real. My experiment demonstrated that a stuffed cat does scare birds. I wonder how long it would take the birds to discover the stuffed cat was fake. Would they ever figure out it was fake? These questions could be answered by doing another experiment in which I left the fake cat out longer.

Discuss with Your Group

1. What was Amy's hypothesis?
2. What was the independent variable in this study?
3. What was the dependent variable in this study?
4. What factors did Amy hold constant?
5. What questions or concerns do you have about her methods? Was the study well-designed?

Answering Your Scientific Questions

Two ways of answering your questions involve collecting and analyzing your own data—**Experimental** and **Descriptive** studies. The other two involve investigating the data that others have collected (**Data Exploration**) or examining references others have published (**Reference**).

1. Experimental Questions

Sample Questions

- What would happen if we set up a birdbath?
- Do birds prefer a certain kind of birdseed?
- Does our playground noise affect birds?
- Does temperature affect the number of birds that visit our feeders?

For these types of questions, you are interested in whether some change has an effect on the birds, so you'll conduct an experiment. Experimental studies look for the effect of one variable (the thing that changes, which is called the Independent Variable, or IV) on another variable (the thing you measure, which is called the Dependent Variable, or DV). For example, one student wondered if the amount of playground noise (Independent Variable) affects the number of birds that visit (Dependent Variable). In order to be sure that changes in the DV are due to the IV, the researcher attempts to control—hold constant—all other variables that might affect the DV.

What Do You Do?

Measure your Dependent Variable to see if it is affected by the Independent Variable by collecting data on your study site. Change only one thing—the Independent Variable—while you hold other variables constant. Analyze your data and draw conclusions.

For example, for the question about birdbaths, you could ask: "Do birds prefer feeders that are with or without a birdbath?" Since you are really only interested on any effects of a birdbath, you want to be sure that the only thing you change is whether or not there is a birdbath. You want everything else, like the time of day that you count, where you count, and how you count, and everything about the feeder, to stay the same. See Figure 1.

In the example above, the presence or absence of a birdbath is the Independent Variable since it is the thing you changed. The number of bird visits to the feeders is the Dependent Variable since it is the thing you measure. Notice that when you graph, the Independent Variable is graphed along the X-axis (along the bottom) and the Dependent Variable is always on the Y-axis (the up-and-down axis).

Answering Your Scientific Questions

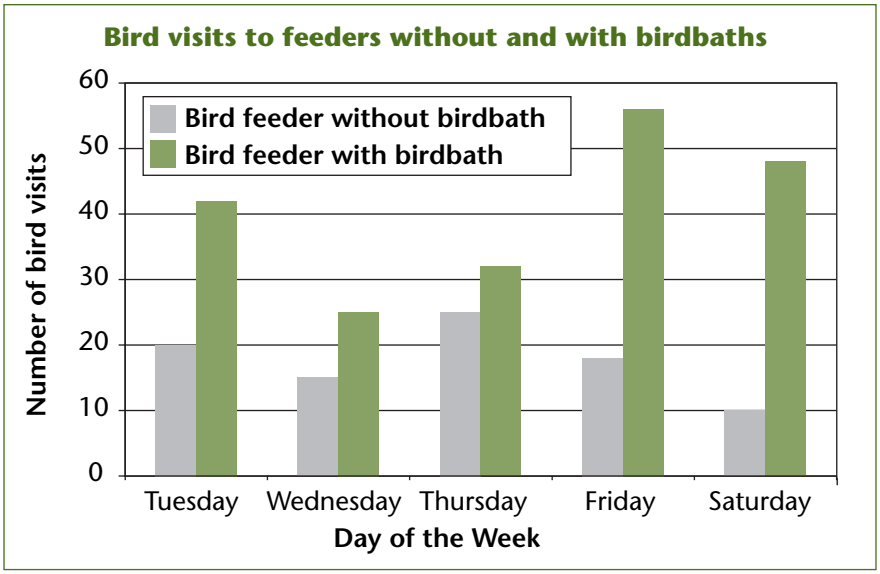


Figure 1

WHAT DO YOU THINK? Does the presence of a birdbath seem to affect the number of birds?

For the question, "Does temperature affect the number of birds on our schoolyard?" YOU don't change the Independent Variable, it just naturally changes. You still try to hold everything else constant. Record the temperature (Independent Variable) and count the birds (Dependent Variable) and then summarize your data, such as in Figure 2.

