

Backwards Goes It Does

Chicago River Classroom Activity

Summary

Students will use the web to investigate the topography of the Chicago River watershed. Then students will make a model of the Chicago River watershed to observe how the Chicago River was reversed.

Background

Once a meandering stream surrounded by wetlands, the Chicago River has been channelized, polluted and even changed to flow backwards.

See included articles for more details on the Chicago River.

Procedure

I. Topographic Maps on www.topozone.com

1. Pass out the student instructions for this section.
 - ◆ Make sure to tell students to read ALL the directions before beginning.
 - ◆ Make sure to explain how the cross cursor works on the www.topozone.com website, otherwise the students are likely to lose their place.
2. Allow students to work at computers. Note: A teacher version of the instruction sheet is included. It contains all the answers to the questions.

II. Creating the Map and Making the Model

1. The day before class:
 - ◆ Make the pans of gelatin. Pour enough prepared gelatin into the roasting pan to make it about six inches deep.
 - ◆ When putting the gelatin filled pans in the refrigerator, place one piece of wood under the top of the pan and the other on the left side of the pan. This is to simulate elevation change, where the northern part of the watershed is higher than the southern, and the western part is higher than the eastern part.

Grade Level: 9th-12th

Duration: Three 45 min class periods

Objectives:

1. Students will be able to use topographic maps.
2. Student will create a 3D model of the Chicago River watershed.
3. Students will be able to articulate how the Chicago River was reversed.

Materials:

- ◆ Turkey roasting pan (with stabilizing rack) 16"X12" X 2.5" (1/grp of 4)
- ◆ Clear Knox© gelatin (1 canister)
- ◆ Two inch thick piece of wood for placing under the turkey roasting pan (2/grp of 4)
- ◆ Water
- ◆ Blue food coloring
- ◆ Yellow food coloring
- ◆ Clay (1" piece/ grp of 4)
- ◆ Rulers (1 per group of 4)
- ◆ Plastic knives (1/grp of 4)
- ◆ Plastic spoons (2/ grp of 4)
- ◆ Plastic cups, or beakers (2/ grp of 4)
- ◆ Permanent markers (1/grp of 4)
- ◆ Copies of reference map (1/grp of 4)
- ◆ Copies of student directions and 3 articles (1 per student or group of 4)

Standards:

1.B.4c, 1.B.5d , 1.C.4c, 6B4, 6.D.4, 7.A.4a, 7.C.4a-c, 9.A.4a, 9.B.5, 13.B.4c, 13.B.5b, 16.A.4a, 16.E.5a, 17.A.5, 17.C.4a, 17.C.5b ,17.D.4

2. At the beginning of class:

- ◆ Divide students into groups of four.
- ◆ Pass out the student instruction sheets, a beaker, the food coloring, plastic knives, spoons, rulers, clay and permanent markers.
- ◆ Have students follow the direction sheets to make the model. Note: A teacher version of the instruction sheet is included. It contains all the answers to the questions.

Backwards Goes It Does: Teacher Version of Student Pages

I. Topographic Maps

View the “Reference Map” of the Chicago River (attached) and notice its shape. It has three forks on top, turns toward the Lake and then travels south a bit.

Originally, the river flowed from the north forks, south, into the main stem and from the south branches, northwest, into the main stem. Everything then flowed out into Lake Michigan. Why? To find out we will have to consult a topographic map. A topo-grapho-what you say?

A topographic map (or topo map for short) is a two dimensional representation of the land. It shows streets and buildings (maybe even your school), water bodies, parks and wetlands. It also shows the topography – or the hilliness of the area. Brown lines curving all over the map, have numbers on them. The numbers represent the number of feet that line (and hence that part of the land) is above sea level. If you look at several lines next to each other and the numbers are getting higher, you are climbing up a hill. If the numbers are getting lower, you are sliding down the hill.

