17 *People, Weather, and Climate*

TALKING IT OVER
2–3 CLASS SESSIONS

ACTIVITY OVERVIEW

NGSS CONNECTIONS

In this culminating activity, students analyze data for a fictional city. The data relate to local atmospheric, water, weather, and climate conditions. Students have an opportunity to apply their understanding of these topics as they attempt to determine whether humans are affecting local conditions and what can be done to mitigate any such impact.

NGSS CORRELATIONS

Performance Expectations

Applying MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

Disciplinary Core Ideas

MS-ESS3.D Global Climate Change: Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.

MS-ESS3.C Human Impacts on Earth Systems: Typically as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

MS-ESS3.A Natural Resources: Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes. These resources are distributed unevenly around the planet as a result of past geologic processes.

Science and Engineering Practices

Analyzing and Interpreting Data: Analyze and interpret data to provide evidence for phenomena.

Using Mathematics and Computational Thinking: Use mathematical representations to describe and/or support scientific conclusions and design solutions.

Engaging in Argument from Evidence: Use an oral and written argument supported by evidence to support or refute an explanation or a model for a phenomenon.

Crosscutting Concepts

Patterns:

Patterns can be used to identify cause and effect relationships.

Graphs, charts, and images can be used to identify patterns in data.

Patterns in rates of change and other numerical relationships can provide information about natural and human designed systems.

Cause and Effect:

Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability.

Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation.

Stability and Change: Stability might be disturbed either by sudden events or gradual changes that accumulate over time.

Connections to Engineering, Technology and Applications of Science: Influence of Science, Engineering, and Technology on Society and the Natural World: All human activity draws on natural resources and has both short- and long-term consequences, positive as well as negative, for the health of people and the natural environment.

Common Core State Standards—ELA/Literacy

RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

SL.8.1: Engage effectively in a range of collaborative discussions with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.

WHST.6-8.1: Write arguments focused on discipline-specific content.

WHAT STUDENTS DO

Students role play atmospheric scientists, climatologists, hydrologists, and meteorologists who analyze data summarizing weather, climate, water usage, and atmospheric conditions for the fictional Sunbeam City. Students consider the possible link between population growth and changes in local weather, atmosphere, and water availability. They then make recommendations about ways to reduce humans' impact on local conditions.

MATERIALS AND ADVANCE PREPARATION

- *For the teacher*
    1   Scoring Guide: EVIDENCE AND TRADE-OFFS (E&T)
    1   Visual Aid 2.1, "Comparing Temperature Scales" (optional)

- *For each group of four students*
    1   Student Sheet 17.1, "Atmospheric Scientist's Report"
    1   Student Sheet 17.2, "Climatologist's Report"
    1   Student Sheet 17.3, "Hydrologist's Report"
    1   Student Sheet 17.4, "Meteorologist's Report"

- *For each pair of students*
★   1   calculator (optional)

- *For each student*
    1   Student Sheet 2.1, "Scientific Careers in Weather"
    1   Student Sheet 17.5, "Intra-act Discussion: People, Weather, and Climate"
    1   Scoring Guide: EVIDENCE AND TRADE-OFFS (E&T) (optional)

★not included in kit

This activity employs a jigsaw method of instruction. Students are broken up into groups of four for this activity. One student from each group of four students attends a "regional meeting" and reports back to the group. To keep the size of the regional meetings to about four students (rather than eight or more), plan to have two tables for each type of scientist (two meetings of atmospheric scientists, two meetings of climatologists, etc.). Establish a place for the regional meetings by creating signs indicating where each group will meet. You might assign roles and student groups ahead of class.

TEACHING SUMMARY

GET STARTED

1. Review the career-related scientific skills and knowledge that students have developed over the unit.

   a. Review the weather-related careers listed on Student Sheet 2.1, "Scientific Careers in Weather."

   b. Ask students, "Are there common skills and knowledge shared by the weather-related science careers? What skills and knowledge are unique to each career?"

2. Introduce the Sunbeam City scenario.

   a. Direct students to read the scenario in the introduction.

   b. Ask students, "In what ways do you think people can influence the weather and atmosphere? How could you investigate this question?"