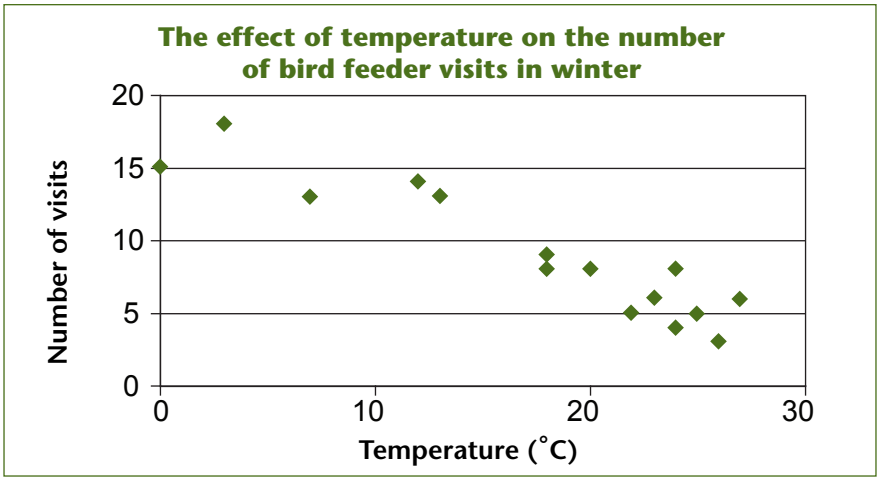


Figure 2

WHAT DO YOU THINK? Does temperature affect the number of birds? If so, how does it affect them?

Answering Your Scientific Questions

2. Descriptive Questions

Sample Questions

- How do finches behave when they visit our feeders?
- How many species has my class seen?
- What bird is seen most often at our school?
- What birds are found around my house?

Like experimental studies, descriptive studies involve making observations and collecting data, but in descriptive studies, you don't change any variables. You just try to accurately describe what you observe. Often, questions about animal behavior lead to descriptive studies. For example, "How do birds behave when a hawk flies over?"

What Do You Do?

You might watch birds in a specified area at specified times and record what you see, then analyze this data and draw conclusions.

For example, if you wanted to explore the question, "What birds are seen most often at our school?" you might count birds at different times of day over a few weeks or months and record the kinds and numbers of birds you see (see Figure 3). In your scientific paper, you could tell readers how many total species you saw and perhaps what times of day you saw the most birds. To help readers actually see the answer to your question, you could include a graph of the three most common species, like the pie chart found in Figure 3.

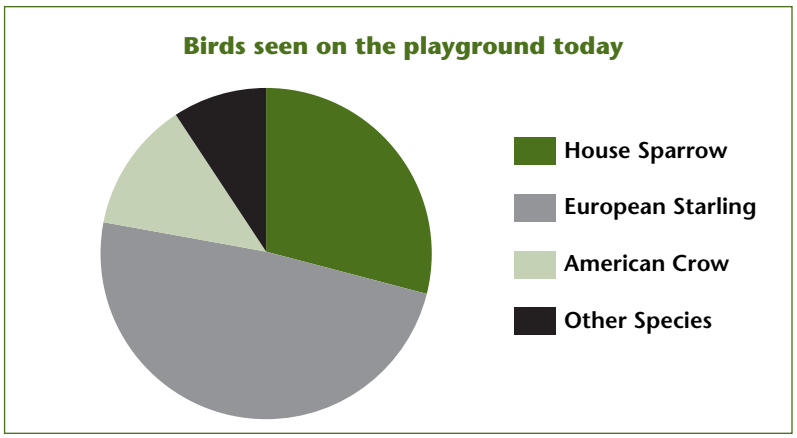


Figure 3

Answering Your Scientific Questions

3. Data Exploration Questions

Sample Questions

- "Are American Crows seen as often in other states as they are here?"
- "When do Ruby-throated Hummingbirds arrive in different parts of the country?"
- "Which birds are most commonly reported by eBirders in my state?"

Using databases such as eBird, you can answer some big questions! The data you are using have been collected by others (and by you, too, if you have submitted data to the database!).

What Do You Do?

Access one of the Cornell Lab of Ornithology online citizen science databases (for example, eBird, Project FeederWatch, or Project NestWatch), and retrieve data that will help answer your question. Analyze the data and draw your conclusions.

For example, if you wanted to explore the question "When do Ruby-throated Hummingbirds arrive in different parts of the country?" you could look at the frequency line graphs in eBird for four states, moving south to north. For example, the frequency graph for New York looks like this (Figure 4):

