If you were to ask 100 people what tools geographers use to study the earth, one of the first answers you will undoubtedly hear will be “maps.” And it is true that maps are one of the most common tools used to answer geographic questions. A map is a visual representation of the earth, or parts of the Earth and can showcase a variety of spatial scales.

What are those spatial scales? You can represent a very small portion of the map with great details. Below is an embedded map from Google. It is set to a city in Northern Michigan at the largest scale that that particular map can go to. Take a moment to explore that map at different scales and then complete the Google Drive journal activity located here.

A Note On Scale:
The map activity on this page is set to focus on a city in Northern Michigan at the most zoomed-in scale. This is called the largest scale because objects like buildings and roads are shown at their largest size. At a more zoomed-out scale, objects like buildings and roads may be so small that we cannot see them.
Maps

Maps are able to show information about geographic areas. Every map has at least one purpose. They can represent a place such as a neighborhood, a town, a country, or the world overall. Sometimes they can show human features. In the very first map you looked at in the Google Maps link above, what human characteristics such as roads, buildings, etc. were you able to see? When you zoomed all the way out, were you still able to see any human characteristics?

When your parents were younger, they probably went on a trip with their families which involved using a map of a state or region to get to their final destination. Modern technology such as smart phones have GPS built in which has made these two dimensional maps obsolete for that purpose. A road trip is not the only use for a map of a city or a state, however. Maps can represent a variety of different features about a place. There is a small problem with maps however...

If you were to take a balloon and inflate it, then draw a map of the world on it, you could, if you were careful, get a very close approximation of what the world overall looks like. If you were extremely careful you could represent the continents of the earth drawn to a precise scaled size. This is because a balloon is a round, three-dimensional object. A map, however, is a two-dimensional object. If you were to pop that balloon (much like peeling the orange in the video above) what you are left with is a much less useful representation of the earth.

In an attempt to represent a three dimensional object in two dimensions, mapmakers, known as cartographers, have created different ways to represent the earth. These are known as map projections. There are hundreds of different types of projections and each has plusses and minuses in its usage.
Take this map for example. This is known as a Mercator projection. A Mercator projection would be an excellent map for a navigator on a ship. In fact, this kind of map was extremely useful in navigation. One of the problems with this map is the distortion of size. If you look at Greenland on this map, it appears to be huge. Australia, the small continent in the bottom right hand portion of the map, looks like it is much smaller than Greenland. In actuality however, Greenland is much smaller. Antarctica almost appears to be as large as the rest of the continents together. So, while a Mercator Projection is a great map for use in navigation, it does not project the world as it is due to the distorted size of certain areas.

Another well known map projection is known as a Gall-Peters Projection, or more commonly, a Peters Projection. There is a great controversy surrounding the origins of this map, which you might want to take a few minutes to look up in the future. In a projection such as the one above, parts of the world are represented closer to their actual scales. If, however, you compare this map to the Mercator projection, what do you notice about the shape of land masses? There is a distinct distortion somewhere on the map.

The next projection we will take a look at is known as a Robinson Projection. Generally speaking, a Robinson projection is an attempt to compromise and show the landmasses as close to their natural size and shape as possible.
on a two dimensional representation. It too, however, suffers from distortion. In this case, much of the world is shown as close to scale as possible, but as you move toward the top and bottom of the map, what do you notice happening?

Now, think back to the video you watched at the beginning about the orange. Another projection is known as the Goode Homolosine Projection, more commonly known as an Interrupted Projection. In this projection type, there is very little distortion in terms of size of continents, however it is very difficult to calculate distances on a map such as this. If you were taking a plane ride from New York to London, it would be difficult to figure out the exact distance if this were the only map available to you.

Below is a gallery of many different map projections. As you flip through the gallery, think about how each map might be useful, and what the disadvantages of the map might be.

**Gallery 1.2 More Map Projections**
So, yes...maps are one of the many tools that geographers use to study the earth. But what are some of the others?

**Aerial Photographs and Satellite Imagery**

When you look at the image above, what do you see? This is a satellite image captured of the United States. The “gold” on the map represents city lights, which in turn can help someone studying this image understand where some of the major metropolitan areas are in the United States. You will notice that one portion of the United States seems to have a lot of these lights, while large portions of the Western half of the United States are much spottier. A “why” question a geographer might ask about this would be: “Why are there more large urban areas on the eastern half of the United States than the western half?” By looking at this image, geographers might then look at maps and other aerial photographs to get an answer to this question.
A satellite image has many purposes and can be helpful at a variety of spatial scales from large to small. An aerial photograph is similar to this, but is generally speaking at a larger. The aerial photograph that shows Washington, DC, shows a zoomed-in view of a city at a larger scale in which we can see individual buildings and streets. A picture like this one might help someone study patterns of development for neighborhood planning. It could be useful in surveying an area for a potential building project. Other aerial photographs could be useful in determining location of farmland, where irrigation systems could be created, among many other things. Both of these tools are useful for geographers in answering their “why” and “where” questions.

GPS (Global Positioning Systems)

Do your parents have a smartphone they sometimes use to get directions to places they have never been? What about you? Global Positioning Systems (commonly referred to as GPS) make use of satellites in orbit to collect information about where the user is on the earth. Your GPS device, be it a phone or a commercially available stand-alone unit, sends information up into the sky where it connects with a satellite, which then determines your position on the planet. This information is then relayed back to the user and displayed on a map. Aside from just locating yourself on a map, how might GPS be a useful tool for geographers?

GIS (Geographic Information System)

A geographic information system, commonly referred to as GIS utilizes software and hardware to collect and display data. It can help you display forms of information useful for geographers to explore. It is a combination of map making (cartography), data
about places, and computer technology to create a representation of places. Someone who uses a GIS is then able to create a representation of places by layering information on top of the map and allowing the people using them to manipulate information in an attempt to better understand a place.

Other tools

You may not initially think of things like stories, people, charts, tables and graphs as being things a geographer might use, however, even with a wealth of other tools such as maps, satellite imagery, and GPS and GIS available, more information is needed in pursuit of the answer to the questions of “why” and “where.” In this case, geographers use some of the same tools as everyone else to explore and learn more, such as data in tables, and charts and graphs which can help with numerical data about a place. If a geographer is trying to understand why people settled in a given area, they might look back at historical data about when people came to a region in an attempt to understand why. They might also look at primary source documents - first hand accounts from people who lived during the time to get a sense of why people came there. If movement to this region was recent, they might even interview living people to get clues.

What has been outlined in this section is by no means a full list that shows you every tool a geographer can use. It focused on some of the most common ones, and you’ll get practice with these and many more throughout the book.

Return once more to the “What Tools Do Geographers Use to Study the Earth” note guide. There is one final question for you to explore before moving into the next section.