DO THE ACTIVITY

3. Set up a cooperative learning strategy known as a jigsaw.

   a. Review the Celsius temperature scale using Visual Aid 2.1, "Comparing Temperature Scales."

   b. Set up a jigsaw method of instruction in the classroom.

4. Students summarize data at expert meetings.

   a. Have students begin the activity by working with their groups on Procedure Steps 1 and 2.

   b. Circulate around the room to help the groups of experts summarize data and identify patterns.

5. (LITERACY) Students present their findings and discuss the Sunbeam City situation with their groups.

   a. Have students return to their original groups.

   b. Hand out Student Sheet 17.5, "Intra-act Discussion: People, Weather, and Climate," and have students evaluate each statement independently.

   c. Have students share their responses.

BUILD UNDERSTANDING

6. (E&T ASSESSMENT) Students discuss possible recommendations to the people of Sunbeam City.

   a. Engage the class in a discussion about human impact on Sunbeam City.

   b. Discuss ways of mitigating the effects of the increasing human population.

TEACHING STEPS

GET STARTED

1. Review the career-related scientific skills and knowledge that students have developed over the unit.

    a. Review the weather-related careers listed on Student Sheet 2.1, "Scientific Careers in Weather."

    Ask students, "What did you learn about these different careers that you did not know at the beginning of the unit?" Encourage the class to brainstorm and create a list of their ideas. If students are having difficulty providing responses, take a few minutes to review previous activities in the unit. Ask, "Which of these careers do you now think is most interesting? Why?" Have different students share their ideas. Then ask students to summarize or highlight some of the career-related skills and knowledge that they have built over the course of the unit.

    b. Ask students, "Are there common skills and knowledge shared by the weather-related science careers? What skills and knowledge are unique to each career?"

    Make a list on the board of similarities and differences. For example, even though a climatologist and meteorologist both study the movement of global winds, a climatologist would be more likely to study these changes over a longer period of time. Use these questions to provide an opportunity to draw common threads among the careers and highlight ways they are specialized.

DO THE ACTIVITY

2. Introduce the Sunbeam City scenario.

    a. Direct students to read the scenario in the introduction.

    The activity begins with the story of fictional Sunbeam City, a city with a climate that continues to attract new residents. This population growth has drawn the attention of city planners who are concerned that the increase in population is causing changes in the city's weather, atmosphere, and water availability.

    b. Ask students, "In what ways do you think people can influence the weather and atmosphere? How could you investigate this question?"

    Allow students to suggest answers to these questions. Explain that in this activity, they will evaluate data relevant to this question.

Teacher's note: Sunbeam City is a fictional city set in the American southwest. It is presented as fictional to keep students from projecting any bias. Some, but not all, of the statistics provided are similar to data for a city in the U.S. Southwest.

3. Set up a cooperative learning strategy known as a jigsaw.

    a. Review the Celsius temperature scale using Visual Aid 2.1, "Comparing Temperature Scales."

        Because students will be analyzing weather and climate data in degrees Celsius, you might want to review the Celsius temperature scale. During this activity, students will also apply the observation and teamwork skills. Reiterate the idea that scientists work together to produce more-complete work than they could individually.

    b. Set up a jigsaw method of instruction in the classroom.

        Explain to students that they will first work in their groups of four to analyze the figure, "Population Changes in Sunbeam City," and to decide who in the group will represent a particular type of scientist. Remind students of the jigsaw structure that they used in the "Ocean Temperatures" activity, where students attended a "regional meeting" of experts before reporting back to their original groups. Identify the areas of the room where different experts will meet. To reduce confusion, you may want to hand out Student Sheets 17.1–17.4 only after students have moved to the regional meeting locations rather than in advance.

4. Students summarize data at expert meetings.

    a. Have students begin the activity by working with their groups on Procedure Steps 1 and 2.

        After students have decided which scientist to role play, they attend an expert meeting. There they work with their specialty group to complete their Student Sheet, summarize their data, and discuss the questions listed in Procedure Step 6.

    b. Circulate around the room to help the groups of experts summarize data and identify patterns.

        Encourage students to construct diagrams and sketches if it will help them interpret the information provided in the reports. Sample responses to the Student Sheets and the discussion questions follow.