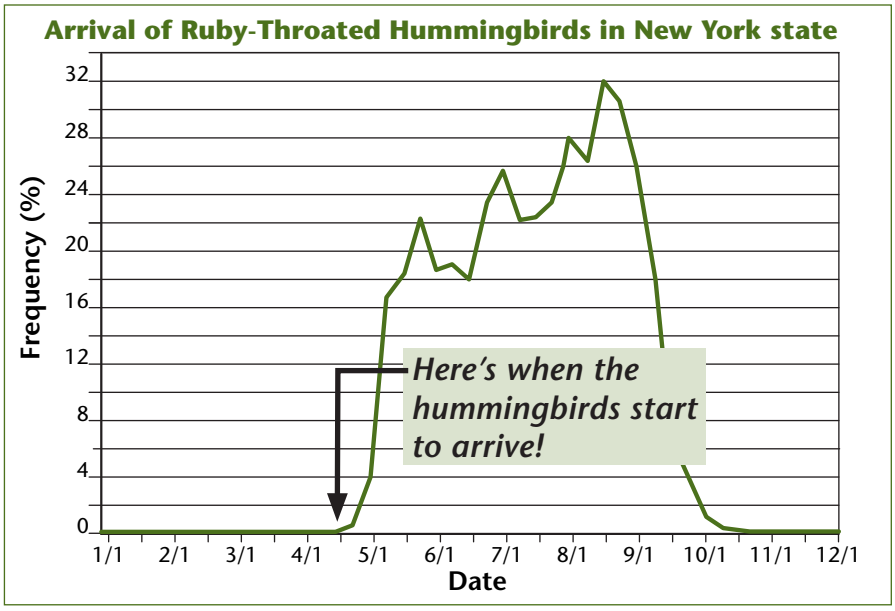


Figure 4. Data from www.ebird.org

Answering Your Scientific Questions

You can see from that eBird graph that the migratory Ruby-throated Hummingbirds do not begin arriving in New York until after April 15 (4/15). Look at a few other states and then summarize what you find, in a table such as Figure 5.

When do Ruby-throated Hummingbirds arrive in four states?		
	State	**Arrival Date**
Further South ↓ **Further North**	Florida	Found here year-round
	South Carolina	3/15
	Virginia	4/1
	New York	4/15

Figure 5

Answering Your Scientific Questions

4. Reference Questions

Sample Questions

- "How many species of birds are there?"
- "What are some of the biggest survival threats facing my favorite bird?"
- "Do bigger birds lay bigger eggs?"
- "How does a bird find its way when it migrates?"

The answers to these questions can be found by looking them up in one or more sources, such as books, magazines, or on the Internet.

What Do You Do?

Identify the best available references for your topic. Read each one, take notes, and summarize the information in a well-researched answer.

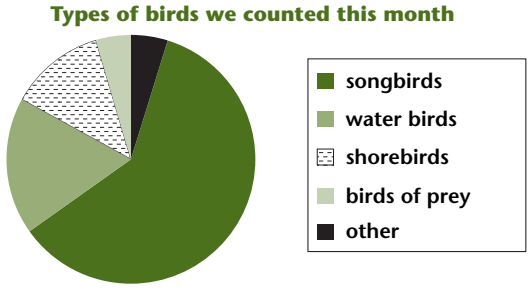
Some questions are narrow in scope, and you might find the answer by looking in only one source. For example, the answer to the question, "How many species of birds breed in North America?" might be found by looking at a North American checklist of birds published by the American Birding Association, or by trying to look up the answer online. Other questions are broader or more complicated, and are best answered by synthesizing (pulling together) an answer from a number of different sources. The question, "What are some of the biggest survival threats facing my favorite bird?" requires that you look up information in multiple sources, and pull it all together as a well researched list.

WHAT DO YOU THINK? Have you ever been curious about a bird or another kind of animal, and looked up information about it? Where did you look? Is it sometimes important to look things up in more than one place, like two different books, or a book and a web site? Why or why not?

