# Graphs in Environmental Science

*by Sophia*

WHAT'S COVERED

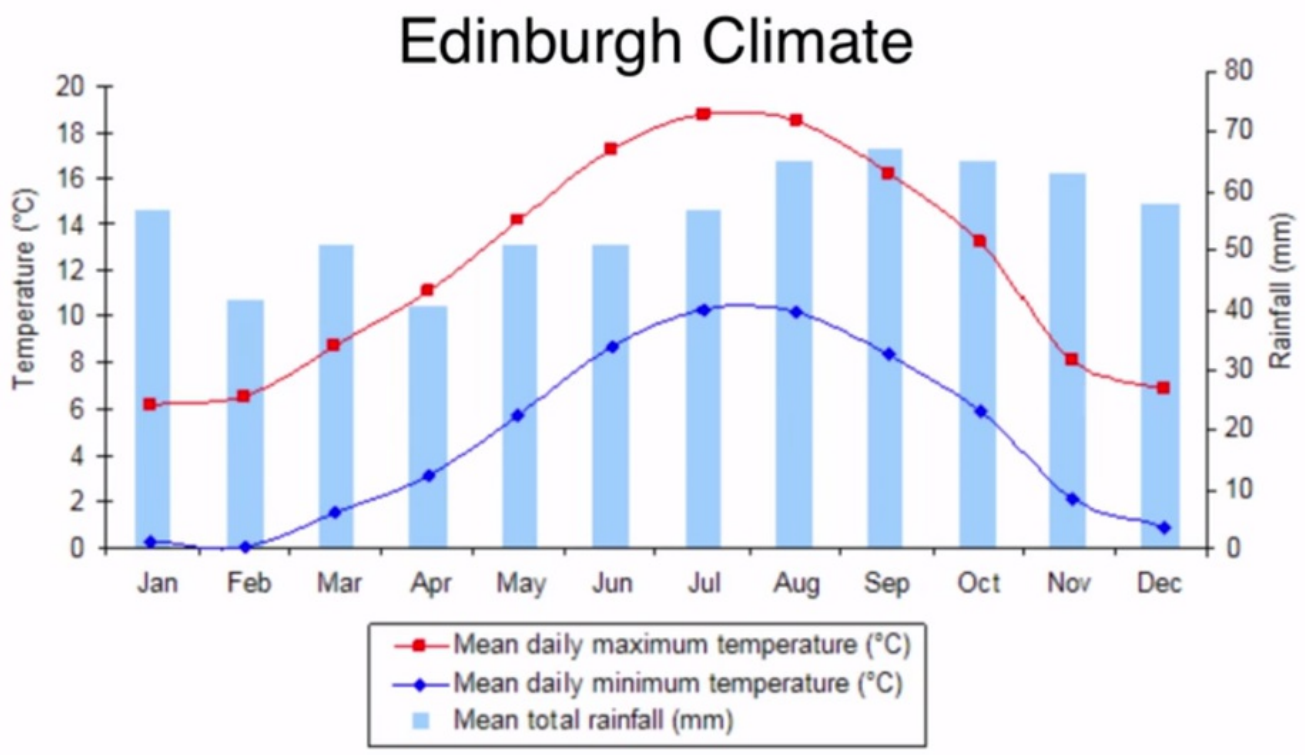
In this lesson, we're going to discuss the topic of graphs in environmental science. We will cover four different examples of graphs that are used in environmental science though there are more that will not be discussed here. We will also explore how graphs can be manipulated to present false or misleading information and discuss examples of environmental photos and their purpose. Specifically, this lesson will cover the following:

## 1. Examples of Graphs in Environmental Science

As mentioned above, we're going to explore four different examples of graphs that are used in environmental science. The image of each graph type will be paired with a written version or description of what the graph is communicating.

### 1a. Line and Bar Graph Combination

The first graph below communicates the climate of Edinburgh, Scotland's capital. It is an example of a combination of a line and a bar graph and is a visual representation of information. The title of the graph is “Edinburgh Climate.” The legend at the bottom explains that the red line graph is for the mean daily maximum temperature, and the blue line is the mean daily minimum temperature. The *x*-axis indicates the time with the months of the year, while the *y*-axis indicates the temperature in °C on the left. This graph also shows rainfall in Edinburgh year-round in millimeters on the right, making for a second *y*-axis.