PROCEDURE STEP 6 SAMPLE STUDENT RESPONSE

	Atmospheric Scientists	Climatologists	Hydrologists	Meteorologists
What patterns do you observe in your data?	*The amounts of carbon monoxide (19% increase) and particulate matter (90% increase) have each gone up a lot and exceed 2015 EPA limits. Nitrogen oxides have gone up a little (8%), and sulfur dioxide has gone down a little (–4%).*	*Sunbeam City is very sunny, with over 300 days of sunshine. It has a dry climate with very little precipitation year-round. The prevailing winds are from the south/ southwest and can cause dust storms and sandstorms. Factors that affect the climate include the sun's energy, mountains, altitude, and prevailing winds.*	*Most of the city's water comes from Cross Country River, and a small amount comes from groundwater. The amount of groundwater used by the city kept going up from 1945 to 1975, and then it started to go down.*	*Urban heat islands can occur as the number of concrete and other buildings increase in a city. This can result in higher air and surface temperatures in the city. Temperatures were measured for 1961–75 and 2001–2015 for Sunbeam City and the surrounding rural areas.*
Why would people like to live in Sunbeam City?	*The data do not help explain why people would like to live in Sunbeam City.*	*The data do help explain why people would like to live in Sunbeam City. The climate is sunny, warm, and dry year-round.*	*The data do not help explain why people would like to live in Sunbeam City.*	*The data do not help explain why people would like to live in Sunbeam City.*
Is the weather, atmosphere, or available water of Sunbeam City affected by an increase in its population?	*It appears that the atmosphere has been affected by population changes. Amounts of carbon monoxide and particulates have gone up during the same time that the population increased by 83%. Both of these can be released by car exhaust. With more people, there are probably more cars. That doesn't explain why nitrogen oxides have not gone up more, unless that gas was blown away from the area.*	*The data do not show any relationship between weather and population growth.*	*The data do show a relationship between water availability and population growth. The amount of groundwater being used kept increasing until the city passed a law limiting its use. Also, each household uses about 800,000 liters of water each year. As the number of people living in the area increases, the amount of water use will increase.*	*The data do show a relationship between climate and population growth. The mean monthly temperatures appear to be higher in the city than the surrounding rural areas during certain months of the year. The city could be an urban heat island. This would mean that more city development could be changing the temperature of Sunbeam City.*

5. (LITERACY) Students present their findings and discuss the Sunbeam City situation with their groups.

    a. Have students return to their original groups.

        Each student should present their findings to their group.

    b. Hand out Student Sheet 17.5, "Intra-act Discussion: People, Weather, and Climate," and have students evaluate each statement independently.

        This is the second time in this unit that students will be using the Intra-act literacy strategy, which facilitates discussion and helps students synthesize concepts. Have students evaluate each statement on Student Sheet 17.5 independently and record whether they agree or disagree by circling "Agree" or "Disagree" next to each statement in the column titled "Me." Students should then predict the responses of the other three members of the group.

    c. Have students share their responses.

        Group members should take turns revealing how each responded to the four statements and why. As each member shares their opinions, the other group members should compare their predictions to the actual responses. Sample responses to the statements are shown at the end of this activity.

BUILD UNDERSTANDING

6. (E&T ASSESSMENT) Students discuss possible recommendations to the people of Sunbeam City.

    a. Engage the class in a discussion about human impact on Sunbeam City.

        Ask students to take a position on whether humans are having an impact on Sunbeam City. Remind students to cite evidence to support their positions. Analysis item 2 can be used to frame this discussion.

    b. Discuss ways of mitigating the effects of the increasing human population.

        Ask students to share their ideas about possible actions that the people of Sunbeam City could take to reduce the possible impact of people on the city's weather, atmosphere, and water availability. Possible responses include limiting the number of new residents, limiting the number of cars, limiting freshwater use, planting more vegetation, and limiting the number of new housing units. Ask students to identify some of the advantages and disadvantages of each option.

Note that Analysis item 3 can be assessed using the E&T Scoring Guide. Tell students about your expectations for a Level-4 response before you assign the question. If you anticipate that your students may have difficulty answering Analysis item 3, you might use or construct a writing frame to guide their writing. For more information on writing frame strategies, see the Literacy section of Teacher Resources II, "Diverse Learners."