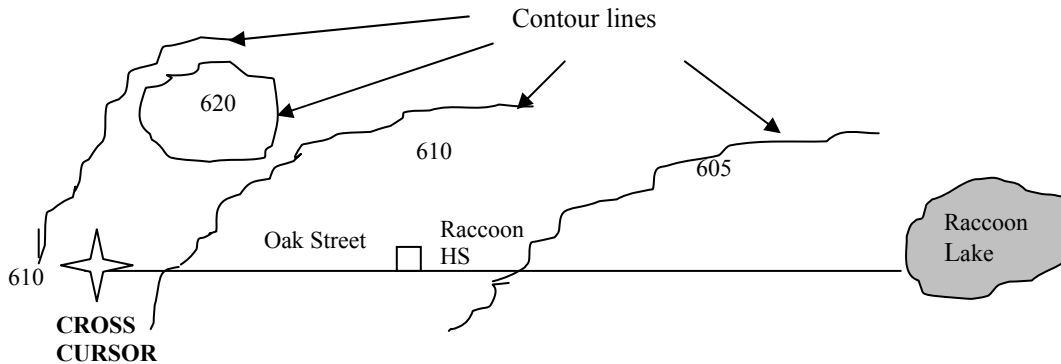
Follow the instructions to view the elevation pattern in the Chicago River watershed and find out why the river originally flowed into the lake.

Instructions

Go to www.topozone.com. This is a website approved by the United States Geologic Survey for viewing topographic maps online.

Lets Practice: Find the elevation of your school.

1. On www.topozone.com, go to “view maps”.
2. In the “Place Names” box on the topozone.com homepage type in your school name. (If your school does not appear, pick a well-known landmark near you, like the Field Museum.)
3. Select map
4. When the map is on the screen be sure that it is set to LARGE and to the 1: 50000 scale for the easiest viewing.
5. Notice the brown curving lines all over the map. These are called contour lines and they indicate the elevation of an area.
 - When you want to know the elevation of a particular spot follow the brown line closest to it until you see the brown number. This number indicates the elevation of that area in ft above sea level. Contour lines next to each other are five feet apart. (**See the example below.**)
 - If a place is between two contour lines, the elevation of that place is between those two elevations. For example, look at “Raccoon High School” above. The elevation of the school is between the 610 and 605 ft above sea level.



6. What is the elevation of your school? _____
7. Practice moving around the map.

If you want the map to move east, west, north or south, place the cross cursor at the edge of the map in that particular direction. When you click it, the map moves. A little red dot will mark where you were. This is especially helpful if you want to follow a street.

Pick any east west street and practice moving to the west.

Place your cursor on the street as far to the left as you can. Click it. The entire map will move west, but the dot will mark your place so that you'll still be on the same street. Make sense?

Lets Get Going: Find the Elevation of the Three Forks of the North Branch of the Chicago River

Now lets take a look at the Reference Map given to you by your teacher.

1. What is the landmark at the top of the West Fork of the Chicago River? *Florsheim Park*
 - a. Type this landmark into the "Place Name" box on topozone.com.
 - b. What is the elevation of this landmark? *675 above sea level*
2. What is the landmark at the very top of the North Branch where the three forks meet? *Linne Woods*
 - a. Go back to "View Maps" on the toolbar above the topo map that you are looking at.
 - b. Type this landmark into the "Place Names" box
 - c. What is the elevation of this landmark? (Remember to follow the line CLOSEST to the site.) *620 feet above sea level*

Keep it Going: Find the Elevation of the Main Branch of the Chicago River

Take another look at the Reference Map and locate the Main Branch of the Chicago River. You will be tracing the elevation changes along the Main Branch, by following Kinzie Avenue.

1. Go to "view maps" and type in Ogden Slip in "Place names". Continue to follow Kinzie Avenue west when it becomes railroad tracks.
2. Fill in the elevation chart for the following locations

Location	Elevation
Ogden Slip	590
Kinzie Avenue and Ashland Avenue	595
Kinzie Avenue and Sacramento	600
Kinzie Avenue and Kostner Avenue	605
Kinzie Avenue and Lockwood	610
Kinzie Avenue and Pine	615
Kinzie Avenue and Oak Park Avenue	620
Kinzie Avenue and Kenilworth	625
Kinzie Avenue and Franklin	630
Kinzie Avenue and GAR Woods	625

One More to Go: Find the Elevation of the South Branch of the Chicago River

Look back at the Reference Map and locate the South Branch of the Chicago River. You will be tracing the elevation changes along the South Branch and beyond, by following Cermak Avenue.

