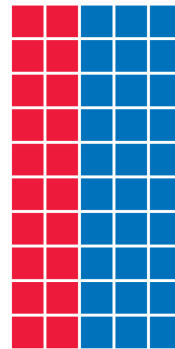
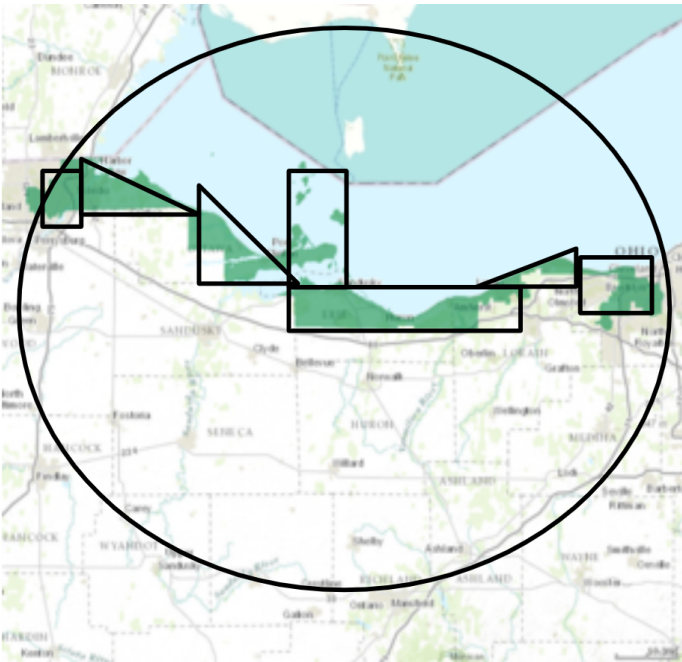
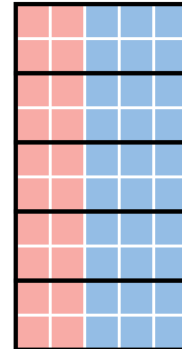


Workshop Description

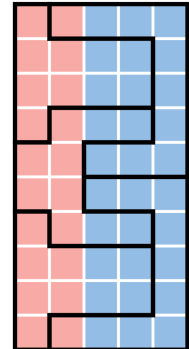
Who gets a say in democracy? How do politicians get to pick their voters? When district maps are drawn after every census, they are sometimes designed to benefit one party. Sometimes this allows a minority of voters to elect a majority of seats, like in the map on the far right. In the process, gerrymandering creates voting districts that look more like an inkblot test than a real map. In this workshop, you'll find a way to quantify gerrymandering based on both the shapes of districts and how much the outcome of an election differs from the actual votes cast.



50 PRECINCTS
60% BLUE
40% RED



5 DISTRICTS
5 BLUE
0 RED
BLUE WINS



5 DISTRICTS
3 RED
2 BLUE
RED WINS

Workshop Requirements

- Time: **55 minutes (or more)**
- Materials: **Access to computers with google sheets, slides, docs, and ability to download files.**
- Suggested ages: **7th-12th grade**
- Students should know: **how to use google apps**


Learning Goals

- Understand that very simple math can have great consequences
- Learn how to quantify compactness by analyzing shapes
- Learn how to quantify fairness by comparing voting data with election data
- Gain interest in representation and voting issues

Preparation for Gerrymander Activity

Make a form like [this one](#) for the live gerrymandering activity. You can ask the students what are some contentious issues for them (they should be light-hearted, like the ones in the template). There should be at least 3-4 topics to vote on - you will choose the topic where the results are easiest to gerrymander.

Have the students fill out the form beforehand (ideally during the previous class). Have them write down their answers so they don't forget. It is important that everyone has filled it out before you do the next step.

Open up the responses in a spreadsheet using the  button in the top right of the form. Now choose a voting topic to gerrymander. A good target is one that is split roughly $\frac{1}{3}$ to $\frac{2}{3}$. Copy the columns with the student names and the chosen voting topic over into a blank area of the spreadsheet. Then rearrange the students and their votes by cutting and pasting them into groups.