SAMPLE RESPONSES TO ANALYSIS

1. Would a weather map provide more evidence about a possible relationship between population growth and changes in the weather and atmosphere of Sunbeam City? Explain why or why not.

   A weather map provides information about daily weather. In this scenario, a weather map would be of limited use, since it would not explain the general climate of Sunbeam City nor the effect of people on its weather and atmosphere.

2. Based on the evidence in the scientists' reports, is there any possible relationship between population growth and the weather, atmosphere, or water availability of Sunbeam City? Support your answer with evidence from this activity and this unit.

   The data do show a possible relationship. The amount of carbon monoxide and particulate matter have gone up a lot as population increased. One source of these atmospheric pollutants is cars. More people usually means more cars. Also, with more people living there, more water is being used. The amount of groundwater being used is more than the rate at which it recycles back. And lastly, the temperature of the city is sometimes higher than the temperature of the nearby rural areas. This could be because roads and buildings were built for the bigger population.

   Teacher's note: A "no" response would reference evidence from the scientists' reports but state that the evidence is inconclusive.

3. (E&T ASSESSMENT) What do you think the people of Sunbeam City could do to reduce the possible effects of population growth on their weather, atmosphere, and water availability? Make a recommendation to Sunbeam City's residents, explaining what you think should be done and why. Be sure to support your recommendation with evidence and identify the trade-offs.

   Student responses may vary.

   SAMPLE LEVEL-4 RESPONSE

   I think that there should be no new housing built in Sunbeam City. It is clear from the evidence that humans have had an impact on the atmosphere by adding

pollutants from their activities, such as driving vehicles. As the population has grown, so has the use of water, and the climate seems to have changed due to urban heat islands. People moving into Sunbeam City will need places to live. By not allowing new housing to be built, fewer people will find a place to live in the city and therefore fewer people will move there. This will limit population growth. A trade-off is that with no new housing, there will be more competition for existing housing, and that will make living in Sunbeam City less affordable.

Teacher'snote: Other possible responses include the following:

- Plant more trees.

- Further limit the amount of water that can be consumed by households.

- Reduce emissions from cars.

4. In this unit you have learned about global climate change and what the possible effects on Earth's climate could be.

   a. What do you think might be happening to Sunbeam City's climate?

   Sunbeam City's climate seems to be getting warmer. The average temperature in Sunbeam City and the surrounding areas increased each month from the 1961–1975 period to the 2001–2015 period.

   b. What do you predict will happen to Sunbeam City's climate in the future? Explain.

   Global climate change will probably make Sunbeam City even warmer. The historical data show that trend. Since it is already in a desert, it will probably also get drier. If it does, water, especially groundwater, will be a problem. Sunbeam City is growing in population. The increased population will put more of a strain on water resources, and this could lead to even more of a temperature increase.

   c. How certain are you of your prediction? What would make you more certain?

   Based on the available data, an increase in temperature seems likely. More data about rainfall and national weather conditions, including storm data over these two decades, might result in a more accurate prediction.

5. **Reflection:** In this unit, you learned about weather-related careers and the kind of work that scientists in these careers do. Which of these careers is most interesting to you? What kinds of scientific questions or issues would you be most interested in investigating? Why?

Student responses may vary. Students may be interested in investigating scientific questions associated with air pollution, water use, weather patterns, factors influencing climates, and so on. One sample response is shown here:

I am most interested in being a climatologist. We have learned that climates are changing and it looks like human activity is at least part of the cause of these changes. I would like to learn more about the causes and effects of climate change and work with others to help figure out solutions to the problem.

EXTENSION

If students have shown an interest in weather-related careers, encourage them to investigate the education, training, and salaries related to such careers. The *Weather and Climate* page of the SEPUP website *www.sepuplhs.org/middle/third-edition* includes links to information related to various weather-related careers.

REVISIT THE GUIDING QUESTION

Is the growth of Sunbeam City affecting its weather, atmosphere, and water availability?

The data seem to support that population growth in Sunbeam City is affecting the weather, atmosphere, and water.