1. Go to “view maps” and type in McCormick Place at “Place Names”
2. Fill in the elevation chart for the following locations

Location	Elevation
Cermak at it’s beginning at lakeshore	595
Cermak and Canalport	590
Cermak and Avers Avenue	595
Cermak and Pulaski	600
Cermak and Cicero	605
Cermak and Lombard	610
Cermak and Ridgeland	615
Cermak and Bur Oak Avenue (Woodlawn Cemeteries)	620
Cermak and DesPlaines River	615

So What Do All Those Numbers Mean?

All the numbers you found determine which way water flows – because water flows downhill (from areas of higher to areas of lower elevation). Every water body is surrounded by a watershed – an area of land that drains into the water body because the land is at a higher elevation than the water body. And water in a river itself will flow downhill until it reaches a lake, sea or ocean. Answer these questions to find out what your numbers mean for the flow of water in the Chicago River.

1. Which place has a higher elevation, the top of the West Fork or the top of the North Branch where the three forks meet?
West Fork
2. Based on that information, which way does the water flow – towards the north or south?
South. The three North Forks have a higher elevation than the beginning of the North Branch where the forks meet. Therefore, water will flow from north to south.

3. Look at your list of elevations from along the main stem. What happens to the elevation as you get further away from the lake? *It decreases.*
4. Based on that information, which way does the Chicago River flow, into Lake Michigan or away from Lake Michigan? *Into Lake Michigan.*
5. Look at the elevations between the Chicago River and the Des Plaines River along Kinzie Avenue. What happens to the elevation? *Goes up and then down.* What is the highest point? *630 feet above sea level*
6. Now look at the elevations between the Chicago River and the Des Plaines River along Cermak Avenue. What happens to the elevation? *Goes up and then down.* What is the highest point? *620 feet above sea level*
7. Based on that information what does the water do west of the highest point? *Flow into Des Plaines River.* What does it do east of the highest point? *Flow into the Chicago River.*

These high points show the presence of a sub continental divide – water flowing into the Chicago River flowed out through the Great Lakes to the Atlantic Ocean while water flowing into the Des Plaines River flowed the opposite direction towards the Gulf of Mexico. Without this sub-continental divide there would be no Chicago today.

Why? Read and find out! Read the article: Location, Location, Location.

II. Creating the 3-D Model of the Chicago River

Now that you understand the lay of the land, it is time to make a model of the Chicago River and watch the river reverse.

Instructions

Take a look at the model. Notice that the gelatin in the pan is sloped, this mimics the elevation changes in your watershed – the same elevation changes you recorded when you looked at the topographic maps. The northern part of the watershed is higher than the southern part and the western part is higher than the eastern part.

Take a look at the reference map and make note of the scale.

1. How many centimeters are equal to a mile? *0.4cm or 4 mm*

On you model, the scale will be a little different, 1cm will equal 1mile. Therefore, when you make measurements on the reference map, you will have to convert them to the scale of the model. If you do not know how to do this, make sure to ask!

Draw Lake Michigan

1. On the reference map, how many miles across its top section is Lake Michigan? *22cm*
2. How many centimeters across will Lake Michigan be on your model? *55 cm*
3. On the reference map, how many miles across its bottom is Lake Michigan? *5.3 cm*
4. How many centimeters across its bottom will Lake Michigan on your model? *13.25cm*
5. Measure out the top and bottom of Lake Michigan on your model. Using the reference map as a guide, draw the shape of Lake Michigan on your model.

Draw the Chicago River

Use the following measurements of the different segments of the Chicago River along with the reference map when drawing the Chicago River on your model. REMEMBER: you must convert the miles of the actual river using the scale of your model where 1mi = 1cm.

