In the United States, the Food and Drug Administration requires that most prepared food be labeled with nutrition information. Today part of the data set for the lesson was gathered from the list of required nutrition facts that appear on boxes of breakfast cereals.

Below are the nutrition facts for three cereals. There is a lot of information given. An entire math lesson could probably be designed around reading and understanding the information given on cereal labels. For now though, you will look over the labels fairly quickly, like you might do in the grocery store. Use your initial impressions to pick the cereal that you would rate as the most nutritious (the best for your health). You have a few minutes to do this.

serving)	ize 1	.U CI	ıp (1 NL	.EA
Amount Pe	r Sen	ving		
Calories	117	Ca	lories fr	om Fat 9
			% Dai	ly Value
Total Fat	1g			1%
Saturated Fat 0g				1%
Polyunsa	aturat	ted	Fat 0g	
Monoun	satur	ated	Fat 1g	
Choleste				0%
Sodium 1	71m	g		7%
Total Car	bohy	dra	te 26g	9%
Dietary F				3%
Sugars 1				
Protein 1	g			
Vitamin A	0%	•	Vitamin	C 10%
Calcium 1	0%	•	Iron 309	6
* Percent Da 2,000 caloric higher or low needs:	e diet. ver de Calo	Your pend ries:	daily valuing on you	e may be
Total Fat	Less		- 0	80g
Sat Fat	Less			25g
Cholesterol Sodium			2,400mg	300mg 2,400mg
Total Carbol			300a	2,400mg 375g
Dietary	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		25g	30g

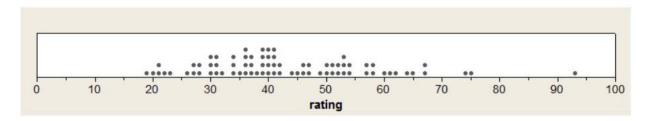
Serving Si serving)	ize 1.	0 cu	ıp (1 NL	.EA			
Amount Pe	r Serv	ing					
Calories	101	Ca	lories fr	om Fat			
% Daily Valu							
Total Fat	0g			09			
Saturate	d Fat	0a		09			
Polyunsa			at 0g				
Monouns	satura	ited	Fat 0g				
Cholester			3	09			
Sodium 2		_		89			
Total Carl			e 24a	89			
Dietary F				39			
Sugars 3		- 3					
Protein 2	_						
Vitamin A		. ,	Vitamin	C 10%			
Calcium 0							
			ron 54%	· ·			
* Percent Da 2,000 calorie higher or low needs:	e diet. ver dep	Your	daily valu	e may be			
	Less	than	65g	80g			
Total Fat			200	25g			
Sat Fat	Less		- 0				
Sat Fat Cholesterol	Less	than	300mg	300mg			
Sat Fat Cholesterol Sodium	Less Less	than than	300mg 2,400mg	300mg 2,400mg			
Sat Fat Cholesterol	Less Less	than than	300mg	300mg			

serving s	ize 1.0 c	cup (1 NL	EA
Amount Pe	er Serving	1	
Calories	111 Ca	lories fro	m Fat 16
		% Dai	ly Value *
Total Fat	2g		3%
Saturate	d Fat 0c	1	2%
Polyunsa	aturated	Fat 1g	
Monoun			
Choleste			0%
Sodium 2			9%
Total Car		ate 22a	7%
Dietary F		are LLg	14%
Sugars 1	The second second		1470
Protein 4			
		20.220.000.000	
Vitamin A		Vitamin	C 10%
	2% .	Iron 69%	6
Calcium 1	_		
Calcium 1 * Percent Da 2,000 calorie higher or lov needs:	e diet. You	ur daily valu ding on you	e may be
* Percent Da 2,000 calorie higher or lov	e diet. You wer depend	ur daily valuding on you 2,000	ie may be ir calorie
* Percent Da 2,000 calorie higher or lov needs:	e diet. You wer depend Calories:	ur daily valu ding on you 2,000 n 65g	e may be ir calorie 2,500
* Percent Da 2,000 calorie higher or low needs: Total Fat Sat Fat Cholesterol	Calories: Less tha Less tha Less tha	ur daily valuding on you 2,000 n 65g n 20g n 300mg	2,500 80g 25g 300mg
* Percent Da 2,000 calorie higher or lov needs: Total Fat Sat Fat Cholesterol Sodium	Calories: Less tha Less tha Less tha Less tha	ur daily valu ding on you 2,000 n 65g n 20g n 300mg n 2,400mg	2,500 80g 25g 300mg 2,400mg
* Percent Da 2,000 calorie higher or low needs: Total Fat Sat Fat Cholesterol	Calories: Less tha Less tha Less tha Less tha	ur daily valuding on you 2,000 n 65g n 20g n 300mg	2,500 80g 25g 300mg

