

Activity Summary:

Youth will learn what is in a landfill. Younger youth will learn about the composition of a landfill by looking at a bar graph representation with the option to then take the data and create their own graphs.

This lesson plan was modified by the Keep Austin Beautiful Education Team for self-led learning.

UNIT: Generation Zero

GRADES: 4th-5th

MATERIALS:

- 100 small items about the same size (ex: poker chips - see Lesson Prep section in lesson plan for more information)
- 2 Sheets of paper
- Pencil
- Scissors

OPTIONAL:

- White board and marker
- Calculator
- Microsoft Excel or
- Google Sheets
- Coloring materials

TIME REQUIRED: 60 minutes

OBJECTIVES:

Youth will be able to:
Divide waste into three categories of recyclables, compost, and landfill waste.

Waste by the Numbers

Lesson Prep (10 minutes)

1. Before you start the activity you will need 100 small items that your youth will be able to organize into 9 categories.

Choosing your items:

- You will need items that are around the same size, but vary in some way. Use whatever you can find in the classroom or space where you are leading the activity! Think about things like Legos, coins, paper clips, cereal pieces, leaves, dog or cat kibble.
- You can also have youth cut out pieces of paper and color them!
- **Figure 1** in the Additional Information section at the end of this document will show you an example of items used and what youth will be doing with them in this activity.

You will need:

- a. 23 small items to represent Paper (example uses pink paper clips)
 - b. 22 small items to represent Food Scraps (example uses purple paper clips)
 - c. 12 small items to represent Yard Trimmings (example uses blue paper clips)
 - d. 13 small items to represent Plastic (example uses green paper clips)
 - e. 9 small items to represent Metal (example uses pennies)
 - f. 9 small items to represent Textiles (example uses dimes)
 - g. 6 small items to represent Wood (example uses nickels)
 - h. 4 small items to represent Glass (example uses quarters)
 - i. 2 small items to represent Other (example uses small binder clips)
2. Once you have your items you will need to create a category card set. This will be 9 cards you create that say 'What the item represents (the category)' and 'What you are using to represent it'.
 - a. For example, your card will read "Paper (Pink Paper Clips)"
 - b. **Figure 2** on the Additional Information section shows an example of the category cards
 - c. If you have a youth who cannot read, consider drawing pictures on the cards

What is a landfill? (10 minutes)

1. Ask: *What is "trash"?* Stuff we don't use anymore, gross stuff, old things, etc.
2. *Where does trash go when we throw it away?* **Dump, landfill**
3. *What is the difference between a dump and a landfill?* A dump is a big pile of trash (it goes up). A landfill is a hole in the ground they fill with trash (it goes down). See **Figure 3** in additional resources for a diagram of the differences.
4. *Which is better for the environment dump or landfill?* Landfill. Discuss environmental differences.
 - *What happens when the wind blows?* Trash blows everywhere at a dump, but a landfill is more protected.
 - *What about the rain?* Trash can wash away easier at a dump.
 - *Do you think they both smell? What is going to be attracted to that smell?* All kinds of animals.
 - Explain a landfill as a space that has many layers to protect the ground. *Have you ever left your trash bag sitting for too long? What gathers at the bottom?* Liquid. This liquid is called **leachate**. *Where does that liquid go in the landfill or dump?* With no protection the leachate would go into the groundwater. A landfill has many protecting layers to prevent this from happening.
5. Introduce the "4lbs" of trash per person concept. E.g. a liter soda bottle weighs about 4.5 pounds.
 - *How much trash do you think the average person makes in one day?* 4 pounds
 - *Think about your class at school, how many students are in your class?* 16-22
 - *If we multiply that by four, how much trash does the class make every day?* 80lbs
 - Ask your youth to represent 80 pounds. *Let's pretend they weigh 80 pounds. How many of them would it take to fill the room they are in?* How many days does that represent?
 - *What if we included your whole school? The whole city?*
6. As the landfill fills up, discuss the potential for lack of space and need to find a new place for trash. Even though landfills are better than dumps, they're still not great for the environment. They take up a lot of space and produce harmful gasses which poorly affects air quality. We are going to work on putting less in the landfill.
7. To do that, we are going to answer the question, "*What's in a Landfill?*"

What's in a Landfill? (15 minutes)

1. Ask your youth to name items they have recently thrown out. Guide your youth to give answers that cover all of the categories of the activity (categories are what are written on your category cards). Commonly missed answers:
 - *What if the table you are working at right now were to break beyond repair? Would we throw it away? What is it made out of?* Category: Treated Wood
 - *Do you do chores in your yard?* Cut grass, rake leaves. Category: Yard Trimmings (please note, you can compost untreated wood)
 - *Do you like pickles? What do pickles come in?* Jar. Category: Glass
 - *Do you get holes in your socks?* Socks. Category: Clothing/ Textiles
 - *Do you have a baby sibling? What do they make a lot of?* Diapers. Category: Other
2. Discuss categorizing the items to have a better idea of what we throw away.
 - *We could list items all day, but which is easier, a whole list of trash items or nine categories of trash?* Categories.
 - *Let's come up with some good categories, so that anything else we could think of will fall into one of them. Do you see anything in common with these items listed?*

- Categories: Paper and paperboard, food scraps, plastic, metal, glass, wood, other, yard trimmings, and textiles.