A couple of tips:

- Always copy the student name and their vote together and move them at the same time.
- Aim for district sizes of 3, 5, or 7 students each. Also aim to have an odd number of districts. It's okay if the districts aren't all the same size (it is better if they are similarly sized in case students want to see the details behind the scenes, but you don't need them to be exactly the same size).
- Try to pack and crack: Make some districts where everyone votes the same way, and the rest of the districts where the vote is narrowly won.
- If it isn't working out, try starting over using a different topic - the numbers will be different.

Copy the names of students and their votes down to here, then rearrange them into districts.

37														
38														
39														
40	Nirifa Moalhammon	Ice Cream												
41	Tawnya Tang	Cake												
42	Lanora Seago	Cake												
43	Myles Ranum	Ice Cream												
44	Ramiro Brittain	Ice Cream												
45	Golda Scheel	Ice Cream												
46	Liane Hellyer	Cake												
47	Merna Simon	Ice Cream												
48	Eva Dreyer	Ice Cream												
49	Karie Tolle	Ice Cream												
50	Vanessa Duncanson	Ice Cream												
51	Glen Kempflin	Ice Cream												
52	Christa Laursen	Cake												
53	Nichole Ousley	Ice Cream												
54	Carlton Hassinger	Cake												
55	Vanessa Concannon	Ice Cream												
56	Jamal Burkey	Cake												
57	Harriett Feehan	Ice Cream												
58	Merlene Fly	Ice Cream												
59	Rosalina Laughridge	Cake												
60	Waltraud Lindholm	Cake												
61	Tamera Godwin	Ice Cream												
62	Dick Seigel	Cake												
63	Allonzo Laycock	Cake												
64	Latarsha Mao	Ice Cream												
65	Modesto Covell	Ice Cream												
66	Cedrick Olaszewski	Ice Cream												
67	Jacquie Munch	Ice Cream												
68	Eun Gagner	Ice Cream												
69	Herma Ackley	Ice Cream												
70	Vanessa Finkbeiner	Ice Cream												
71	Nida Holdren	Ice Cream												
72	Tawnya Gonca	Cake												
73														
74														
75														
76														
77														

Start by Packing students with the vote you want to lose into large districts of 5-7.

Then create Cracked districts that are split 2-1, 3-2, or 4-3 for the vote you want to win.

Try to have an odd number of districts - you can always stick extra students into the packed districts - it's OK if they're not all the same size.

At the start of class, you will put the students into groups or breakout rooms based on the districts you created, then have each group report out the majority student vote for their district.

Your objective with creating the districts is to skew the results to demonstrate the impact that gerrymandering can have. It is especially powerful if you can take the minority of student votes and make them win the majority of districts! If the student votes are evenly split, you should be able to make one side win in a landslide.

Preparation for Map Tiling Activity

For the map tiling activity, the objective is to demonstrate how students can estimate the area of complex shapes to measure the compactness of voting districts. The measure of compactness we will use is the ratio of the surface area of the district to the area of the smallest circumscribed circle around the district.

Before class, make a copy of the [Gerrymandered Or Not?](#) slide deck and share with students the new URL (change permissions so that anyone can edit). Each student will take one slide or create a copy of one to work on. For the demonstration, follow the guide below to create shapes in google slides (you want to make the shapes transparent and have a thick border so you can see the district underneath). The students will then do the same thing for a district of their choosing.

1. Create the bounding circle.

2. hold shift to draw a rounder circle

3.

4.

5. Transparent

6.

7.

cover up the district reasonably well using the same technique

Then move the shapes that you used together, to estimate the fraction of the circle that the district took up.

First, draw the smallest circle that encompasses the entire district. If you hold shift you will make sure to draw a circle, instead of an oval.

Then start covering over the district using basic shapes. Here, it takes 7 shapes to adequately cover Ohio's 9th district. The more shapes it requires, the less compact it is, and the more likely it is to be a gerrymandered district.

Then move the shapes into one portion of the circle to visualize what fraction of the circle the district actually takes up. Here, Ohio's 9th district takes up probably a tenth of the circle's area. This district is not very compact, which suggests it may be gerrymandered.