West Fork of the North Branch of the Chicago River: 14 mi

Middle Fork of the North Branch of the Chicago River: 24 mi

Skokie River: 17 mi

North Shore Channel: 7.6 mi

North Branch of the Chicago River: 17.7 mi

Main stem of the Chicago River: 1.4 mi

South Branch of the Chicago River and South Fork of the South Branch of the Chicago River: 3.9 mi

1. Make snakes of clay the length of each of the river segments. For example, the West Fork of the North Branch of the Chicago River is 14 miles long, so the clay should be 14 cm long. Refer to the reference map and mold the clay snake to show the meanders. It doesn't have to be exact, but as close as you can make it.
2. Place the river segment clay snakes on top of the model, in the shape of the Chicago River. To make sure everything is lined up, measure the following
 - a. Distance from the Lake to the top of the Skokie River: 2.25 miles
 - b. Distance from the Lake to the top of the North Branch: 6.25 miles
 - c. Distance from the Lake to the bottom of the North Branch: 3.75 miles
 - d. Don't forget to convert these measurements to the scale of your model! As a reminder, the scale of the reference map is 1mi=0.4cm and the scale of the model is 1mi=1cm.
3. Check against the reference map. Does it look right? Take some measurements to make sure.
4. Draw the river, by tracing with your permanent marker along the right side of all the forks and branches.
5. Remove the clay. You now have a map drawn on the gelatin.

Cutting the River and Lake

1. Once you have the map on the gelatin you are ready to cut.
2. Dig out Lake Michigan to the bottom of the pan. Slope the edge of the lake near the land down to the bottom of the pan.
3. Cut the river with the plastic knife. Just trace the lines, going down into the gelatin about 0.5 cm. You shouldn't be removing any gelatin as you go. Do NOT make trenches or else the gelatin will become unstable and your model will be ruined.

Adding Water

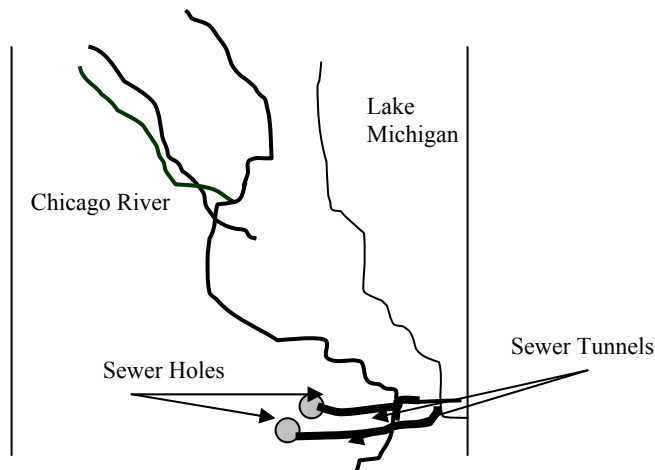
1. SLOWLY pour some blue colored water into the lake. Fill the lake to just below the top of the gelatin. Do NOT flood over the top of the gelatin or your model will fall apart.
2. Now SLOWLY pour some yellow colored water into the top of the three forks of the Chicago River.
3. Where does the yellow water in the Chicago River go? *Down to the North Branch, into the Main Stem and out to Lake Michigan.*

4. Why does the water flow from the Chicago River into Lake Michigan? *Because the river is higher up than the lake. Or stated another way, the lake is downhill from the river.*

Adding Sewers

When Chicago was still young, in the mid and late 1800's, the sewers would pour directly into the river. The sewage polluted more than the river. Read a 19th century account of the problems: "Is Chicago a Swamp?"

1. Using the diagram below as a guide, you are going to be adding sewers to your model. With your knife, make some small holes in the gelatin. Connect the holes to the river with very shallow lines.



2. Pour some red food coloring into the holes. This represents sewage.
3. Where did Chicago's sewage go in the mid to late 1800's? *Into the Chicago River and out to Lake Michigan.*
4. How did this affect Chicago's drinking water? *Chicago got its drinking water from the lake, so the city's drinking water source was polluted with sewage.*

Adding the Sanitary and Ship Canal

No one wants sewage in his or her drinking water! What was Chicago to do? It decided to reverse the Chicago River by building the Chicago Sanitary and Ship Canal.