#### Part I

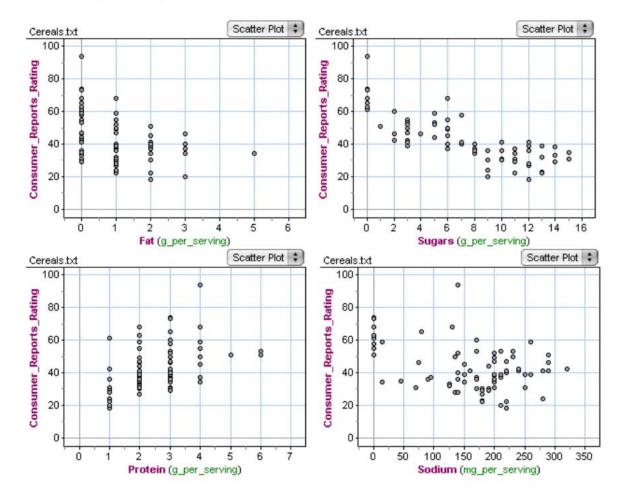
Instead of making up your own rating system, you are going to investigate the *Consumer Reports* nutritional ratings for 77 breakfast cereals. *Consumer Reports* is published by a nonprofit organization called the Consumers Union, whose mission it is to work for a fair, just, and safe marketplace for all consumers and to empower consumers to protect themselves. *Consumer Reports* rates products based on its own criteria and testing. It prides itself on producing objective results. *Consumer Reports* maintain its objectivity by not allowing advertising within their publications and not allowing use of their results for commercial gain. (Retrieved from www.consumerreports.org/cro/aboutus/mission/overview/index.htm)

Consumer Reports uses a rating system with a scale of 0 to 100. Here is the distribution of Consumer Reports ratings for 77 cereals:



- What does each dot represent in this distribution?
- · For this distribution, what seems to be an average rating?
- How would you describe the variability in ratings?
- How would you describe the shape of this distribution? What does the shape suggest about the rating system?

What you cannot tell from the dotplot is how the cereal ingredients (such as sugar or fat) are related to the ratings. You need a new type of graph, called a scatterplot, to investigate how two variables relate to each other. The scatterplots below show the amount of an ingredient in a serving of cereal and the *Consumer Reports* rating for 77 breakfast cereals.



The Consumer Reports rating formula is not made public. So, you do not know which ingredients are used in its rating formula. In this lesson, you will try to "crack their code" in a sense. Use the data to figure out which ingredients Consumer Reports may, or may not, use in their rating formula. The only clues you have are these scatterplots.

The first step in this investigation is to answer the following two questions AND write down enough of your reasoning that someone can follow your thinking.

Two new cereals are being rated by Consumer Reports. Cereal A has 10.5 grams of sugar in a serving and Cereal B has 2.5 grams of protein in a serving.

(1) Based on the data shown, predict the Consumer Reports rating for the two cereals.

(2) For which cereal do you think your prediction is probably more accurate (more likely to be closer to the actual Consumer Report rating)? Why?

## Part II: Scaffolded Conceptual Tasks

### Task 1: Reading and Interpreting Scatterplots

In this task, you are going to take a short detour from your investigation into which ingredients are the best predictors of *Consumer Reports* ratings. Here, you will work on interpreting scatterplots just to make sure everyone is comfortable with reading this new type of graph.

(3)	Captain Crunch has the lowest Consumer Reports rating of the 77 cereals in the data set. H	ow
	much fat is in a serving of Captain Crunch?	

(4) In this set of 77 cereals, Product 19 has the most sodium in a serving. What is the rating for Product 19?

(5) All-Bran Extra Fiber is the cereal with the highest rating. How much sugar, fat, and sodium are in a serving of All-Bran Extra Fiber?