Waste by the Numbers Activity (15 minutes)

1. We are going to do an activity to answer the question, "*What's in a Landfill?*"
2. First you will focus on the category cards (see **Figure 2** in additional information section for an example), put your collected items aside. Youth will line the category cards up along one edge of their table (or floor if you need more room!).
 - Put the cards in order from what you think we throw away the most to the least
 - Once the cards are placed, do not move them
3. After you have decided on the order of the category cards, you will want to get your items. The items should not be in any sort of order, just one pile
4. Youth will now organize the items to match the category cards! Lay out your items across the table in line with the category cards.
 - Have youth count how many items there are for each category card and record their answers
5. Ask youth about the results. Refer to the data:
 - *What did we just make?* A bar graph
 - *What does it show us?* How much of each category we throw away?
 - *What is a bar graph really good for?* Comparing and contrasting
6. Ask several data interpreting questions. Be sure to follow up with "how do you know that?" and look for responses that justify the critical thinking behind their answers.
 - *What two kinds of trash do we produce the most of?* Paper and Food scraps
 - *What kind of trash do we produce the least of?* Other
 - *Do we produce more or less plastics than metal?* Plastic > metal
 - *Which material is greater than yard trimmings but less than food scraps?* Plastic
7. Allow youth the opportunity to do some math- add up the numbers recorded for each category to get a grand total. Help them get to 100 if needed.

Extensions for Older Students:

1. Youths will graph the data as a bar graph and a pie chart on Excel. See the **Additional Resources** below for full instructions on how to make a bar graph and pie chart on Microsoft Excel and Google Sheets.
2. Explain how each number of items per category represents a part of a whole.
 - *How many items were there total?* 100
 - *How many items representing paper were there?* 23
 - *How much does the paper make up out of the total? How is this written mathematically?* Fraction. 23/100.
3. Demonstrate how fractions can also be represented as decimal and then as percentages. Illustrate this on the board. Model this with several different categories.
 - *What is another way of writing a fraction?* Decimals. 0.23.
 - *Is there another way?* Percentages. 23%
 - Practice writing the fractions, decimals, and percentages for several other categories.

Closing (5 minutes)

1. Ask youth to tell you what they were looking at in this activity. *What did the items represent?* The items represent what we are throwing in our trash can, and what they are finding in the landfill.
2. Looking at the categories we created in the activity, determine which categories can be recycled, composted, re-used etc.
 - *Do all of these items have to go into the landfill? Which categories can we send elsewhere?*
3. Go category by category and mark each as Compostable, Recyclable, Re- useable or Landfill:
 - Metals, Glass -> Recyclable
 - Food Scraps, Yard trimmings (including untreated wood) -> Compostable
 - Paper -> Compostable and Recyclable
 - Plastic -> Mostly Recyclable The only plastic we recommend throwing away is plastic that doesn't stretch.
 - Textiles -> Most can be reused in some way. Donate, take to Austin Recycle and Reuse Center, utilize the clothing and housewares program
 - Treated Wood -> Re- use, landfill
 - Other -> Mostly landfill, though some can be recycled in a special place.
4. *We're only left with Treated Wood and Other. How much does Treated Wood equal? 6% How about Other? 2% How much is 6 + 2? 8. That's all we should be putting in the landfill. How much should we NOT be putting in the landfill? 92%. We should repair and repurpose wood for as long as possible before putting it into the landfill.*
5. Introduce the City of Austin's Zero Waste Goal.
 - Goal in Austin to divert 90% of our waste from the landfills by year 2040.
 - Ask youth to calculate how old they will be in the year 2040. Prompt them: in how many years will it be 2040?
6. *Is it possible to meet the Zero Waste Goal?*
 - Yes! We just need to learn how to compost and recycle as best as possible.
 - Three cart collection system- recycling (blue cart), composting (green cart), and trash cart (brown cart). Please note, it may look different at apartments and condos.
7. **CHALLENGE** youth to check their trash can and see what they throw away the most. Does it actually belong in the trash can?