1. Read the 1900 newspaper article about the opening of the canal. Refer to "Turn the River into Big Canal."
2. The Sanitary and Ship Canal has the following dimensions:
From the end of the South branch to Summit: 7.8 mi
From Summit to Willow Springs: 5.3 mi
From Willow Springs to Lockport: 14.95 miles
It has an average depth of 20 ft.
3. Create the Sanitary and Ship Canal just as you created the Chicago River. However, when you go to cut, start at the edge of the tray and move towards the South Branch of the Chicago River. (You are cutting it just like you read in the article!)
4. Watch what happens! Clue: Watch the Chicago Sanitary and Ship Canal.

5. What color is the water in the Chicago Sanitary and Ship Canal? *Green*
6. Based on the color of the water in the Chicago Sanitary and Ship Canal, where is the water in the canal from? *Lake Michigan (blue water) and the Chicago River (yellow water).*
7. So, is the river flowing into the lake or is the lake flowing into the river? *The lake is flowing into the river.*
8. Now block up the old river mouth (where the river meets the lake) with a piece of clay. Pour some blue water into the three northern forks.
9. Where does the water go? *Into the canal.*
10. Which part of the river is running backward? *The Main Stem and South Branch.*
11. How did the completion of the canal save the city's drinking water and help clean up the river? *Clean lake water came in and flushed away the pollution, and the river no longer flowed into the lake.*

Backwards Goes It Does: Student Pages

I. Topographic Maps

View the “Reference Map” of the Chicago River (attached) and notice its shape. It has three forks on top, turns toward Lake Michigan and then travels south a bit.

Originally, the river flowed from the north forks, south, into the main stem and from the south branches, northwest, into the main stem. Everything then flowed out into Lake Michigan. Why? To find out we will have to consult a topographic map. A topo-grapho-what you say?

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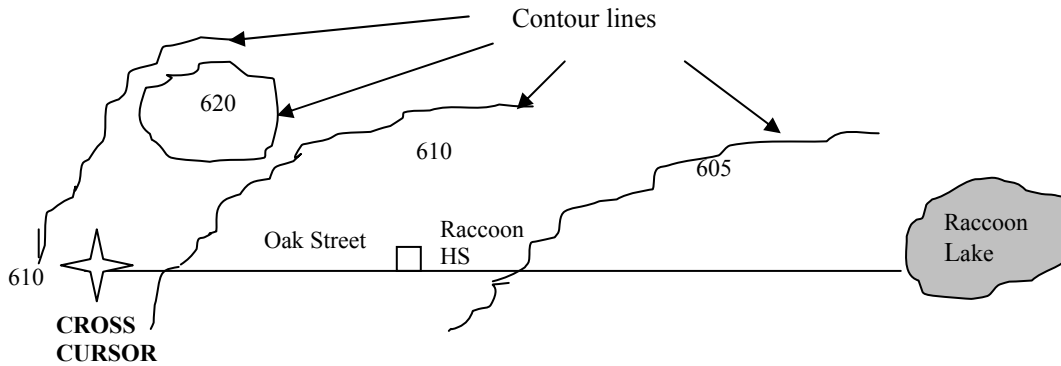
Follow the instructions to view the elevation pattern in the Chicago River watershed and find out why the river originally flowed into the lake.

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8. Select map
9. When the map is on the screen be sure that it is set to LARGE and to the 1: 50000 scale for the easiest viewing.
10. Notice the brown curving lines all over the map. These are called contour lines and they indicate the elevation of an area.
 - When you want to know the elevation of a particular spot follow the brown line closest to it until you see the brown number. This number indicates the elevation of that area in ft above sea level. Contour lines next to each other are five feet apart. (**See the example below.**)
 - If a place is between two contour lines, the elevation of that place is between those two elevations. For example, look at “Raccoon High School” above. The elevation of the school is somewhere between the 610 and 605 ft above sea level.



8. What is the elevation of your school? _____
9. Practice moving around the map.

If you want the map to move east, west, north or south, place the cross cursor at the edge of the map in that particular direction. When you click it, the map moves. A little red dot will mark where you were. This is especially helpful if you want to follow a street.

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Lets Get Going: Find the Elevation of the Three Forks of the North Branch of the Chicago River

Now lets take a look at the Reference Map given to you by your teacher.