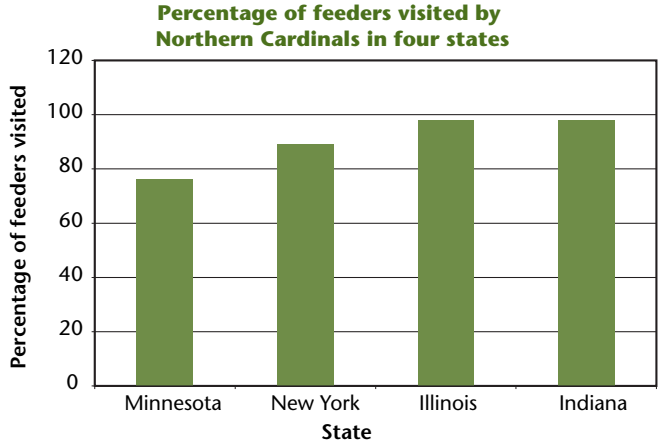
Graphs of Bird Data

BIRD Sleuth

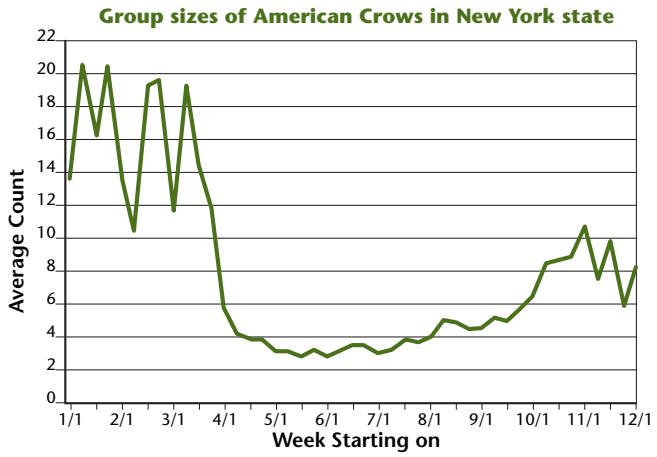
Pie Charts



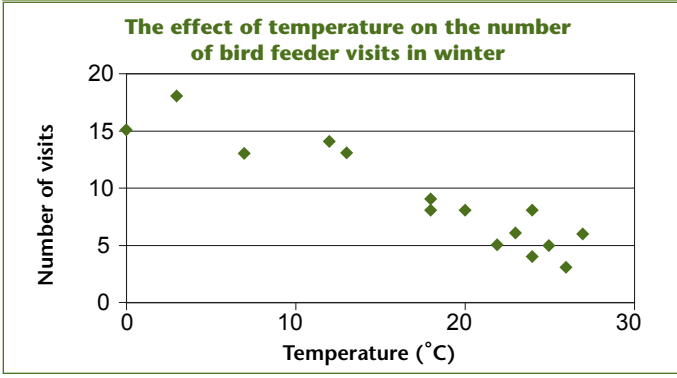
Bar Graphs



Line Graphs



Scatter Plots



Graphing My Data

BIRD Sleuth

You've probably heard the phrase, "A picture is worth a thousand words." A well-made graph is worth a thousand words—it summarizes your data and might even make it easy to see any trends in your data! Graphing is all about showing people your data visually.

There are many kinds of graphs. Not every kind of graph will be best for your data. Deciding on what kind of graph to draw, and how to draw it, can require thought—which makes graphing a fun challenge! Here, you'll learn about four kinds of graphs and when to use each kind.

Pie Charts

- When you can convert data to show percentages, you can use a pie chart.
- Remember that the pieces of a pie together make 100%.

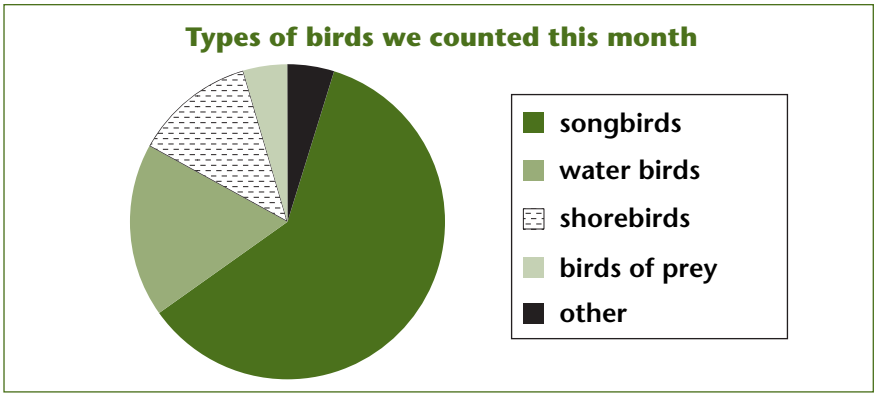


Figure 1

WHAT DO YOU THINK? *What is the most common kind of bird the students counted? What kind of bird was seen least often? Approximately what proportion of birds counted this month were water birds?*

Graphing My Data

Bar Graphs

- Use a bar graph when there is no connection from one data point to another (this is called categorical data). For example, a bar graph can be used to present data from different sites.

In the example in Figure 2, students wanted to know whether Northern Cardinals are seen at feeders more often in states where the cardinal is the state bird. They hypothesized that Northern Cardinals would be seen more in states like Illinois and Indiana, where the cardinal is the state bird, than in states that chose another bird as the state bird, like Minnesota and New York.