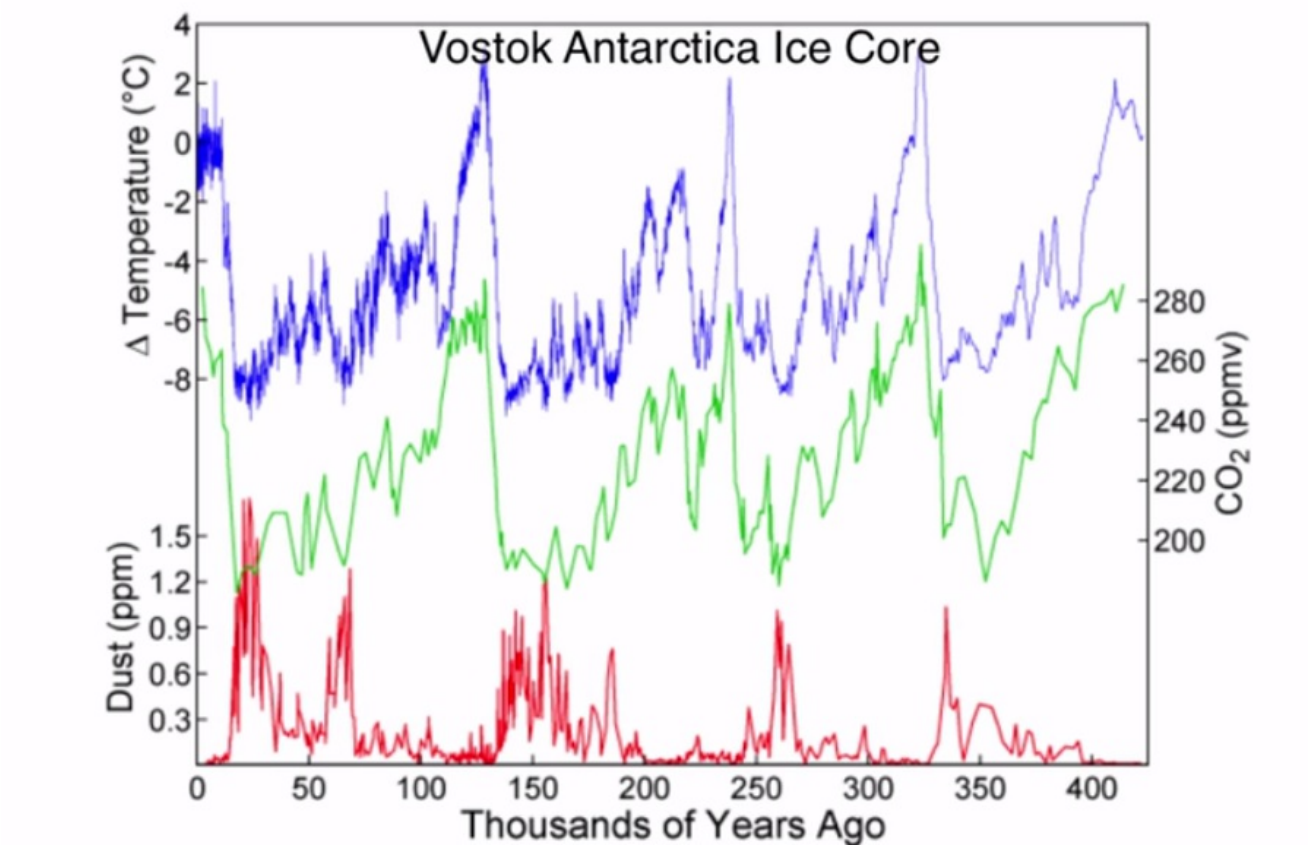



A written version would look something like this:

Edinburgh has a mean peak maximum temperature of about 19 °C in the month of July and a low mean minimum temperature of about 0 °C in the month of February.