1. What is the landmark at the top of the West Fork of the Chicago River?

 a. Type this landmark into the "Place Name" box on topozone.com.
 b. What is the elevation of this landmark? _____
2. What is the landmark at the very top of the North Branch where the three forks meet?

 a. Go back to "View Maps" on the toolbar above the topo map that you are looking at.
 b. Type this landmark into the "Place Names" box
 c. What is the elevation of this landmark? (Remember to follow the line CLOSEST to the site.) _____

Keep it Going: Find the Elevation of the Main Branch of the Chicago River

Take another look at the Reference Map and locate the Main Branch of the Chicago River. You will be tracing the elevation changes along the main branch, by following Kinzie Avenue.

1. Go to "view maps" and type in Ogden Slip in "Place names". Continue to follow Kinzie Avenue west when it becomes railroad tracks.
2. Fill in the elevation chart for the following locations:

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Kinzie Avenue and Kenilworth	
Kinzie Avenue and Franklin	
Kinzie Avenue and GAR Woods	

One More to Go: Find the Elevation of the South Branch of the Chicago River

Look back at the Reference Map and locate the South Branch of the Chicago River. You will be tracing the elevation changes along the south branch and beyond, by following Cermak Avenue.

1. Go to “view maps” and type in McCormick Place at “Place Names”
2. Fill in the elevation chart for the following locations:

Location	Elevation
Cermak at it’s beginning at lakeshore	
Cermak and Canalport	
Cermak and Avers Avenue	
Cermak and Pulaski	
Cermak and Cicero	
Cermak and Lombard	
Cermak and Ridgeland	
Cermak and Bur Oak Avenue (Woodlawn Cemeteries)	
Cermak and DesPlaines River	

So What Do All Those Numbers Mean?

All the numbers you found determine which way water flows – because water flows downhill (from areas of higher to areas of lower elevation). Every water body is surrounded by a watershed – an area of land that drains into the water body because the land is at a higher elevation than the water body. And water in a river itself with flow downhill until in reaches a lake, sea or ocean. Answer these questions to find out what your numbers mean for the flow of water in the Chicago River.

1. Which place has a higher elevation, the top of the West Fork or the top of the North Branch where the three forks meet?
2. Based on that information, which way does the water flow – towards the north or south?

3. Look at your list of elevations from along the Main Stem. What happens to the elevation as you get further away from the lake?
4. Based on that information, which way does the Chicago River flow, into Lake Michigan or away from Lake Michigan?
5. Look at the elevations between the Chicago River and the Des Plaines River along Kinzie Avenue. What happens to the elevation? What is the highest point?
6. Now look at the elevations between the Chicago River and the Des Plaines River along Cermak Avenue. What happens to the elevation? What is the highest point?
7. Based on that information what does the water do west of the highest point? What does it do east of the highest point?

These high points show the presence of a sub continental divide – water flowing into the Chicago River flowed out through the Great Lakes to the Atlantic Ocean while water flowing into the Des Plaines River flowed the opposite direction towards the Gulf of Mexico. Without this sub-continental divide there would be no Chicago today.

Why? Read and find out! Read the article: Location, Location, Location.

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Take a look at the reference map and make note of the scale.

1. How many centimeters are equal to a mile? _____

On your model, the scale will be a little different, 1cm will equal 1mile. Therefore, when you make measurements on the reference map, you will have to convert them to the scale of the model. If you do not know how to do this, make sure to ask!

Draw Lake Michigan

1. On the reference map, how many miles across its top is Lake Michigan? _____
2. How many centimeters across will Lake Michigan be on your model? _____
3. On the reference map, how many miles across its bottom is Lake Michigan? _____
4. How many centimeters across its bottom will Lake Michigan be on your model? _____
5. Measure out the top and bottom of Lake Michigan on your model, using the reference map as a guide, draw the shape of Lake Michigan on your model.

Draw the Chicago River

Use the following measurements of the different segments of the Chicago River along with the reference map when drawing the Chicago River on your model. REMEMBER: you must convert the miles of the actual river using the scale of your model where 1mi = 1cm.