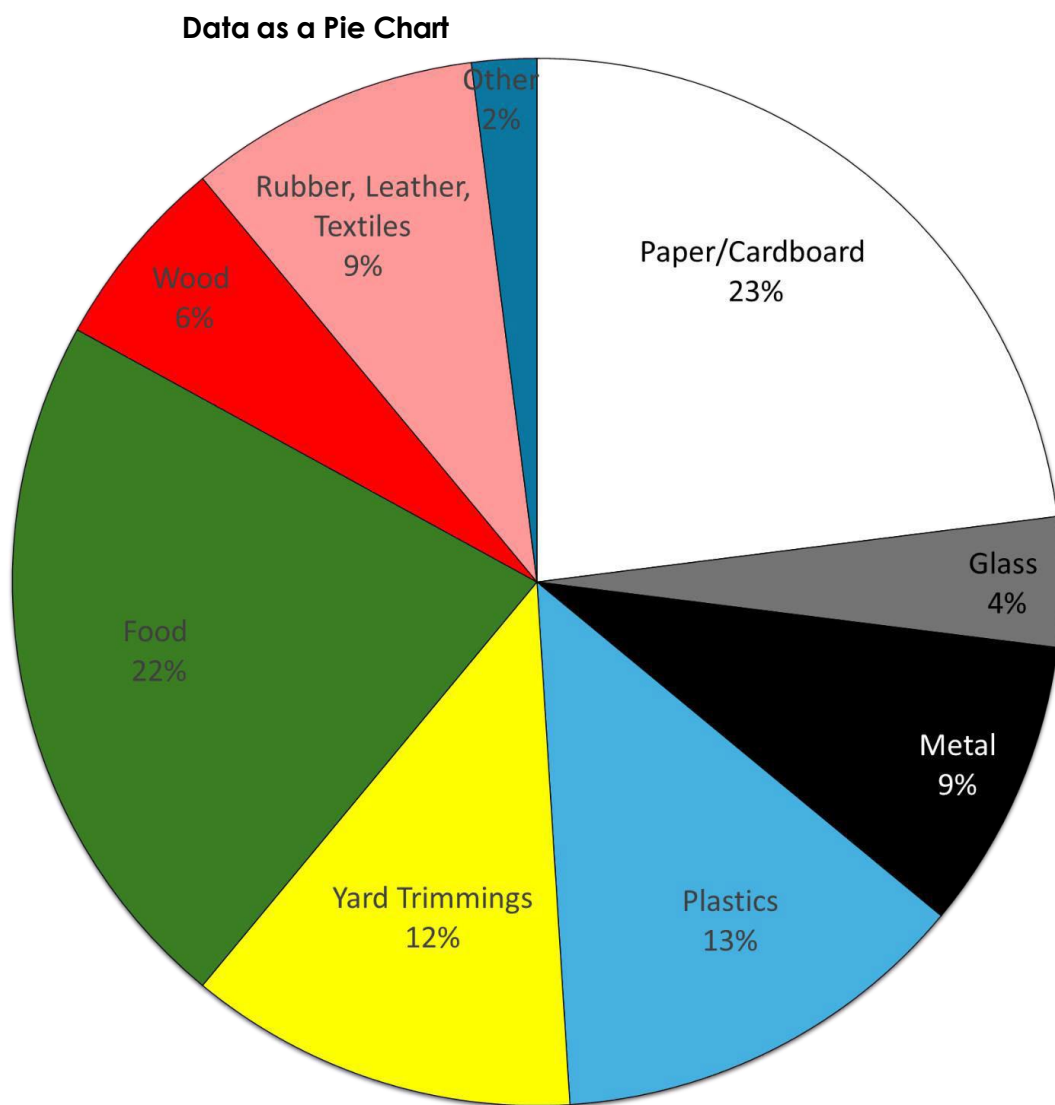
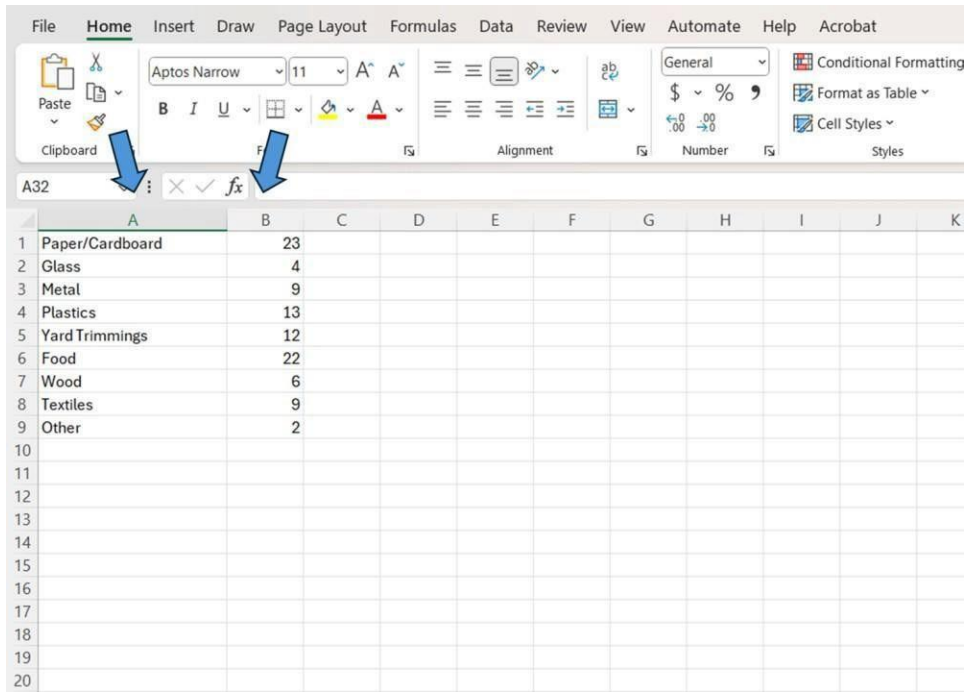