## 1b. Line Graph

The next graph is of an ice core sample taken from Vostok, Antarctica. Looking at the graph, you can see the title “Vostok Antarctica Ice Core” at the top. There is no legend in this line chart, but the *x*-axis shows time in thousands of years, starting at the making of the graph and going back 400,000 years. There are three *y*-axes showing three separate units: dust in parts per million, $CO_2$ concentration in parts per million by volume, and change in temperature in °C. The graph shows a cycle of rises and falls in temperature, $CO_2$, and dust over the last 400,000 years.

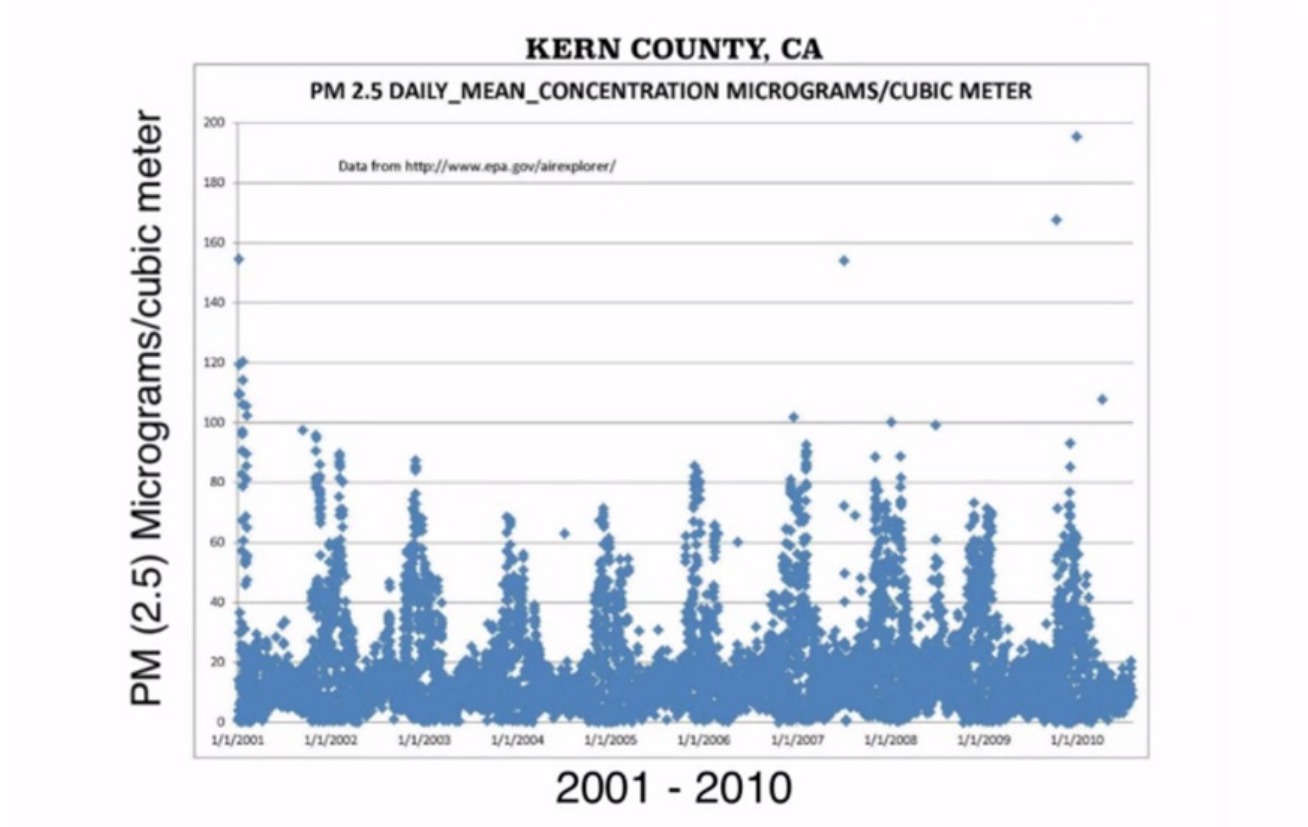



A written version would look something like this:

It shows multiple things, one of which is that the Earth has had multiple peaks in temperature and $CO_2$ concentrations in the atmosphere over the last 400,000 years.