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Main stem of the Chicago River: 1.4 mi

South Branch of the Chicago River and South Fork of the South Branch of the Chicago River: 3.9 mi

1. Make snakes of clay the length of each of the river segments. For example, the West Fork of the North Branch of the Chicago River is 14 miles long, so the clay should be 14 cm long. Refer to the reference map and mold the clay snake to show the meanders. It doesn't have to be exact, but as close as you can make it.
2. Place the river segment clay snakes on top of the model, in the shape of the Chicago River. To make sure everything is lined up, measure the following
 - a. Distance from the Lake to the top of the Skokie River: _____
 - b. Distance from the Lake to the top of the North Branch: _____
 - c. Distance from the Lake to the bottom of the North Branch: _____

Don't forget to convert these measurements to the scale of your model! As a reminder, the scale of the reference map is 1mi = 0.4cm and the scale of the model is 1mi = 1cm.

3. Check against the reference map. Does it look right? Take some measurements to make sure.
4. Draw the river, by tracing with your permanent marker along the right side of all the forks and branches.
5. Remove the clay. You now have a map drawn on the gelatin.

Cutting the River and Lake

1. Once you have the map on the gelatin you are ready to cut.
2. Dig out the Lake to the bottom of the pan. Slope the edge of the lake near the land down to the bottom of the pan.
3. Cut the river with the plastic knife. Just trace the lines, going down into the gelatin about 0.5 cm. You shouldn't be removing any gelatin as you go. Do NOT make trenches or else the gelatin will become unstable and your model will be ruined.

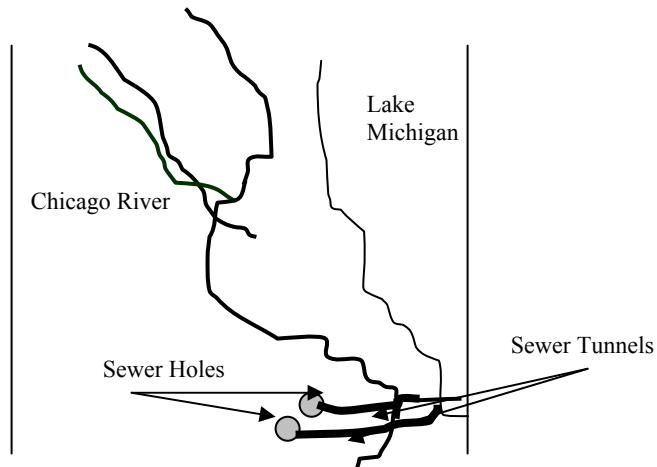
Adding Water

1. SLOWLY pour some blue colored water into the lake. Fill the lake to just below the top of the gelatin. Do NOT flood over the top of the gelatin or your model will fall apart.
2. Now SLOWLY pour some yellow colored water into the top of the three forks of the Chicago River.
3. Where does the yellow water in the Chicago River go?
4. Why does the water flow from the Chicago River into Lake Michigan?

Adding Sewers

When Chicago was still young, in the mid and late 1800's, the sewers would pour directly into the river. The sewage polluted more than the river. Read a 19th century account of the problems: "Is Chicago a Swamp?"

1. Using the diagram below as a guide, you are going to be adding sewers to your model. With your knife, make some small holes in the gelatin. Connect the holes to the river with very shallow lines.



2. Pour some red food coloring into the holes. This represents sewage.
3. Where did Chicago's sewage go in the mid to late 1800's?

4. How did this affect Chicago's drinking water?

Adding the Sanitary and Ship Canal

No one wants sewage in his or her drinking water! What was Chicago to do? It decided to reverse the Chicago River by building the Chicago Sanitary and Ship Canal.

1. Read the 1900 newspaper article about the opening of the canal. Refer to "Turn the River into Big Canal."
2. The Sanitary and Ship Canal has the following dimensions:
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4. Watch what happens! Clue: Watch the Chicago Sanitary and Ship Canal.
5. What color is the water in the Chicago Sanitary and Ship Canal?

6. Based on the color of the water in the Chicago Sanitary and Ship Canal, where is the water in the canal from?

7. So, is the river flowing into the lake or is the lake flowing into the river?

8. Now block up the old river mouth (where the river meets the lake) with a piece of clay. Pour some blue water into the three northern forks.
9. Where does the water go?

10. Which part of the river is running backward?

11. How did the completion of the canal save the city's drinking water and help clean up the river?