Presentation Notes

Rapid Quiz

You get 15 seconds to write in the chat what each shape reminds you of.

Short Game to get students excited about the topic. Tell them you're about to show them 4 different shapes for each one you want them to call out what the shapes remind them of. Then on the last slide you'll reveal that each shape was the mirrored image of a voting district in America and how they look so odd



Gerrymandering

All of these are voting districts in the U.S. Why is that? How is it done? Why is it done.



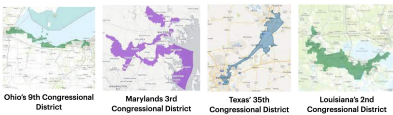
because of Gerrymandering which is the topic of today.

Gerrymandering What is it?

- When a political party draws the boundaries of legislative districts in a way that favors them.
- It's often said gerrymandering is a way for elected officials to pick their voters instead of voters getting to choose their elected officials.




Read through the bullets to help give students a better definition of what gerrymandering is.

Gerrymandering Some examples



Share these examples with the class and point out the odd shapes like the long skinny one and purple spiral. The reason many districts are shaped this way is to include bits and pieces of different cities that are spread out geographically. So you get skinny lines connecting cities and large bulges near population centers.



<p>What state do you think gerrymandering started in?</p> <p>Why do you think it's called gerrymandering?</p>	<p>Ask the students these questions and have them call out guesses. The answer to the first is Massachusetts. The answer to the second is explained on the next slide.</p>
<p>Gerrymandering The origin story</p> <ul style="list-style-type: none"> In 1812 the Governor of Massachusetts, Elbridge Gerry, signed a bill that allowed his party, the Democratic-Republicans, to redraw state Senate districts to its advantage. The Boston Gazette published a cartoon that compared the shape of a Senate district in Essex County to a salamander which led to the term Gerrymander. This attempt actually failed a year later with the Federalist gaining control of the state Senate and some thought the practice was dead. There is no clear evidence Gerry actually supported the map his party drew. 	<p>Read through this slide and note that this is the comic.</p>
<p>How do we quantify how Gerrymandered a district is?</p> <ul style="list-style-type: none"> This is actually still hotly debated. The Supreme Court in 2019 said to evaluate partisan gerrymandering they needed a "limited and precise standard" that would be "clear, manageable, and politically neutral" but no one has proposed one. 	<p>It is important to emphasize that people are working on inventing this math right now! People are currently working on how to determine if a district is gerrymandered or not. While gerrymandering is deemed unconstitutional, people still need to figure out ways to quantify what it means for a district to be gerrymandering, for a case to be able to stand up in a court.</p>
<p>How do we quantify how Gerrymandered a district is?</p> <p>Method #1</p> <ul style="list-style-type: none"> We can use geometry to determine "compactness" Look at perimeter of the district vs. its surface area. Draw a circle around the district & calculate its surface area then calculate the surface area of the district and compare. 	<p>The first method we'll cover is compactness.</p> <p>The launch for the activity is on the next slide. Here, you should do a demo of the activity, following the steps in the Preparation section. In advance, make a copy of the Gerrymandered Or Not? slide deck and share with students the new URL (change permissions so that anyone can edit).</p>
<p>Activity</p> <p>Let's quantify compactness</p> 	<p>Now you have students get onto the shared google slide deck and do the compactness activity for their own district.</p> <p>You can monitor their progress by scrolling through the slide deck. You may have to help troubleshoot. If there are not enough slides for every student, or if they want to do multiple, they can make a copy of another slide.</p>
	<p>When they're done, screenshare as you go through each slide in the presentation. Point out districts that are especially compact or not compact, and relate this to gerrymandering: if a district is not very compact, it usually means a politician had to work hard to shape it that way in order to manipulate who their voters</p>

were. Districts that are long and skinny and have a small district to circle area ratio are usually a sign of gerrymandering.

---- This is a good time for a break ----

Your Voting Districts

Enter your breakout room and we will come and tally your votes.