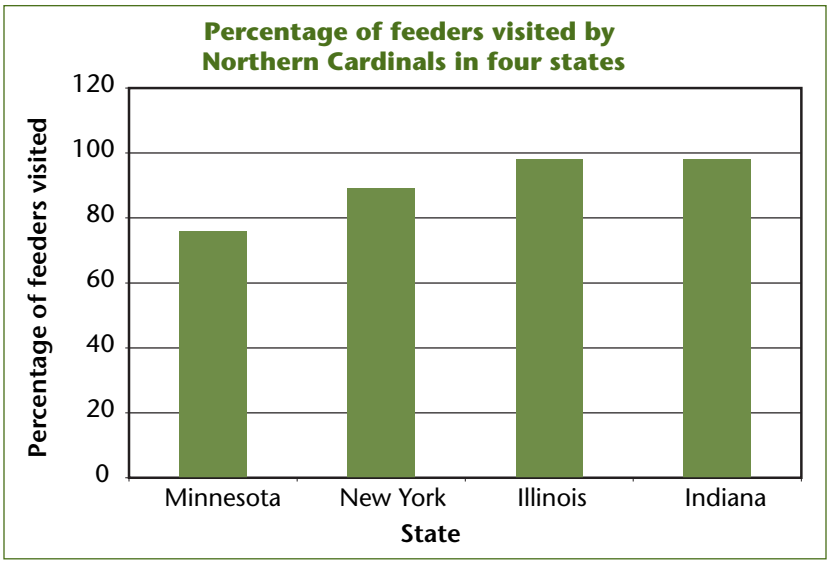


Figure 2: Percentage of feeders visited by Northern Cardinals in four states
by Kelsey, Anna, Charlotte, and Hannah, 7th Grade,
Minnehaha Academy, Minneapolis, MN, Mrs. Humason

WHAT DO YOU THINK? *Was the girls' hypothesis right? Were Northern Cardinals reported more often in states that have Northern Cardinal as the state bird?*

Graphing My Data

Line Graphs

- Line graphs are an excellent way to map Dependent and Independent Variables that are both quantitative (measured with numbers). Unlike a bar graph, the data are not grouped in categories.
- Line graphs are most useful for showing whether something changes over time.
- Draw a line through the data points when you have plotted them.

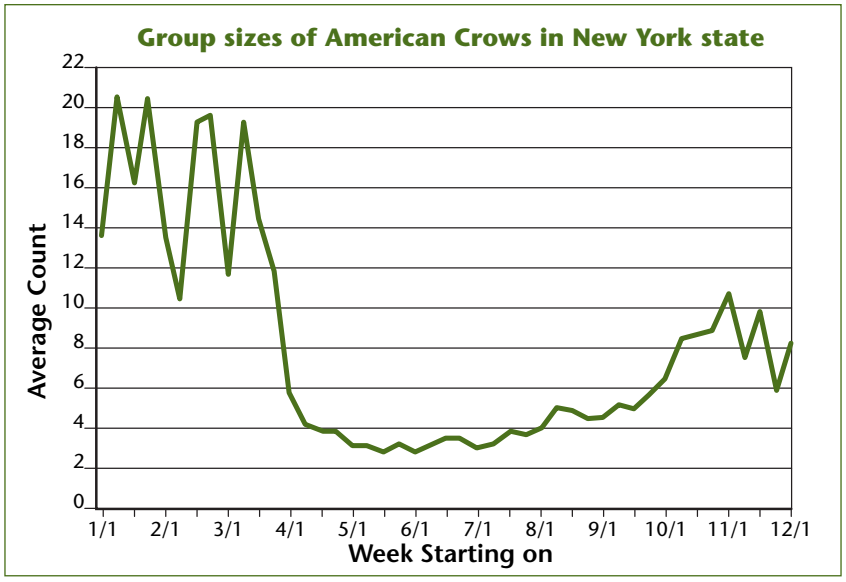


Figure 3: Group sizes of American Crows. From www.eBird.org

WHAT DO YOU THINK? *Does the group size of American Crows seem to change during the year in New York state?*

Graphing My Data

Scatter Plots

- Scatter plots show at a glance whether a relationship exists between the Dependent and Independent Variables.
- Scatter plots are like line graphs in that the Dependent and Independent Variables are both quantitative, but you don't draw a line through the data points.
- You may wish to draw a "line of best fit" between or near the points to show any correlation or relationship.

Examples

Imagine you wanted to determine whether the availability of food affects the weight of nestlings. You might imagine that the more insects a mother Eastern Bluebird brings to the nest in an hour, the heavier her fledglings will be when they leave the nest. The graph in Figure 4 shows a **positive correlation**; as one variable goes up, the other does too.

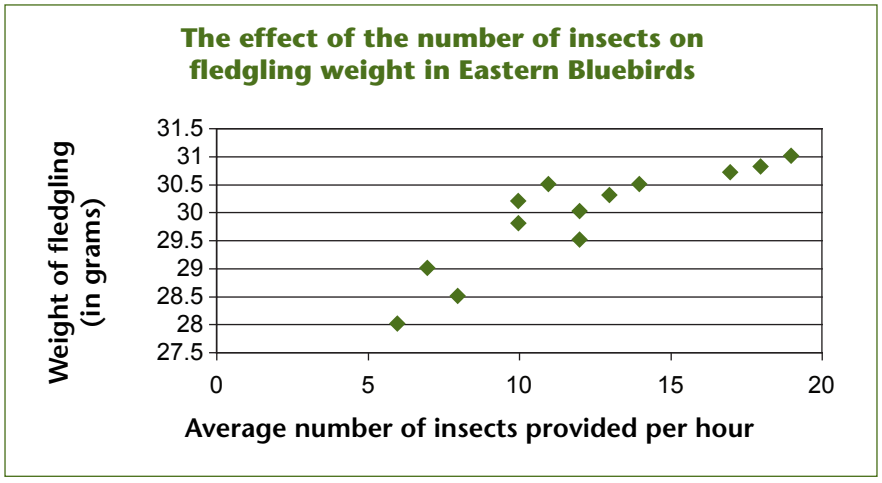


Figure 4: A scatter plot showing a positive correlation

WHAT DO YOU THINK? *What is the range of weights of these Eastern Bluebird fledglings? In this sample, about how much does an average flegling weigh?*