## 1c. Scatter Plot

Next, we're going to look at a visual chart first and then examine a written representation of it. The title of the scatter plot below explains that this chart is about particulate matter pollution of a certain size, which was recorded as a daily mean concentration for Kern County, California. The *x*-axis shows time over the period 2001 to 2010 with a data point for every day of the year. The *y*-axis shows the particulate matter concentration measured at 2.5 µg/m$^3$. Note that a majority of the data points fall below 20 but spike seasonally.

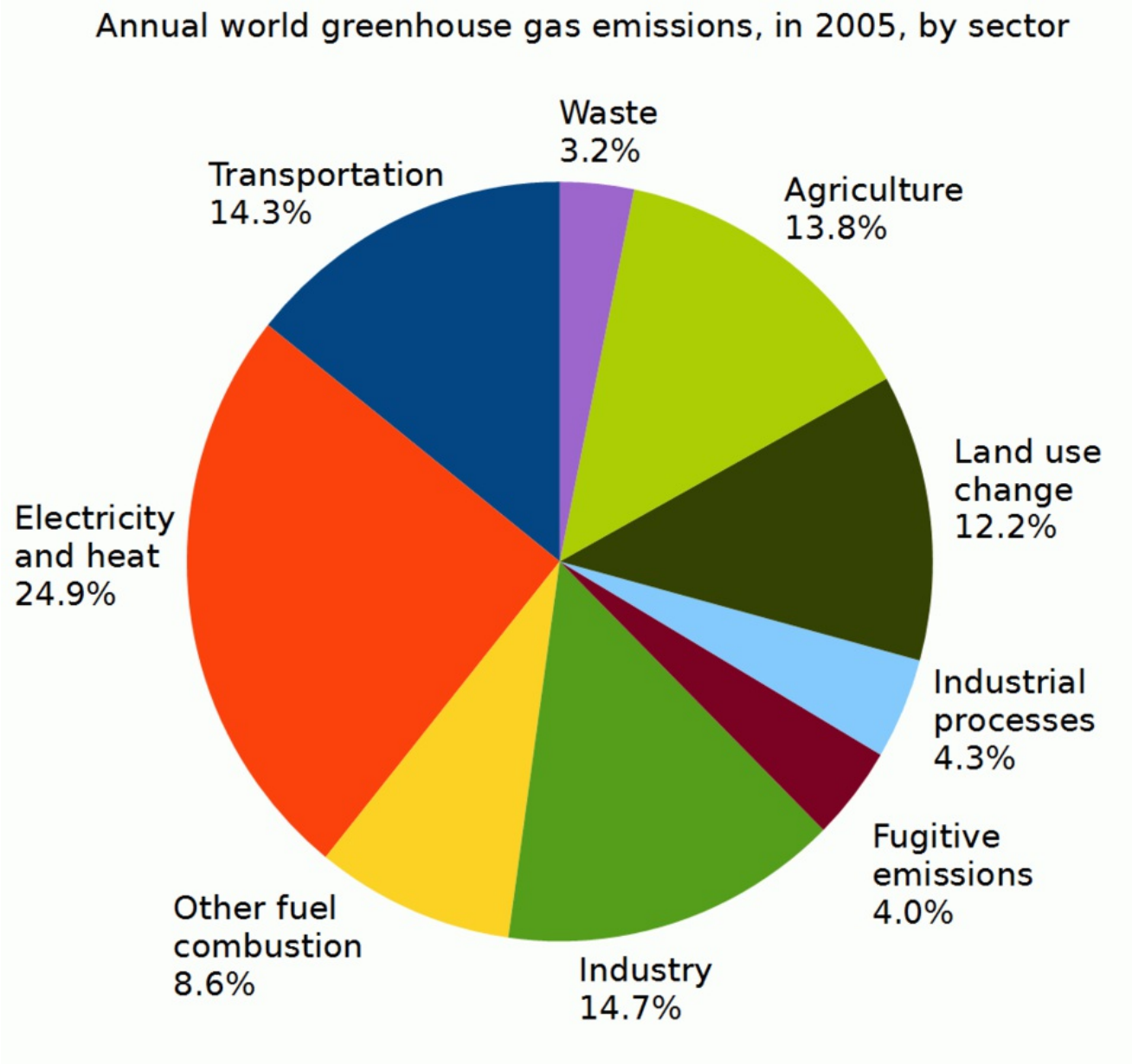



A written version would look something like this:

The daily mean particulate matter for Kern County, California, at 2.5 µg/m³ from 2001 to 2010 had the vast majority of days at or below 20. There is a seasonal variation in the middle of the year, where a spike occurs.