Figure 4: Waste by the Numbers Pie chart

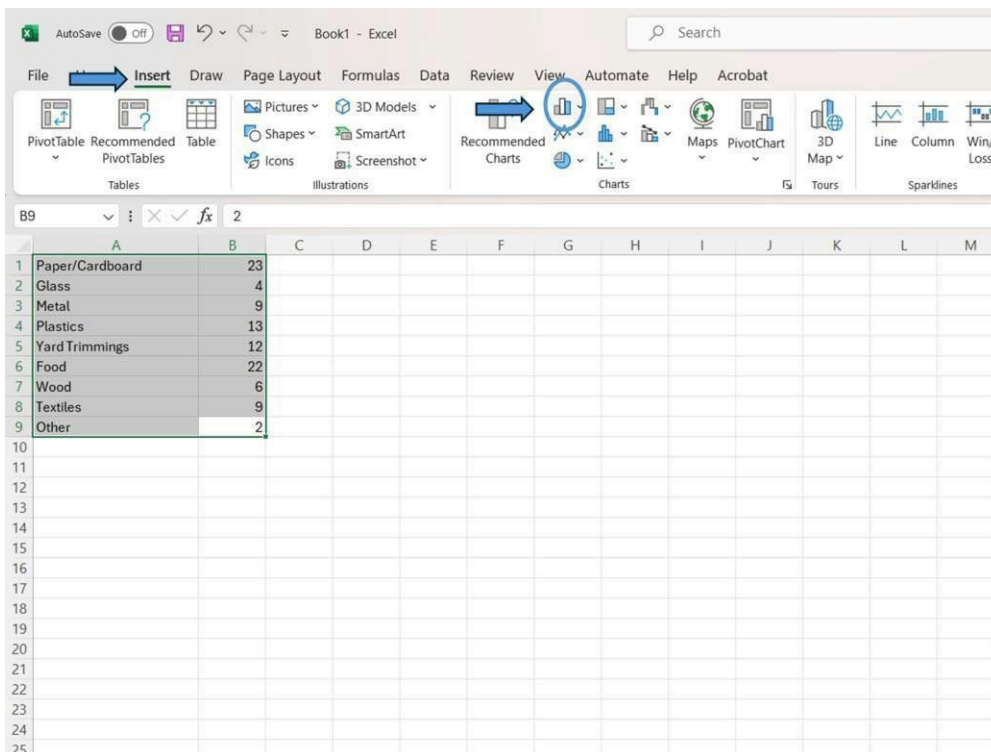
How to Graph in Microsoft Excel:



	A	B	C	D	E	F	G	H	I	J	K
1	Paper/Cardboard	23									
2	Glass	4									
3	Metal	9									
4	Plastics	13									
5	Yard Trimmings	12									
6	Food	22									
7	Wood	6									
8	Textiles	9									
9	Other	2									
10											
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20											

First Steps:

1. You will need to open a new sheet in Microsoft Excel
2. In **column A**, you will type each category in their own row (look at rows 1-9)
3. In **column B**, you will type the number of items for each category

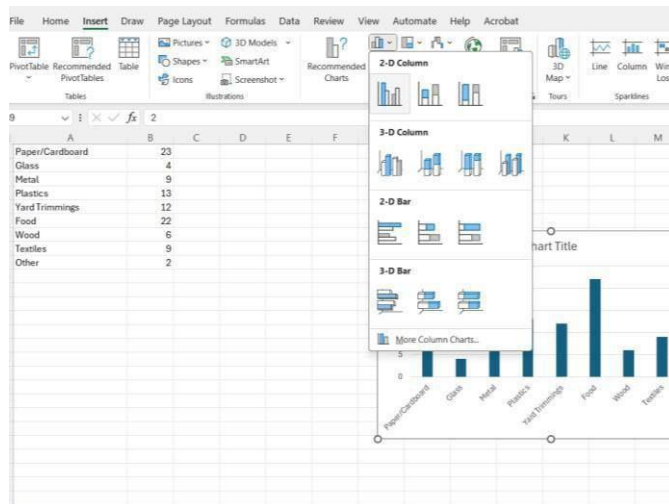
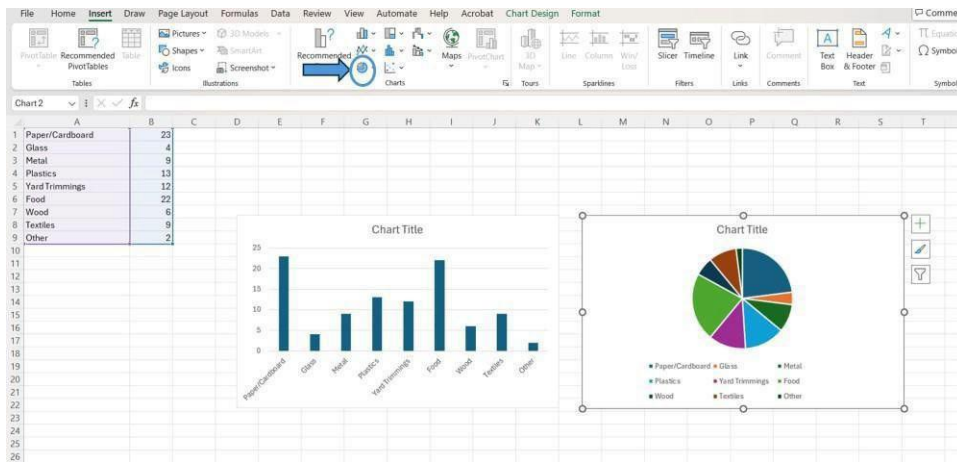