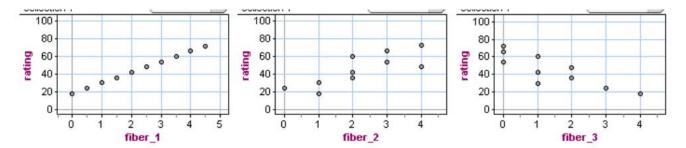
#### Conceptual Task 2: Seeing Patterns and Relationships in Scatterplots

Now you will continue your detective work with *Consumer Reports* ratings. Try to identify ingredients that are good predictors of ratings and ingredients that are not. More importantly, focus on how patterns in the data are related to identifying ingredients that are good predictors.

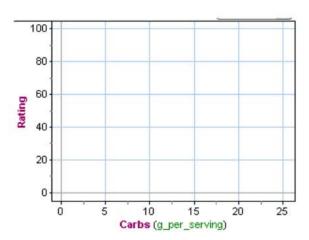
(6) There are four cereals that have 3 grams of fat in a serving. Estimate the ratings for these four cereals. What might explain the variability in the ratings?

(7) Imagine changing the recipe for a cereal that has 0 grams of fat in a serving and a rating of 60. Increase the amount of fat to 3 grams in a serving. Do you think the rating will probably increase or decrease or remain about the same? Or do you think that it is impossible to use the scatterplot to predict the impact of this change on the rating? How does the pattern in the data support your decision?

(8) Think about how the amount of fiber in a cereal might relate to the *Consumer Reports* rating. Here are three scatterplots with make-believe data from 10 made-up cereals. Which scatterplot do you think displays a pattern similar to what you may see in the actual data? Why?



(9) Suppose that carbohydrates are not used in the Consumer Reports rating formula. Sketch a scatterplot with make-believe data from 10 makebelieve cereals to illustrate what the data might look this situation.



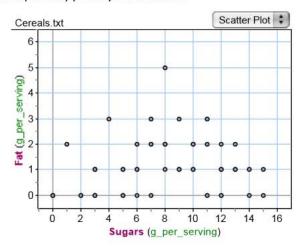
#### Part III: Homework

(10) Summarize what you feel you learned today.

(11) The average *Consumer Reports* rating for these 77 cereals is 44. What is the largest amount of sugar per serving in a cereal that has above average ratings?

(12) Which is a better predictor of the *Consumer Reports* ratings: sugar or sodium? Explain how the scatterplots support your answer.

(13) A friend says that she only pays attention to sugar amounts, even though she is also concerned by fat. Her reasoning is that low levels of sugar signal that the food also has low amounts of fat. Similarly, high levels of sugar signal that the food also has high amounts of fat. Does this appear to be true for breakfast cereals? Explain how the scatterplot supports your answer.



# Supporting Lesson 3.1.2: Developing an Intuitive Sense of Form, Direction, and Strength of the Relationship Between Two Measurements

#### Estimated number of 50-minute class sessions: 1

#### **Learning Goals**

Students will understand that

- each point on the scatterplot represents a single observation consisting of measurements on two variables.
- the overall pattern in a scatterplot can be described in terms of the direction, form, and strength of the relationship between the two measurements.
- the linear relationship between two measurements is positive if smaller values of x tend to correspond to smaller values of y and larger values of x tend to correspond to larger values of y.
- the linear relationship between two measurements is negative if smaller values of x tend to correspond to larger values of y and larger values of x tend to correspond to smaller values of y.

Students will be able to distinguish between

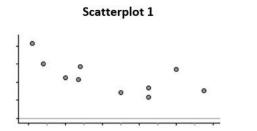
- · linear and nonlinear relationships,
- strong and weak relationships, and
- positive and negative linear relationships.

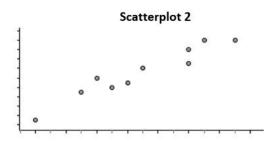
#### Introduction [Student Handout]

In this lesson, you will compare and contrast a variety of scatterplots with the goal of thinking about how to describe relationships you see in the data. At the end of the lesson, you will discuss ways that statisticians describe these relationships.

#### Tasks [Student Handout, 15 minutes]

(1) Match each set of measurements to a scatterplot, and briefly explain your reasoning.





- (a) x = city miles per gallons and y = highway miles per gallon for 10 cars
- (b) x = sodium (milligrams/serving) and y = Consumer Reports quality rating for 10 salted peanut butters

(Answer: Scatterplot 1: b, Scatterplot 2: a)

(2) For each scatterplot in Question 1, describe what a dot represents.

(Answer: Scatterplot 1: Each dot is a peanut butter. Scatterplot 2: Each dot is a car.)