Lesson 5

Plotting the Temperature

Goal

Create a mathematical model of bivariate data using a scatter plot.

Learning Target

I can model data.

Lesson Narrative

In this second in the sequence of optional lessons, students construct a mathematical model to investigate if there is an association between latitude and temperature. The lesson begins with an example of a scatter plot and how to talk about associations seen in data. Then students create and answer questions about the data they gathered or the data provided in the lesson. In either case, students create a scatter plot of the data and approximate a line of best fit. They must make decisions about reasonable values when creating their axes and interpreting the data.

Student Learning Goal

Let's construct a model.

Access for Students with Diverse Abilities

- Representation (Activity 2)

Access for Multilingual Learners

- MLR5: Co-Craft Questions (Activity 1)

Instructional Routines

- MLR5: Co-Craft Questions
- Notice and Wonder

Required Materials

Materials to Gather

- Dried linguine pasta: Activity 2

Lesson Timeline

5 min	15 min	15 min
Warm-up	Activity 1	Activity 2

Warm-up

Notice and Wonder: California Rain

5 min

Activity Narrative

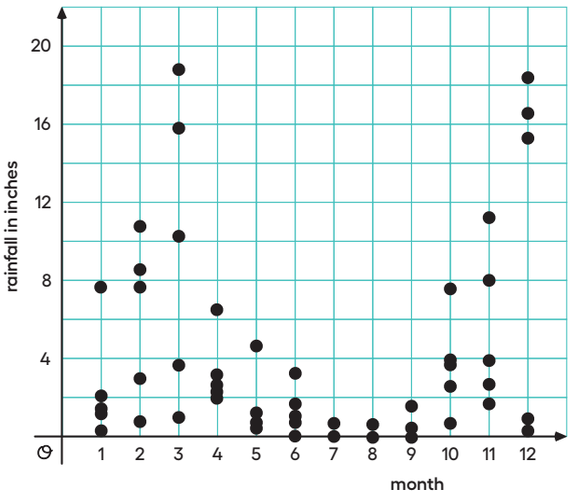
The purpose of this *Warm-up* is to remind students of associations in scatter plots, which will be useful when students analyze a scatter plot in a later activity. While students may notice and wonder many things about the scatter plot, associations are the important discussion points. This *Warm-up* prompts students to make sense of a problem before solving it by familiarizing themselves with a context and the mathematics that might be involved.

Launch

Keep students in the same groups. Display the scatter plot for all to see. Ask students to think of at least one thing they notice and at least one thing they wonder. Give students 1 minute of quiet think time, and then 1 minute to discuss the things they notice and wonder with their partner.

Student Task Statement

What do you notice? What do you wonder?



Students may notice:

- There is hardly any rainfall in the summer.
- Most of the rainfall happens in December through March.
- The high rainfall totals happen in December and March, and they are about 19 inches for each month.
- For some months (for example, March), the rainfall varies a lot year to year.

Students may wonder:

- Why does it rain less in the summer than in the winter?
- Why are the dots so spread out in the colder months?

Instructional Routines

Notice and Wonder

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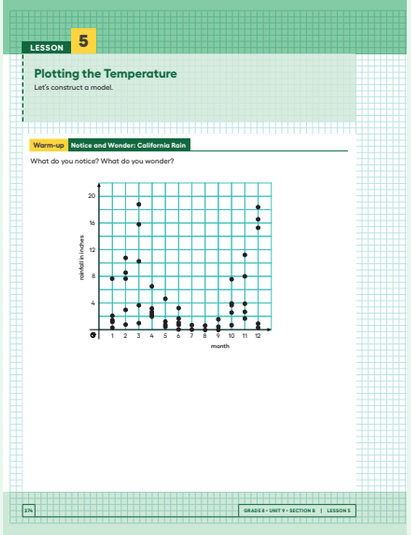
Please log in to the site before using the QR code or URL.

Student Workbook


LESSON 5
Plotting the Temperature
Let's construct a model.
Warm-up Notice and Wonder: California Rain
What do you notice? What do you wonder?

Instructional Routines

MLR5: Co-Craft Questions

ilclass.com/r/10695544
Please log in to the site before using the QR code or URL.

Activity Synthesis

Ask students to share the things they noticed and wondered. Record and display their responses without editing or commentary for all to see. If possible, record the relevant reasoning on or near the scatter plot. Next, ask students,

💬 *"Is there anything on this list that you are wondering about now?"*

Encourage students to observe what is on display and respectfully ask for clarification, point out contradicting information, or voice any disagreement.

If the association between month and amount of rain does not come up during the conversation, ask students to discuss this idea.

Discuss what each point in the scatter plot represents (rainfall during that month for one given year). Ask students to describe general patterns visible in the plot. Ask,

💬 *"Is there a pattern of association?"*

Yes, it is not linear, but it is possible to say that there is more rain in the winter and less rain in the summer.