## 1d. Pie Chart

Let's do one more like this. The title of the chart below is "Annual world greenhouse gas emissions, in 2005, by sector." This pie chart doesn't have any axes or legends, but its subdivisions are separated by sector. As you can see, some sections make up larger portions of the pie, while others make up smaller ones.

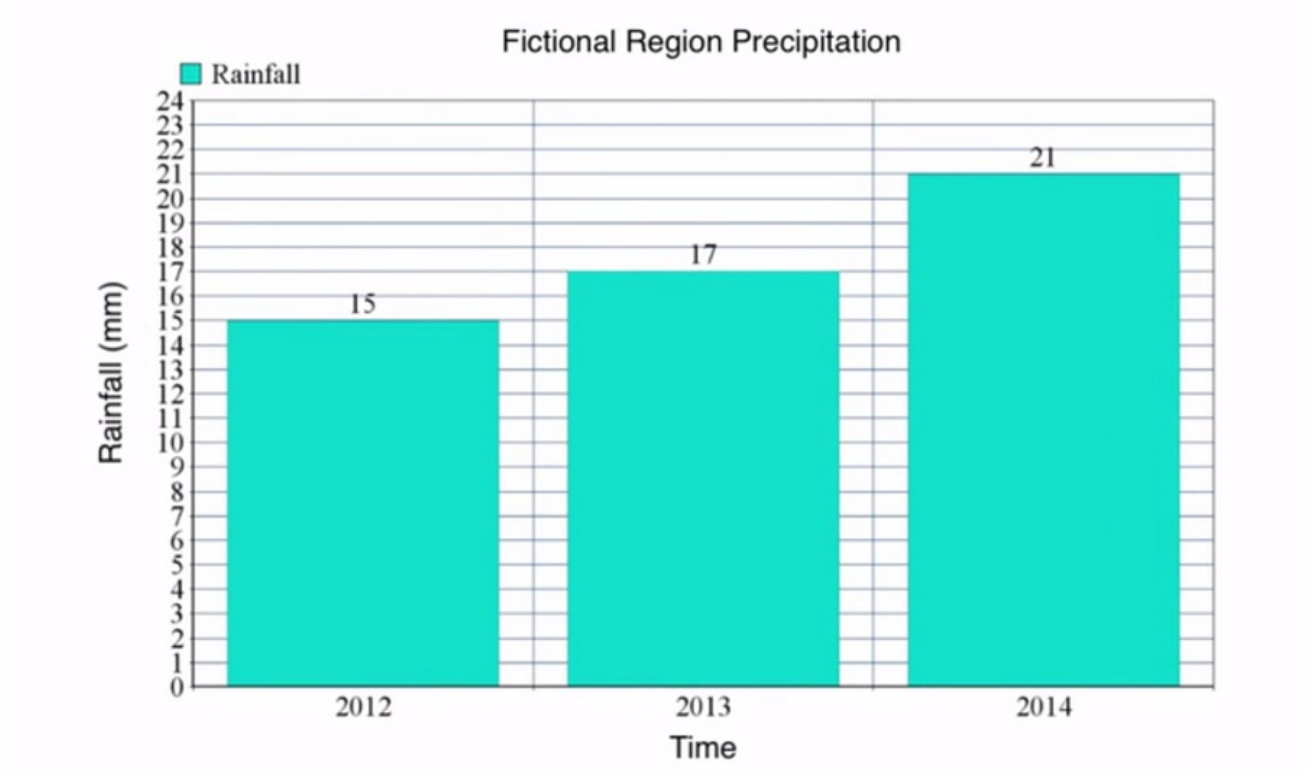



A written version would look something like this:

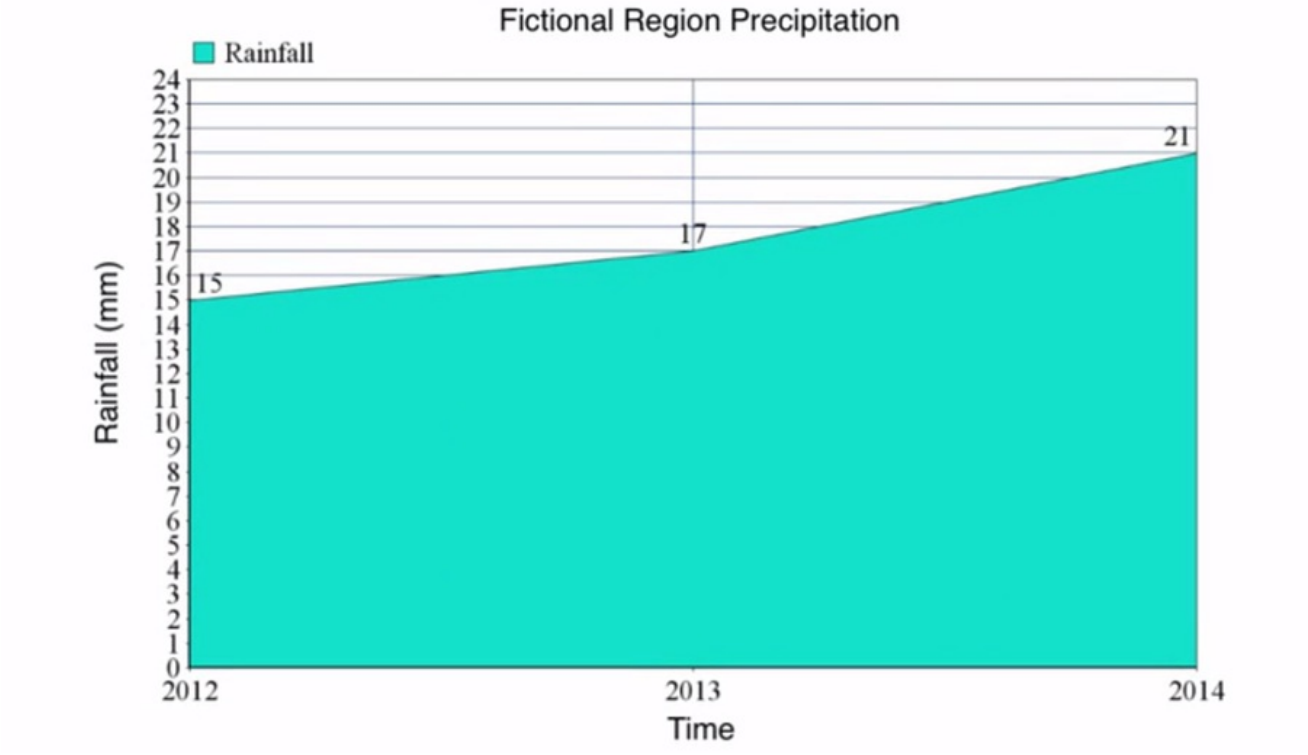
In 2005, a majority of greenhouse gas emissions came from the electricity and heat sector, followed closely by the industry and transportation sectors. A few other sectors produced emissions as well but were only minor emitters.

## 1e. Bar Graph vs. Area Chart

In our last example, we're going to look at two different graph types presenting the same information. The first one is a bar graph of a fictional region. The title "Fictional Region Precipitation" is at the top of the graph. The legend indicates that the bar chart and its color represent rainfall. The *x*-axis represents units of time in years from 2012 to 2014. The *y*-axis represents rainfall in mm. From this graph, it can be concluded that the year with the highest amount of precipitation was 2014.




Next, we have a different chart called an area chart using the same data. Once again, you can see that the title indicates that this is a graph about rainfall in a fictional region. The legend is the same as the previous graph's. The *x*-axis is the same, and the *y*-axis is also the same. However, the data points are represented as shaded-in sections of the graph underneath them. This makes the graph look different, even though it is the same information.