Graphing My Data

Some researchers have found that when it is snowier or colder, birds visit feeders more (perhaps because they burn more energy staying warm, or perhaps when it is colder there is less food available besides seed at feeders, or both). If you graphed this relationship, you would find a **negative correlation**; as one variable goes up, the other goes down. See Figure 5.

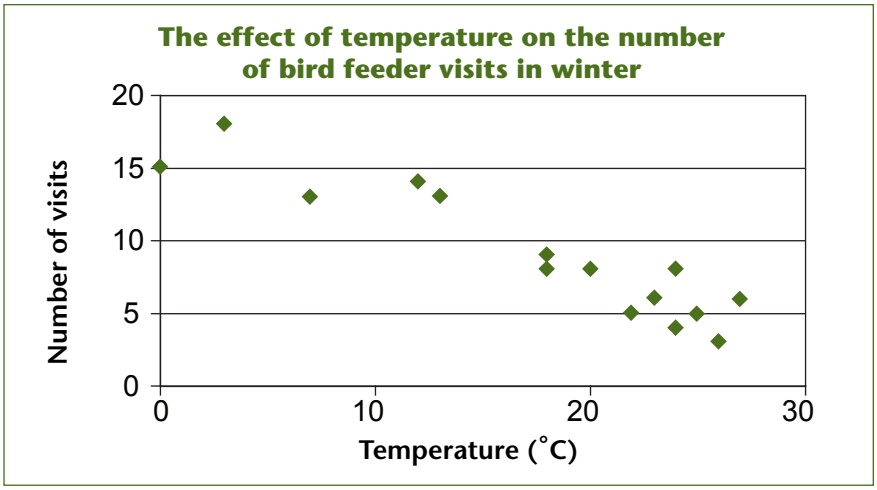


Figure 5: A scatter plot showing a negative correlation

Conclusion

After you summarize your data in graphs, you might notice a trend in the data, or you might find no trend at all. Either will help you draw conclusions about the evidence of data in your experiment or observational study, and show others what you found, too!