ACTIVITY RESOURCES

KEY VOCABULARY

atmospheric scientist

atmosphere

climate

climatologist

groundwater

hydrologist

meteorologist

weather

Name_____ Date_____

STUDENT SHEET 17.1

ATMOSPHERIC SCIENTIST'S REPORT

Air Pollutant	Major Source(s)	Important Facts	Percent Change*	Percent change in population, 2005–2015

* To calculate percent change:

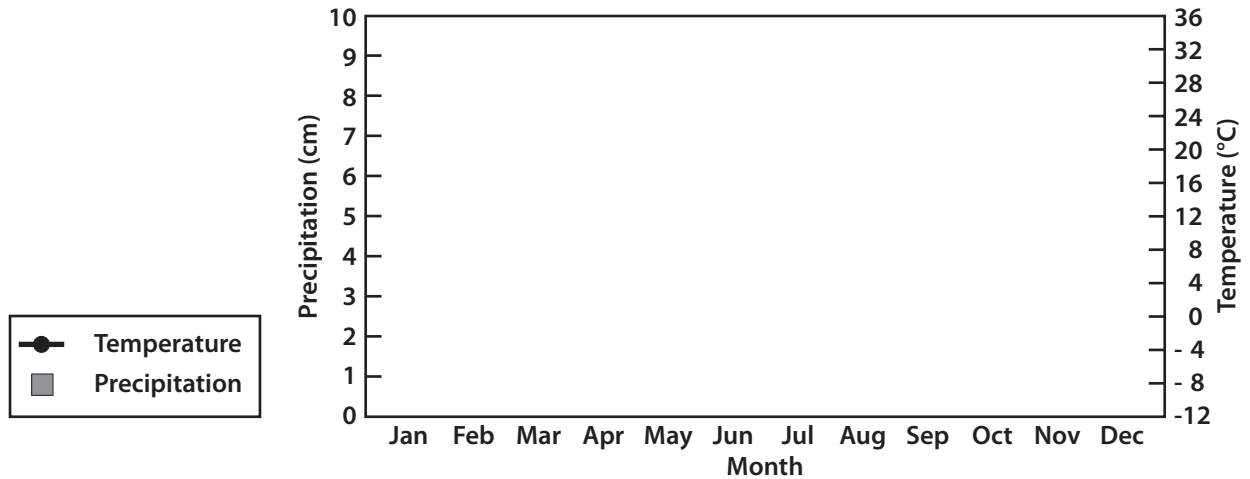$$\frac{(2015\ release - 2005\ release)}{2005\ release} \times 100$$

STUDENT SHEET 17.2

CLIMATOLOGIST'S REPORT

1. **Create a climate graph of the data in the table "Mean Monthly Temperature and Precipitation for Sunbeam City (1986–2015)."**

2. **Use the information from the introduction and the climate types described in the activity "Climate Types and Distribution Patterns" to identify the climate type of Sunbeam City.**

   _____ polar   _____ mild

   _____ severe   _____ dry

   _____ highland   _____ tropical

3. **Identify which climate factors most directly affect the climate of Sunbeam City.**

   _____ energy from the sun

   _____ ocean currents

   _____ presence of large bodies of water

   _____ large landforms, such as mountains

   _____ altitude (height of land above sea level)

   _____ prevailing winds

   _____ cloud cover

4. **Explain how each factor that you identified in item 2 above influences the climate of Sunbeam City. Be as specific as you can.**

   _____

   _____

   _____

Name_____ Date_____

STUDENT SHEET 17.3

HYDROLOGIST'S REPORT

1. **Identify Sunbeam City's water resources by filling the percentage of water that it gets from each of the following sources:**

   _____ **groundwater**

   _____ **oceans**

   _____ **rivers or lakes**

2. **Identify which of the following statements are true (T) and which are false (F).**

   _____ **Sunbeam City businesses use most of the city's water supply.**

   _____ **Sunbeam City gets most of its water supply from the Cross Country River.**

   _____ **The amount of groundwater that is being replenished by natural processes is the same as the amount of groundwater being used.**

3. **Create a line graph of the data in the table "Groundwater Use Since 1945." Be sure to determine the scale of each axis and include the units of measurement.**

Groundwater used (billions of liters per year)