	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Paper/Cardboard	23											
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4. Highlight all the data in your spreadsheet. To do this (left) click into the A1 and drag your mouse to highlight all of your data.
5. While keeping your data highlighted click on the “**Insert**” tab on the top of the page.
6. Then you will want to click on the **bar graph picture**, if it gives you options click the “**2D Cluster Column Chart**”

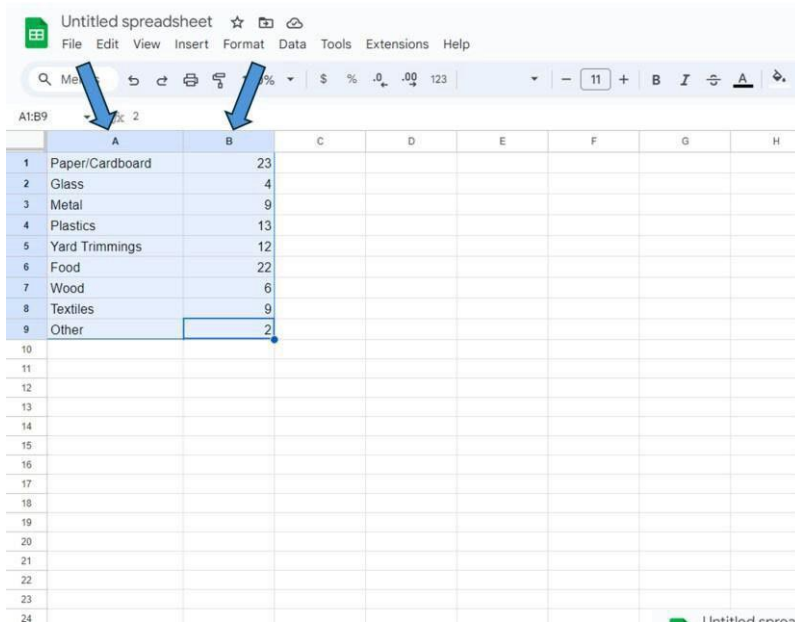
How to Graph in Microsoft Excel cont.

7. A bar graph should pop up on your screen!



8. You have successfully created a bar graph of your data
9. We will now make a pie chart
10. Highlight all the data in your spreadsheet. To do this, (left) click into the A1 and drag your mouse to highlight all of your data.
11. While keeping your data highlighted click on the "Insert" tab on the top of the page.
12. Then you will want to click on the pie chart picture, if it gives you options click the "2D Pie Chart"
13. You have created a pie chart!
14. Now you can play around and add a title, axis titles, change the colors.
15. Compare and contrast your graphs!

How to Graph in Google Sheets:

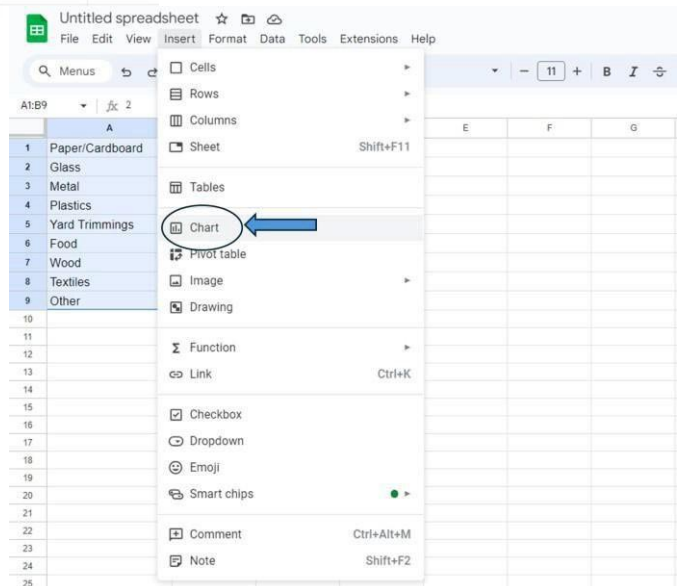


	A	B	C	D	E	F	G	H
1	Paper/Cardboard	23						
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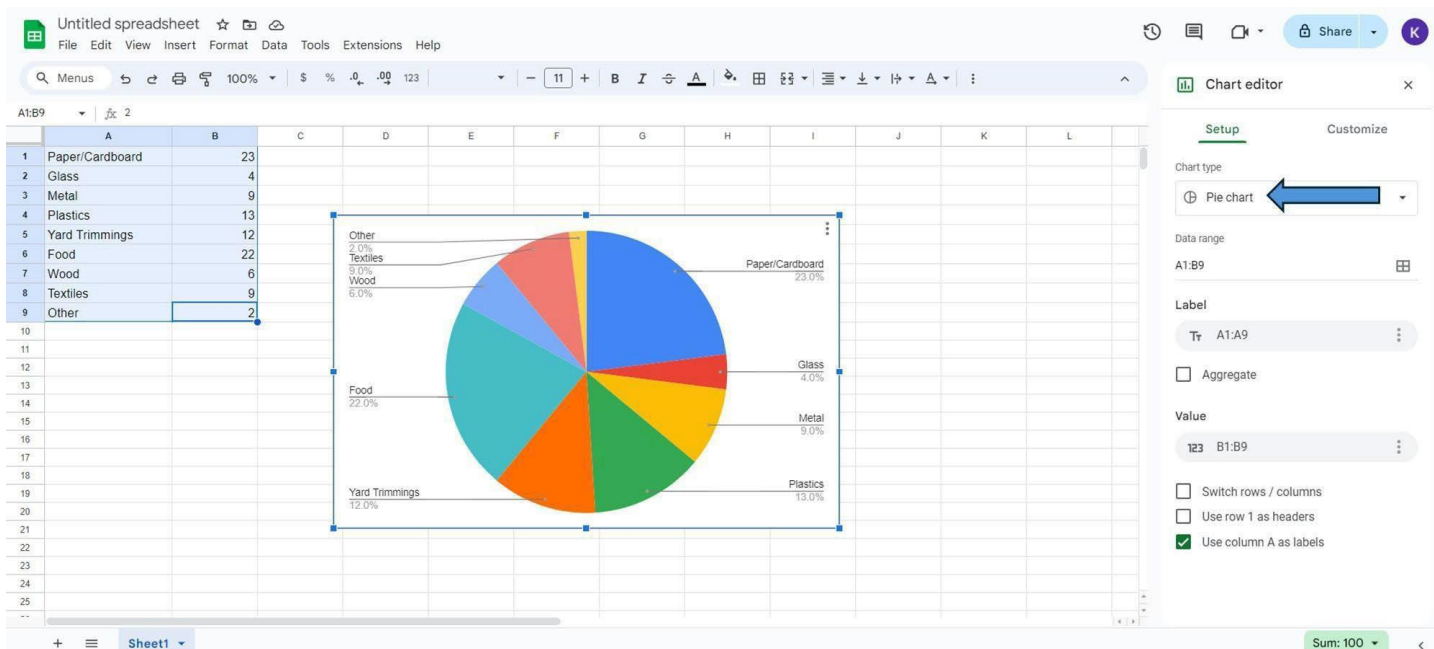
First Steps:

1. You will need to open Google Drive and go into Google Sheets
2. In **column A**, you will type each category in their own row (look at rows 1-9)
3. In **column B**, you will type the number of items for each category