Despite appearances, the same conclusions can be drawn. The written version for both these graphs would look something like this:

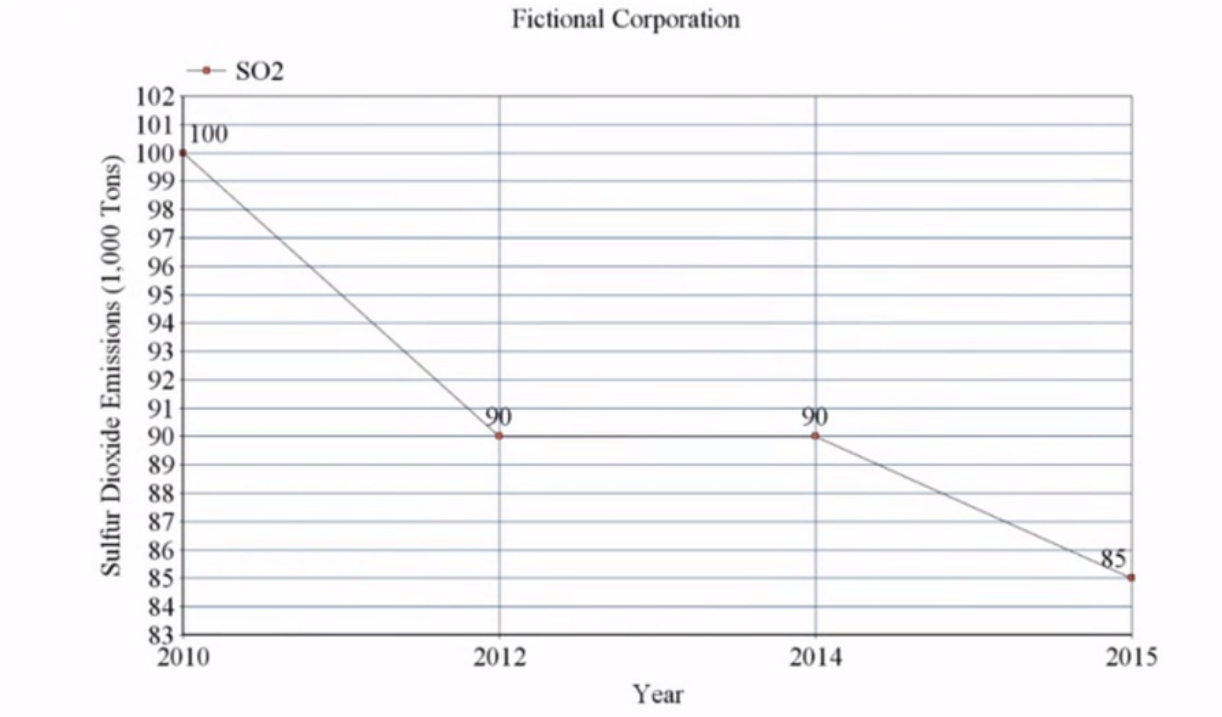
2014 had the highest precipitation in millimeters.