Year
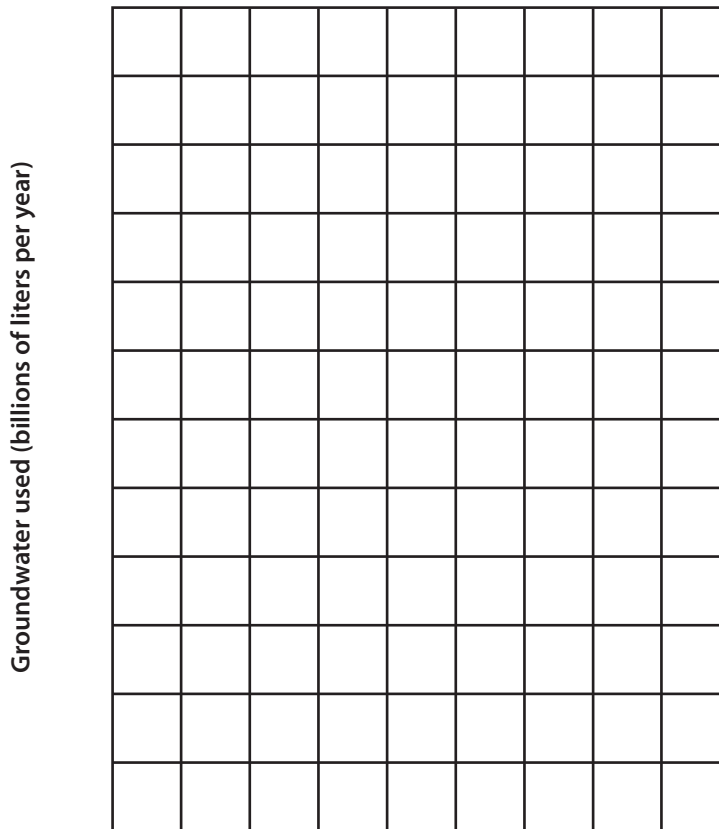
STUDENT SHEET 17.4

METEOROLOGIST'S REPORT

1. **Complete the following two tables by calculating the change in temperature over time.**

   Table A: Change in Temperature for Sunbeam City from 1961–1975 to 2001–2015

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Change in Temperature (°C)												

   Table B: Change in Temperature for Rural Areas Outside of Sunbeam City from 1961–1975 to 2001–2015

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Change in Temperature (°C)												

2. **Determine if the change in temperature in Sunbeam City is more, less, or the same as the rural areas outside of the city by calculating the difference in temperature between the two areas.** *Hint: Subtract your Table B data from your Table A data.*

   Difference in Temperature Change

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Difference in Temperature Change (°C)												

3. **Based on your analysis, is Sunbeam City an urban heat island? Explain your conclusions, and support your findings with specific evidence.**

   _____

   _____

   _____

   _____

   _____

Name_____ Date_____

STUDENT SHEET 17.5

INTRA-ACT DISCUSSION: PEOPLE, WEATHER, AND CLIMATE

1. **Sunbeam City will soon run out of freshwater.**

   _____

   _____

   _____

   _____

2. **The atmosphere of Sunbeam City is different from the atmosphere at other places over Earth's surface.**

   _____

   _____

   _____

   _____

3. **The best climate is one where there is lots of sunshine and very little rain.**