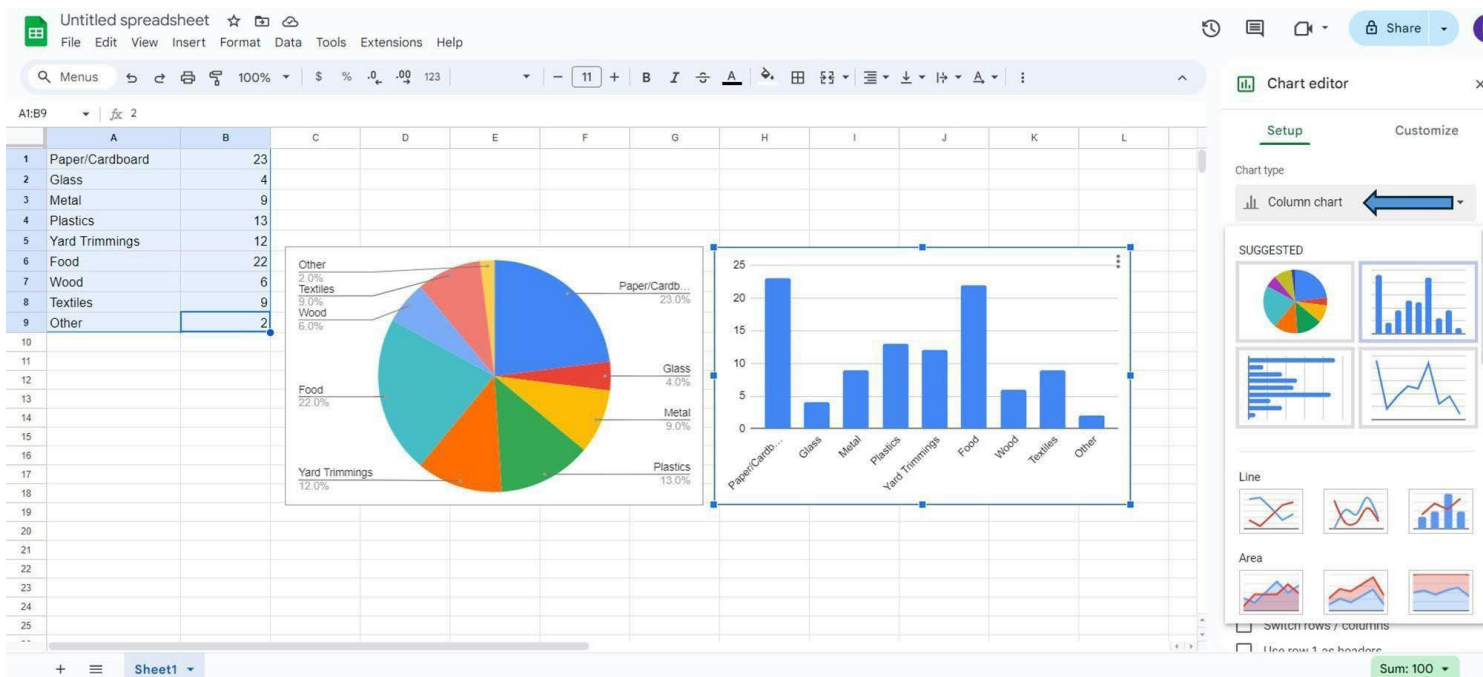
4. Highlight all the data in your spreadsheet. To do this (left) click into the A1 and drag your mouse to highlight all of your data.
5. While keeping your data highlighted click on the **“Insert”** tab on the top of the page.
6. Then click on **“Chart”**



How to Graph in Google Sheets cont.



- On the right hand side of your screen you will see a 'chart editor,' in this editor you can chose the type of chart you want. Click **Pie Chart**.
- You have successfully created a pie chart for your data!



You will now make a bar graph. To do this you will follow **steps 4-6**.

- Once you have clicked on **chart**, you will click on the drop down under chart types. You will see different chart options.
- Click on **column graph** or **bar graph**.

11. You now have successfully created two graphs.
12. Play around with the graphs adding titles, changing colors etc.
13. Compare and contrast your graphs!

Background Information

ADDITIONAL INFORMATION

EPA Site about Landfills
<https://www.epa.gov/landfills>

City of Austin Resource
Recovery Recycling Guide:
<http://austintexas.gov/what-do-i-do>

Municipal Solid Waste (MSW): What is it?

In 2014, Americans generated approximately 258 million tons of trash, and they recycled and composted over 89 million tons of this material. This is the equivalent to a 34.6 percent recycling rate. On average, we recycled and composted 1.5 pounds out of our individual wasted generation of 4.4 pounds per person per day. (Source: epa.gov) Municipal solid waste is made up of the things we commonly use and then throw away. These include packaging, food scraps, grass clippings, sofas, computers, tire and appliances. This trash does not include industrial, hazardous or construction waste. Municipal waste may also include sludge and septic waste. (Source: epa.gov)

Municipal Solid Waste in Texas

According to the Texas Natural Resource Conservation Commission, Texans dispose of approximately 21 million tons of municipal solid waste per year and pay more than \$1 billion each year for the management of it. A study conducted for the Texas Water Commission (now the Texas Natural Resource Conservation Commission), found 63% of the MSW generated in Texas is residential and 37 percent is commercial or institutional. Municipal solid waste is disposed of through landfills, incineration, waste-to-energy facilities, and land application (for sludge). Recycling and composting are also used to manage municipal solid waste. In Texas as in most other places in the U.S., landfill disposal is still the predominant method of solid waste management.

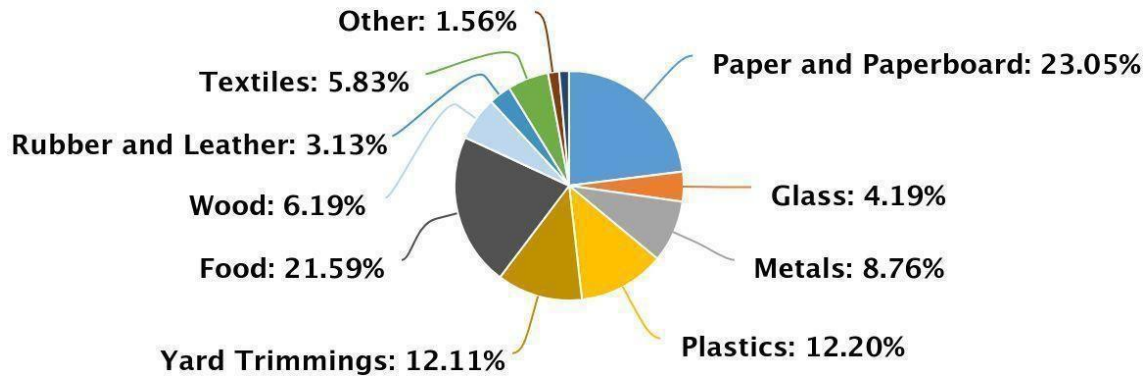
An average Texan generates about a pound more per day of municipal solid waste than the national average of 4.4 pounds per person per day. The discrepancy between the amount of solid waste generated and the amount disposed of is due to several factors, including the use of recycling and composting. According to the Texas Natural Resource Conservation Commission, if the total amount of all types of waste - including construction, demolition debris and sludge - received by municipal solid waste facilities in Texas is considered, the per capita disposal rate is to about 6.7 pounds per day. So we have our work cut out for us! (Source: Texas Natural Resource Conservation Commission, Municipal Solid Waste Division)