Activity 1
Data Snooping

15 min

Activity Narrative

The task statement provides data students can analyze for the remainder of this lesson. It gives the average high temperature in September in different locations across North America. This is only one possible choice for data to analyze. If appropriate, students can instead use the data collected for locations from the earlier lesson. If the class-collected data set is used, the instructions are the same. As students interpret the data they are reasoning about the situation.

Launch

Keep students in the same groups. After the data has been collected or using the given data, use *Co-Craft Questions* to orient students to the context and elicit possible mathematical questions.

Display only the data table, without revealing the questions. Give students 1–2 minutes to write a list of mathematical questions that could be asked about the situation before comparing questions with their group.

Invite several groups to share one question with the class and record responses. Ask the class to make comparisons among the shared questions and their own. Ask,

- *"What do these questions have in common? How are they different?"*

Listen for and amplify language related to the learning goal, such as

- *"Is there an association between latitude and temperature?".*

Reveal the question

- *"Do you see an association between the two variables? If so, describe the association."*

Then give students 1–2 minutes to compare it to their own question and those of their classmates. Invite students to identify similarities and differences by asking:

- *"Which of your questions is most similar to or different from the ones provided? Why?"*

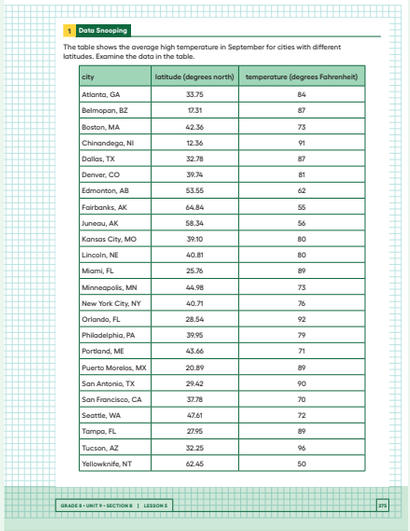
"Is there a main mathematical concept that is present in both your questions and those provided? If so, describe it."

After discussing the questions students created, have them answer the questions provided. If time allows, invite students to answer any class-created questions they find compelling.

Access for Multilingual Learners (Activity 1)

MLR5: Co-Craft Questions
This activity uses the *Co-Craft Questions* math language routine to advance reading and writing as students make sense of a context and practice generating mathematical questions.

Student Workbook



1 Data Snooping

The table shows the average high temperature in September for cities with different latitudes. Examine the data in the table.

city	latitude (degrees north)	temperature (degrees Fahrenheit)
Atlanta, GA	33.75	84
Belmopan, BZ	17.31	87
Boston, MA	42.36	73
Chinandega, NI	12.36	91
Dallas, TX	32.78	87
Denver, CO	39.74	81
Edmonton, AB	53.55	62
Fairbanks, AK	64.84	55
Juneau, AK	58.34	56
Kansas City, MO	39.10	80
Lincoln, NE	40.81	80
Miami, FL	25.76	89
Minneapolis, MN	44.98	73
New York City, NY	40.71	76
Orlando, FL	28.54	92
Philadelphia, PA	39.95	79
Portland, ME	43.66	71
Puerto Morelos, MX	20.89	89
San Antonio, TX	29.42	90
San Francisco, CA	37.78	70
Seattle, WA	47.61	72
Tampa, FL	27.95	89
Tucson, AZ	32.25	96
Yellowknife, NT	62.45	50

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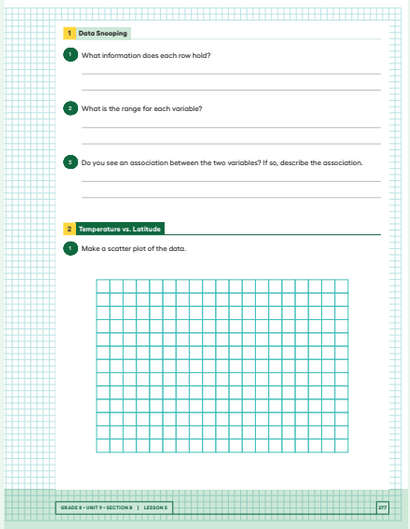
Student Workbook



1 Data Snooping

1. What information does each row hold?
2. What is the range for each variable?
3. Do you see an association between the two variables? If so, describe the association.

2 Temperature vs. Latitude

1. Make a scatter plot of the data.

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Student Task Statement

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1. What information does each row hold?

Each row lists a city, its latitude, and its average high temperature in September.

2. What is the range for each variable?

For latitude, the minimum value is 12.63 degrees north in Chinandega, NI, and the maximum is 64.84 degrees north in Fairbanks, AK. For temperature, the low is 50 degrees Fahrenheit for Yellowknife, NT, in Canada, and the maximum is 96 degrees Fahrenheit for Tucson, AZ.

3. Do you see an association between the two variables? If so, describe the association.

It looks like locations with smaller latitudes have higher temperatures, and locations with higher latitudes have lower temperatures.

Activity Synthesis

Make sure students understand the information listed in the table.
Invite students to share their answers to the question about association.
In the next activity, students will plot their data to see if the association they see in the table would be modeled well by a linear function.