The "I Wonder" Kid

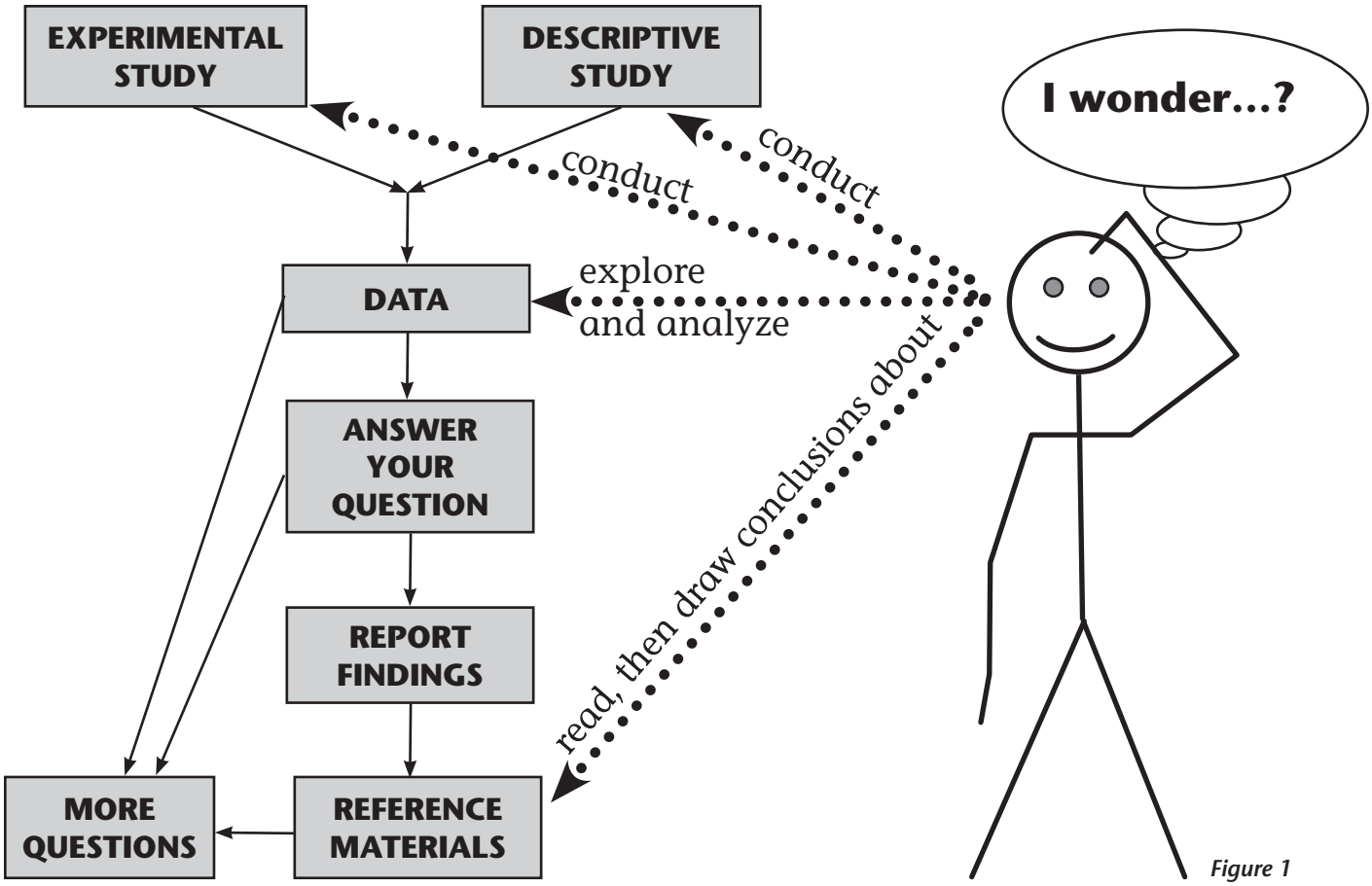


Figure 1

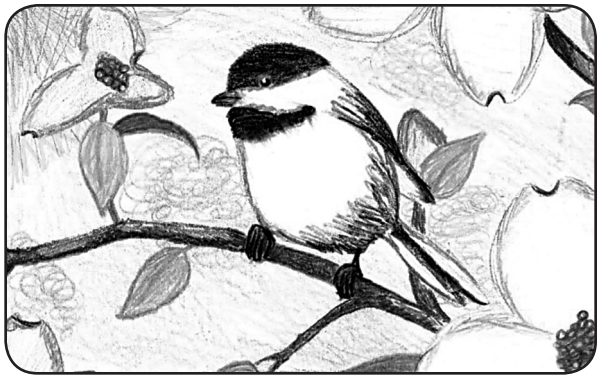
Where will you jump into the process?

Depending on your question, you can enter the process of science at different stages. Look at the dotted arrows to see where this student scientist could jump into the scientific process. Some conduct their investigations through **experimental** *or* **descriptive** *studies, some start by* **exploring and analyzing data** *from a database (like eBird, for example), and still others find answers by* **pulling together information** *they find in reference materials such as books or web sites.*

Annalisa's Report

The Effect of Temperature on Chickadees

by Annalisa, 10th Grade
Tualatin Valley Junior Academy, Hillsboro, OR
Mr. Kahler



Black-capped Chickadee by Caitlyn, Grade 7, Tualatin Valley Junior Academy, Hillsboro, OR, Mr. Kahler

Introduction

I decided to study Black-capped Chickadees and Chestnut-backed Chickadees observed at our feeding station. Both birds are found in mature forests near streams, which makes Downy Creek (near my school) the perfect haven for these active birds. I wanted to know if the temperature affected the number of birds seen eating at our feeders. I predicted that on colder days, I would observe more chickadees than on warmer days. I based this prediction on the fact that spiders and insects—the main food of these little birds—are scarce when it's cold, causing the birds to seek food from feeders.