Categories of Waste

There are about 3,000 active landfills in the United States and they are filling up fast. What is it that is filling up our landfills? Half of the waste that goes into landfills is packaging! The EPA conducts annual studies to identify the composition of the American Municipal Solid Waste.

Total MSW Generated by Material, 2018

292.4 million tons



Interpreting Graphs and Charts

Graphs and charts display data so that it can be easily understood. You can use graphs and charts to compare sets of data. A bar graph uses bars to show data. The bars on a bar graph can be horizontal or vertical. A pie chart is a circular graph which visually represents percentages or proportions. For this lesson the composition of trash will be illustrated in both a bar graph and a pie chart.

Austin's Single Stream Recycling

As residents, it is our job to separate the [recyclables](#) and [compostables](#) from landfill waste and make sure to get it to the curb on the appropriate pick up day. The City of Austin offers a single-stream recycling program, so all recyclables go in a 90-gallon blue cart that is collected every other week. Additionally, The City of Austin will require commercial composting collection at all [multifamily properties](#) starting October 1, 2024. Residents within ARR boundaries will have access to these waste diversion resources. The Austin City Council approved the amendment to the [Universal Recycling Ordinance \(URO\)](#) on Thursday, September 21, 2023.

Austin's Zero Waste Goal

By 2040, the City of Austin hopes to divert or “recover” 90% of all waste. This initiative has been adopted by one or more cities in California, New York, Colorado, Texas, Washington, North Carolina, and Hawaii. The goal of Zero Waste is to systematically eliminate waste in a landfill by changing the production, distribution, and processing of materials, providing comprehensive collection of refuse, and reclaiming waste into usable resources. Zero Waste implementation also eliminates environmental hazards of waste in natural environments such as groundwater, soil, and air pollution.

On the residential side of Zero Waste, Austin has started to implement a 3 cart collection system: composting (the green cart), recyclables (the blue cart), and landfill trash (the brown cart). The City has also built a complex drop off center for all waste products: household hazardous waste (paint, lawn chemicals), bulk material appliances, single stream recyclables, and organics. The facility is called the [Recycle & Reuse Center](#), which provides all residents and small businesses from any area of Austin a central location to dispose of materials. Above all, public education on resources and proper disposal methods will allow many more materials to be recovered.

Useful Definitions:

Trash/Waste/Solid Waste	Any unwanted or discarded material that is considered useless.
Dump	An unprotected site where people would dispose of all types of waste, including hazardous waste. A dump is typically ill-equipped as they produce leachate that can harm groundwater, become a congregation spot for insects and rodents, and can pose health threats. Leachate is a combination of liquid (mostly water) that runs through a trash site that picks up contaminants from the waste as it passes by. You may have heard the term “dumpster juice,” this is an example of leachate.
Landfill	A carefully engineered site for the safe disposal of solid waste. Modern landfills are equipped with collection systems for groundwater contaminants, methane gas controls and environmental monitoring systems. However, landfills require a lot of space, monitoring and still emit gasses into the atmosphere.
Recycling	The collection and reprocessing of a material for use in the manufacturing of a new product.
Single Stream Recycling	A type of recycling program where people can throw mixed items in one cart for collection such as paper, plastic, cardboard, and glass.
Composting	The collection of organic materials to be turned into soil. Organic materials are those that are from the earth, or that were once living. For example, an apple came from the earth and was once growing on a tree.
Bar Graph	Uses horizontal or vertical bars to visually represent percentages or proportions.
Pie Chart/Graph	A circular graph which visually represents percentages or proportions.

TEKS Core Concepts

4th Grade Knowledge and Skills:

Science – 1(A)(F); 2(C); 3(A);

Source: The provisions of this §112.6 adopted to be effective April 26, 2022, 47 TexReg 2136.

Mathematics – 1(A)(C)(D);

Source: The provisions of this §111.6 adopted to be effective September 10, 2012, 37 TexReg 7109.

5th Grade Knowledge and Skills:

Science – 1(A)(F); 2(C);

Source: The provisions of this §112.7 adopted to be effective April 26, 2022, 47 TexReg 2136.