# 2. How Graphs Can Be Misleading

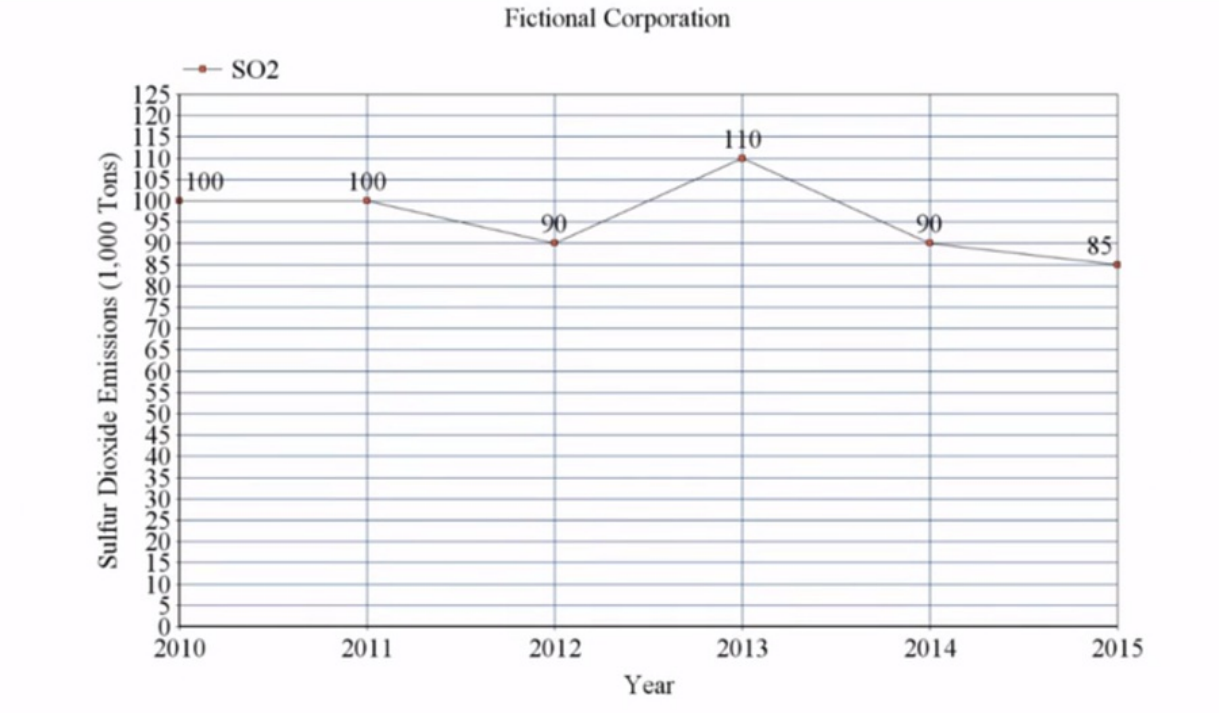
Common ways that graphs mislead viewers are by:

- using a manipulated scale that doesn't begin at zero,
- using a title that misrepresents information,
- using uneven increments on an axis,
- creating a gap in the scale, and
- using a 3D or confusing design to mislead viewers.

↗ EXAMPLE Consider the graph below. It is a made-up graph about a fictional corporation's sulfur dioxide emissions over time. The graph appears to indicate that the company's emissions are going down. However, there's a gap in the scale. The graph only shows data for the years 2010, 2012, 2014, and 2015. The years 2011 and 2013 are entirely missing. This can mislead the viewer's conclusion.




Now let's look at what the graph is like with those 2 years included. You can see that emissions for 2011 were the same as those for 2010 and that emissions for 2013 were higher than emissions in all the rest of the years. The graph below provides a more accurate picture of what the fictional corporation's sulfur dioxide emissions look like from year to year.




# 3. Use of Photographs

Photographs can be used to convey information and generate emotions. Photographs of environmental issues, like the image below of trash collected in a large jumble in the middle of the Pacific Ocean, can convey information on topics, such as oceanic waste.

However, it is not necessarily a purely scientific endeavor. This photo may also have been taken with the purpose of generating feelings of sadness, guilt, or ecological stewardship. The goal of the photo may have been to encourage better ecological behavior, such as recycling, or regulation on dumping of ocean waste.

HINT

Always take into consideration the platform you are consuming scientific information from, and the biases that might be incorporated, depending on the source—be it a scientific journal, an environmentalist magazine, a political source, or popular media.

## SUMMARY

In this lesson, we discussed several **examples of graphs used in environmental science**, which included **line and bar graph combination**, **line graph**, **scatter plot**, and **pie chart**. We discussed **bar graph vs. area chart**. We learned how **graphs can be misleading**. We also learned about the **use of photographs**, which can convey both information and emotion.

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## ATTRIBUTIONS

- Line and Bar Graph Combination | **Author:** World Meteorological Organization | **License:** Public Domain
- Line Graph | **Author:** Unknown | **License:** Creative Commons Attribution-Share Alike 3.0 Unported
- Scatterplot | **Author:** Lldenke | **License:** Creative Commons Attribution-Share Alike 3.0 Unported
- Pie Chart | **Author:** Enescot | **License:** Creative Commons CC0 1.0 Universal Public Domain Dedication
- Scuba Divers | **Author:** Dr. Dwayne Meadows, NOAA/NMFS/OPR. | **License:** Creative Commons Attribution 2.0 Generic