   _____

   _____

   _____

   _____

4. **People can change the weather and atmosphere of a place.**

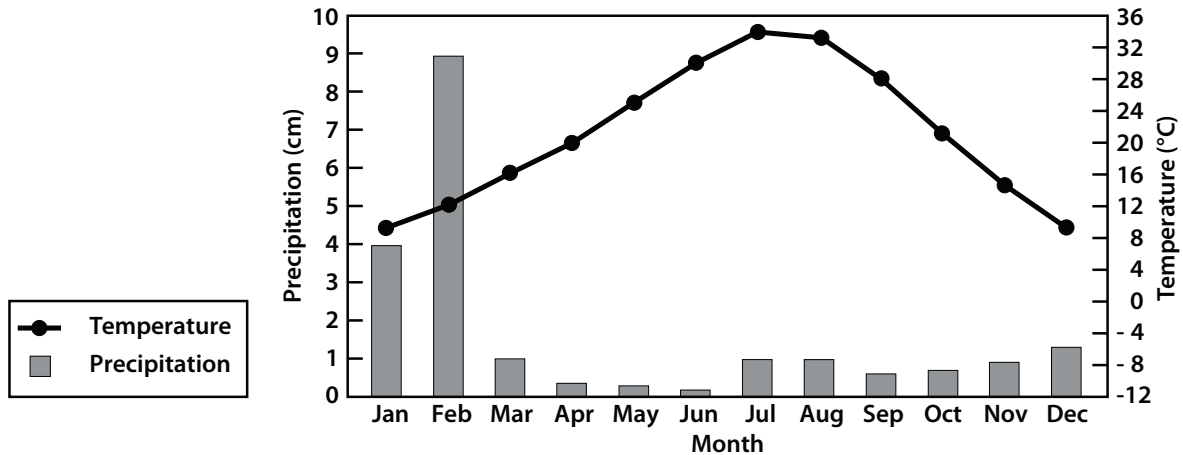   _____

   _____

   _____

   _____

STUDENT SHEET 17.1

ATMOSPHERIC SCIENTIST'S REPORT

Air Pollutant	Major Source(s)	Important Facts	Percent Change*	Percent change in population, 2005–2015
Carbon monoxide	Car exhaust	In cities, 85–95% from cars; Sunbeam City exceeded 2015 EPA limits	19%	
Nitrogen oxides	Car exhaust	Colorless, odorless, brownish in smog; can form acid rain; can be blown over long distances by prevailing winds	8%	
Sulfur dioxide	Power plants	Can be blown over long distances	–4%	19%
Particulate matter	Cars, power plants, construction sites, dust, pollen	Solid and liquid pollutants in the atmosphere; harmful if inhaled; Sunbeam City exceeded 2015 EPA limits	90%	

STUDENT SHEET 17.2

CLIMATOLOGIST'S REPORT

1. Create a climate graph of the data in the table "Mean Monthly Temperature and Precipitation for Sunbeam City (1986–2015)."

2. Use the information from the introduction and the climate types described in the activity "Climate Types and Distribution Patterns" to identify the climate type of Sunbeam City.

   _____ polar   _____ mild

   _____ severe   __X__ dry

   _____ highland   _____ tropical

3. Identify which climate factors most directly affect the climate of Sunbeam City.

   __X__ energy from the sun

   _____ ocean currents

   _____ presence of large bodies of water

   __X__ large landforms, such as mountains

   __X__ altitude (height of land above sea level)

   __X__ prevailing winds

   _____ cloud cover

4. Explain how each factor that you identified in item 2 above influences the climate of Sunbeam City. Be as specific as you can.

   The sun's energy contributes to the sunny climate, with more than 300 days of sunshine per year.

   The mountains keep a lot of precipitation from reaching the city, causing a dry climate.

   The altitude results in cooler nighttime temperatures (sometimes more than 15°C lower than daytime highs).

   The prevailing winds can cause dust storms and sandstorms.

STUDENT SHEET 17.3

HYDROLOGIST'S REPORT

1. **Identify Sunbeam City's water resources by filling the percentage of water that it gets from each of the following sources:**

   _10–15%_ **groundwater**

   _0%_ **oceans**

   _85–90%_ **rivers or lakes**

2. **Identify which of the following statements are true (T) and which are false (F).**

   _T_ **Sunbeam City businesses use most of the city's water supply.**

   _T_ **Sunbeam City gets most of its water supply from the Cross Country River.**

   _F_ **The amount of groundwater that is being replenished by natural processes is the same as the amount of groundwater being used.**