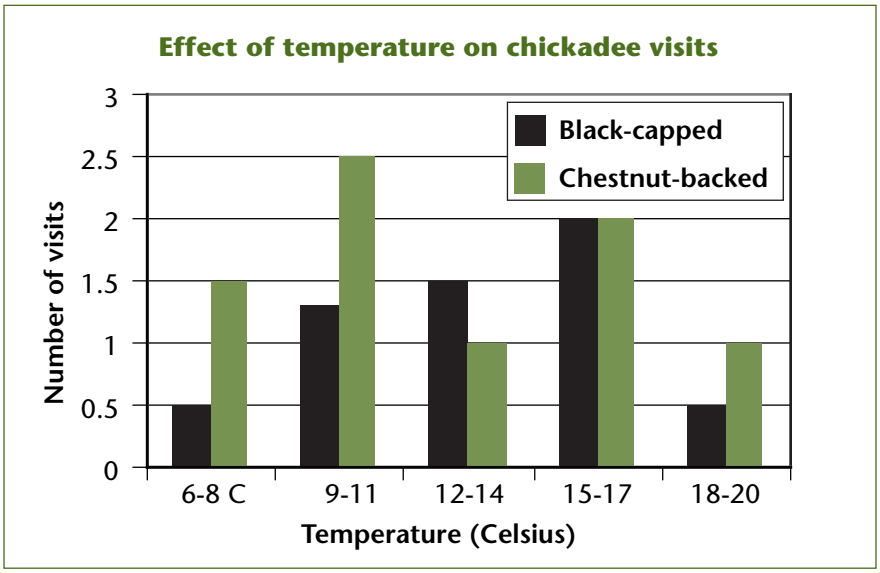
Materials and Methods

I observed the feeders at the bird blind in the wooded area behind the school on 13 different days from November through March. At Downy Creek, we offer birds a variety of birdseed in feeders and on the ground, and suet at feeders hanging from several trees. On each data collection day, my biology class would write weather information on our bird tally sheets, walk to the bird blind, count birds, and compare data. Then we entered the information on the web site. Each bird watch was about 15 to 30 minutes long and took place in the afternoon around 2:30 P.M.

Results and Analysis

The greatest number of Black-capped Chickadees seen on an observation day was three. The greatest number of Chestnut-backed Chickadees seen on an observation day was four. I saw these species on about half the days I watched: on five of the days, no Black-capped Chickadees were observed, and on six of the days, no Chestnut-backed Chickadees were observed. The temperature on observation days fluctuated from 6° C to 20° C (from 43° F to 68° F). I calculated an average number of visits for each temperature category and created a bar graph to see if there were any trends in the data. See my graph.

Annalisa's Report



Discussion and Conclusion

It seems that temperature did not affect chickadee feeding habits at our feeders. They came and went in the same numbers on very cold days as they did on warmer ones. On a day when the temperature was 19˚ C (66˚ F), the highest observation day temperature, we saw no chickadees of either kind. Neither did we see any when it was 6˚ C (43˚ F), the lowest temperature. Looking at my graph, there was no definite pattern in my data, therefore, I must reject my hypothesis that there will be more chickadees present on colder days.

I originally thought that when the temperature was low, I would observe more chickadees than on warmer days. I believed colder days would bring more chickadees looking for food. However, the range of temperatures we had during the study was not large (43-66˚ F). None of the days was below freezing. A longer study over more temperatures might provide a better idea whether temperature affects these species' feeding habits.

Jerry Acton

Black-capped Chickadee

Linda Lamb

Chestnut-backed Chickadee

Sharing My Investigation

Scientists write research papers so they can share their results and ideas with others. Scientific papers and posters include the following kinds of information:

- What were our questions?
- How did we do our research?
- What data did we collect?
- What do the data mean?
- What conclusions can we draw from our research?

To be sure all of this information is in every paper or poster, scientists use a standard outline for their writing:

1. Introduction
2. Materials and Methods
3. Results and Analysis
4. Discussion and Conclusions
5. References (if any)

Introduction

The Introduction explains why you decided to conduct your research. For example, what questions are you trying to answer? What information about previous research or existing knowledge do you have? How did this background help you decide what to do in your own research?

Materials and Methods

The Materials and Methods section provides a clear description of exactly what you did and how you did it. For example, if you conducted a study of the birds at a feeder, what kind of feeder did you use? Where did you set it up? How often did you observe the feeder? How often did you make your observations? What kinds of data did you record? How did you record your data? You should provide enough information so other people can understand what you did and can duplicate your work.

You might also give information about the habitat around your study area. This information is often important in helping other scientists understand your results.

Sharing My Investigation

Results and Analysis

Present your data, including any charts and graphs, in the Results section. For example, what birds did you see? How many birds did you count? What was the temperature? The Results section often contains graphs or tables that summarize the data.

The Results section should match your Materials and Methods section. That is, if you present temperature data in the Results section, the Materials and Methods section should say when and how you measured the temperature. If you explain in the Materials and Methods section that you were looking for certain species of birds, the Results section should show how many of those species you actually observed, even if the number was zero.

In the Analysis section, tell what you think the results mean. For example, did the weather affect bird counts? Was one kind of seed eaten more frequently than another? Patterns that you discovered in the Results section are described in the Analysis section.

Discussion and Conclusion

In the Discussion section, report the conclusions of your study by answering the question(s) you asked in the Introduction. For example, did you discover what you thought you would find? Were the results different from what you expected? What have you learned from your analysis?

For example, if you asked questions about what kinds of food the birds in your area like, and you discovered that they prefer black-oil sunflower seeds, your Discussion might be about what kinds of seeds people in your area should put in their feeders.

The Discussion section is also the place to include ideas about future research studies. You may have answered the big questions you started with, but now the answers lead to new questions. Put those new questions in the Discussion.

References

If you used any books, articles, or web sites, list them here.

Once you have written all these sections, go back and check your work to see if everything is there, if it's in the right order, and if it makes sense.