Breakout District 1: Name A, Name B, Name C...

Breakout District 2: Name A, Name B, Name C...

Breakout District 3: Name A, Name B, Name C...

Here is where you announce the districts you placed them in after they "registered" Refer to the first part of the Preparation section. Have the students go into their districts, either by assigning them to breakout rooms or having them go to different tables.

The Results...

Drum roll please.

Go around and collect the votes from the districts (each person casts their vote but the district is won by the option that got the majority of votes in the district). One way to display the results is to enter each district's vote into a new google form, then view the pie chart in the responses.

The Breakdown

How we manipulated the results



Show your students the two pie charts. The first is from the class registration showing the true breakdown of the class. The second is from your distinct voting and will show how you were able to shift the power. This demonstrates gerrymandering in real time.

How it's done

Packing V Cracking

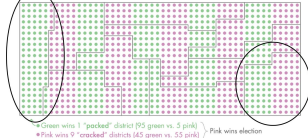
- Packing:** the district is drawn to include as many voters from the opposing party as possible.
- Cracking:** when you split up the opposing party's voters into many districts.
- Each is done to dilute the power of the opposing party.



Now you can break down how you were able to do what you just did by using the packing and cracking techniques. Walk them through the example on the next slide after giving them these definitions.

PACKING AND CRACKING

Say you want to gerrymander a 10-district state that has 500 pink voters and 500 green voters to maximize the number of districts won by the pink party. You could "pack" 50 green voters into one district, where green wins by a much larger margin than needed, and "crack" the remaining 450 green voters by spreading them across the other nine districts, where green loses.



Walk them through this example and highlight the packed and cracked districts (it is explained on the slide).



How do we quantify how Gerrymandered a district is?

- We can look at Partisan symmetry by calculating the **efficiency gap**
- Calculates the difference between the two party's "wasted votes"
- A wasted vote is when it's in a losing district or when it exceeds the 50 percent threshold.



Walk them through the example.

For each district, the number of votes in excess of the 50% needed to win are counted as wasted votes, as well as all of the votes on the losing side. In this example, our packed district has 45 wasted green votes and only 5 wasted pink votes. In the cracked districts there are again 45 wasted green votes and only 5 wasted pink votes. Packing and cracking is a strategy to maximize the number of the opposition's votes that are wasted.

It's important to emphasize that the term "wasted votes" is academic lingo, and no person's vote should ever be considered wasted, as it can still have a big impact on the election.

Gerrymander the Game

<http://gametheorytest.com/gerry/game/>



Now open up this game and walk through how to play with the students showing them when they should pack a district and when they should crack a district. Then give them the link and let them play.

How do we quantify how Gerrymandered a district is?

- Simulation algorithms
- We can create programs that produce MANY different maps and then run these other calculations on them and see how they compare to the original map.
- One simulation looking at a map in Maryland found after drawing 250 million possible maps the proposed map favored Democrats more than 99.79% of the maps drawn by the algorithm.

There are more ways to determine if a district is likely to be gerrymandered. You can pique their interest by introducing another method, which is using algorithms. You could extend this workshop by designing an activity for this method.

How it's done

Who & When

- **Who:** State Legislatures
- **When:** after each census when new districts are drawn
- Redistricting will be taking place this year!

End the class by telling the students who has this power in real life (local and state legislatures), and emphasize how issues about representation and gerrymandering are decided at the local level, which means that local elections are extremely important.

Please use these materials and tailor them to your students!

We encourage you to use these materials, editing and modifying them as appropriate for your students! When you use, share, incorporate, or modify these materials, please keep the license notice (from the footer) and credit "Olin College's course on Mathematics/Engineering Outreach for



Adolescent Learners.” We also humbly request that you email sarah.adams@olin.edu if you use these materials, as we are tracking their impact and how far they travel!

This Teacher’s Guide and the accompanying slides were developed at Olin College in the course Mathematics/Engineering Outreach for Adolescent Learners, spring 2021, taught by Sarah Spence Adams. The slides are licensed under the Creative Commons Attribution-NonCommercial_ShareAlike 4.0 International license.