Activity 2

Temperature vs. Latitude

15 min

Activity Narrative

In this activity, students use the data from the previous activity and draw a scatter plot and a line that fits the data. The given data show a clear linear association, so it is appropriate to model the data with a line. Students can use a piece of dried linguine pasta or some other rigid, slim, long object (for example, wooden skewer) to eyeball the line that best fits the data. (The line of best fit has a variance of $R^2 = 0.83$.) Even though different answers will have slightly different slopes and intercepts, they will be close to each other.

Launch

Keep students in the same groups of 3–4. Remind students that we are developing a model to predict the temperature based on a location's latitude. We have fixed other variables to focus on just latitude and temperature, collected data from a variety of locations, and now we will graph the data. Provide access to pieces of dried linguine pasta.

Access for Students with Diverse Abilities (Activity 2, Student Task)

Representation: Internalize Comprehension.
Use multiple examples and non-examples for a best fit line. Consider displaying charts and examples from previous lessons to aid in memory recall.
Supports accessibility for: Conceptual Processing, Attention

Student Workbook

Data Snooping Handout 1 of 1

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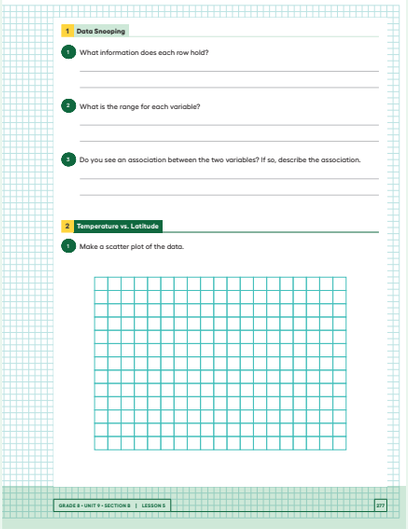
Building on Student Thinking

If students are stuck on making the scale on the graph, consider asking:

"What information do you need to decide the scale?"
"How could you use the range from earlier to help you decide the scale?"

Student Workbook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1 Make a scatter plot of the data.

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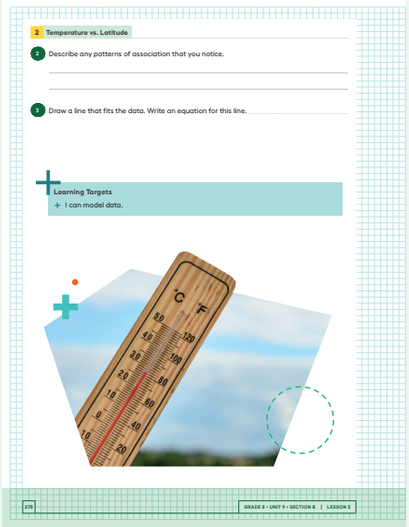
Student Workbook


2 Temperature vs. Latitude

2 Describe any patterns of association that you notice.

3 Draw a line that fits the data. Write an equation for this line.

Learning Targets
+ I can model data.

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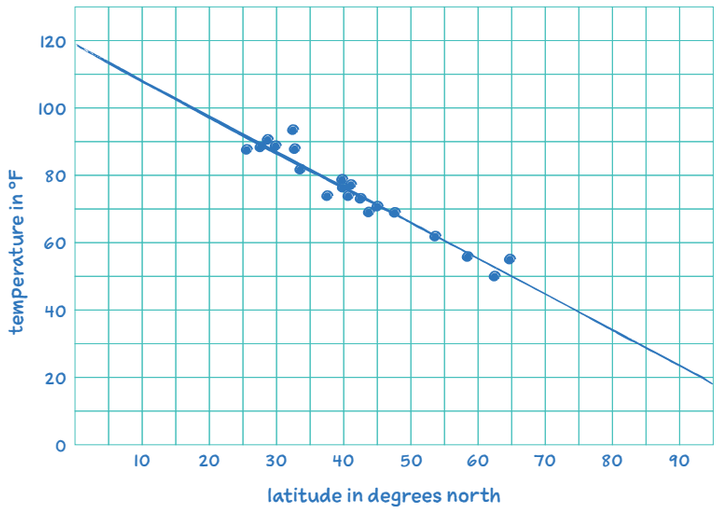
Student Task Statement

1. Make a scatter plot of the data.



2. Describe any patterns of association that you notice.

There seems to be a negative association. A line fits the data quite well.

3. Draw a line that fits the data. Write an equation for this line.

The line is shown above. The line's equation is $y = -0.87x + 111$, where x is latitude and y is temperature. This equation was computed with software. A line drawn and equation determined by eye, without this technology, should have a slope of approximately -1, and a y-intercept of approximately 110 degrees Fahrenheit.

Activity Synthesis

At the start of the discussion, make sure students agree that there seems to be a negative association that looks like a line would fit the data nicely before moving on.

Invite several groups to share the equations they came up with and how they found them. They will likely have slightly different slopes and intercepts. Ask students to explain where those differences come from.

Not everyone chose the same points to guide the trendline they drew for the data.

The differences should be small and the different models give more or less the same information. In the next activity, students will be using the model (equation and graph) to make predictions.