3. **Create a line graph of the data in the table "Groundwater Use Since 1945." Be sure to determine the scale of each axis and include the units of measurement.**
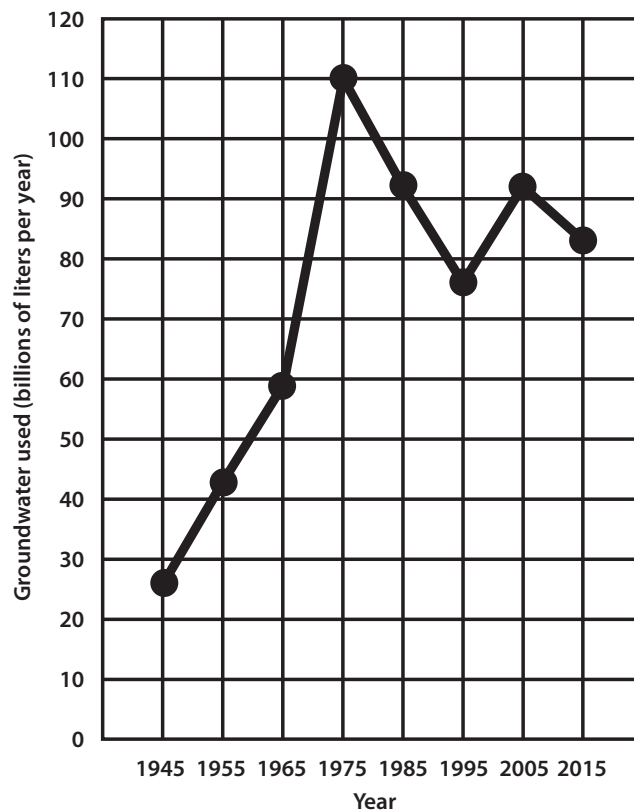
STUDENT SHEET 17.4
METEOROLOGIST'S REPORT

1. **Complete the following two tables by calculating the change in temperature over time.**

   Table A: Change in Temperature for Sunbeam City from 1961–1975 to 2001–2015

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Change in Temperature (°C)	*2*	*2*	*6*	*3*	*3*	*2*	*1*	*3*	*3*	*6*	*5.5*	*2*

   Table B: Change in Temperature for Rural Areas Outside of Sunbeam City from 1961–1975 to 2001–2015

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Change in Temperature (°C)	*2.5*	*2*	*4*	*3*	*3*	*1*	*1*	*3*	*3*	*3*	*2*	*3*

2. **Determine if the change in temperature in Sunbeam City is more, less, or the same as the rural areas outside of the city by calculating the difference in temperature between the two areas.** *Hint: Subtract your Table B data from your Table A data.*

Difference in Temperature Change

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Difference in Temperature Change (°C)	*0.5*	*0*	*2*	*0*	*0*	*1*	*0*	*0*	*0*	*3*	*3.5*	*1*

3. **Based on your analysis, is Sunbeam City an urban heat island? Explain your conclusions, and support your findings with specific evidence.**

   Based on data over a 40-year period, Sunbeam City appears to be an urban heat island certain months of the year. In March, October, and November, the city had temperatures that were 2°–3.5°C warmer than the surrounding rural areas. This could be because of the population increase during the same period, and there was probably a lot more construction of roadways and buildings.

Name   *Sample student response*   Date

STUDENT SHEET 17.5

INTRA-ACT DISCUSSION: PEOPLE, WEATHER, AND CLIMATE

1. **Sunbeam City will soon run out of freshwater.**

   Student responses may vary. Two sample responses are shown here:

   I agree with the statement because the population is increasing while the amount of available groundwater is limited (both by law and by nature), and the amount of available Cross Country River water is limited (by law).

   I disagree with the statement because there are solutions to the availability of water, including purchasing water from other states, using more of the groundwater, and piping in water from elsewhere. Earth's water is constantly being recycled and is not disappearing. That means that water should be available for use from somewhere else.

2. **The atmosphere of Sunbeam City is different from the atmosphere at other places over Earth's surface.**

   Student responses may vary. Two sample responses are shown here:

   I agree with the statement because the amount of certain atmospheric pollutants is increasing, and this appears to be a regional issue.

   I disagree because the troposphere is made up primarily of nitrogen and oxygen gases, and Sunbeam City's atmosphere should not be significantly different from the rest of the troposphere.

3. **The best climate is one where there is lots of sunshine and very little rain.**

   Student responses may vary. Two sample responses are shown here:

   I agree with the statement because that's what it's like where I live, and we can do lots of outside activities all year long.

   I disagree with the statement because I like snow and cold weather activities. Also, rain is an important part of the water cycle.

4. **All scientific ideas are discovered by experimentation.**

   Student responses may vary. Two sample responses are shown here:

   I agree with the statement based on my analysis of the data, in particular, the reports by the atmospheric scientists and the meteorologists. The composition of the atmosphere and the local temperatures are changing due to human actions.

   I disagree with the statement because the composition of the atmosphere is still generally the same, with nitrogen and oxygen making up 99% of atmospheric gases. I don't think there are enough data available to make conclusions about long-term temperature changes in the area.