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.
   ♦ Visit www.trails.com or www.mytopo.com to view topo maps of our area.

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.

Grade Level: 9th – 12th
Duration: Three 45 minute 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 beaters (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:

NGSS:
RI.10.10, RI.3.2, RI.10.8, 7 RP 3, HS G-MG 1, HS G-SRT 8, 7.EE 3, 5.MD 1, HS G-GMD 3, HS G-MG 4, MS-ESS3-4, HS-ESS3-1, MS-ESS3-3, HS-LS4-5
• 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.

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.trails.com or www.mytopo.com. These websites can be used for viewing topographic maps online) you can also order custom topo maps.

Lets Practice: Find the elevation of your school

1. Visit one of the two websites listed above.
2. Locate the United States, Illinois, or the City of Chicago and zoom in. www.trails.com has a locator for your school’s address, or pick a well-known feature near you, like the Field Museum.
3. Find your school on the map.
4. When the map is on the screen be sure that it is set at a scale for easiest viewing. Select “topo” or ‘terrain-topo” mode to obtain a topo map.
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 feet above sea level. Contour lines next to each other are five feet apart. (See the example below.)
   - If a place is between two lines with different elevations, 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 ft 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 cursor on the map and drag it that direction. This is especially helpful if you want to follow a street.

**Let’s Get Going: Find the Elevation of the Three Forks of the North Branch of the Chicago River**

Now let’s 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 (found at 42.2128°, -87.8986°)
   a. Go to “Topo maps” and type in Florsheim Park, IL in “Feature names”.
   b. What is the elevation of this landmark? 689 above sea level

2. What is the landmark at the very top of the North Branch where the three forks meet? Linne Woods (found at 42.0442°, -87.7844°)
   a. Go back to the toolbar above the topo map that you are looking at.
   b. Go to “Topo maps” and type in Linne Woods, IL in “Feature names”.
   c. What is the elevation of this landmark? (Remember to follow the line CLOSEST to the site.) 650 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. (Found at 41.8903°, -87.6169°)

1. Go to “Topo maps” and type in Ogden Slip, IL in “Feature names”. Continue to follow Kinzie Avenue to the west when it becomes railroad tracks.
2. Fill in the elevation chart for the following locations:
### 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.

*(Found at 41.85°, -87.61°)*

1. Go to “Topo maps” and type in McCormick Place, IL in “Feature names”.
2. Fill in the elevation chart for the following locations:

<table>
<thead>
<tr>
<th>Location</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cermak at it’s beginning at the lakeshore</td>
<td>630 41.8528°, -87.6175°</td>
</tr>
<tr>
<td>Cermak and Canalport</td>
<td>591 41.8525°, -87.6513°</td>
</tr>
<tr>
<td>Cermak and Avers Avenue</td>
<td>604 41.8516°, -87.7211°</td>
</tr>
<tr>
<td>Cermak and Pulaski</td>
<td>597 41.8514°, -87.7247°</td>
</tr>
<tr>
<td>Cermak and Cicero</td>
<td>607 41.8512°, -87.7443°</td>
</tr>
<tr>
<td>Cermak and Laramie</td>
<td>607 41.8511°, -87.754°</td>
</tr>
<tr>
<td>Cermak and Ridgeland</td>
<td>614 41.8507°, -87.7835°</td>
</tr>
<tr>
<td>Cermak and Bur Oak Avenue (Woodlawn Cemeteries)</td>
<td>627 41.8501°, -87.8171°</td>
</tr>
<tr>
<td>Cermak and DesPlaines River</td>
<td>617 41.85°, -87.8273°</td>
</tr>
</tbody>
</table>

### 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 the higher to lower elevation.**
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 increases.
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? 627 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 goes out through the Great Lakes to the Atlantic Ocean while water flowing into the Des Plaines River flows 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? 13.25 cm
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.

![Diagram of Chicago River and Lake Michigan with sewers and seweget holes]

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!)
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.
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.
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?

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.trails.com or www.mytopo.com. These websites can be used for viewing topographic maps online) you can also order custom topo maps.

Lets Practice: Find the elevation of your school

1. Visit one of the two websites listed above.
2. Locate the United States, Illinois, or the City of Chicago and zoom in. www.trails.com has a locator for your school’s address, or pick a well-known feature near you, like the Field Museum.
3. Find your school on the map.
4. When the map is on the screen be sure that it is set at a scale for easiest viewing. Select “topo” or ‘terrain-topo” mode to obtain a topo map.
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 feet above sea level. Contour lines next to each other are five feet apart. (See the example below.)
   - If a place is between two lines with different elevations, 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 ft and 605 ft above sea level.

Friends of the Chicago River
CHICAGO RIVER SCHOOLS NETWORK
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 cursor on the map and drag it that direction. This is especially helpful if you want to follow a street.

Let’s Get Going: Find the Elevation of the Three Forks of the North Branch of the Chicago River

Now let’s 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. Go to “Topo maps” and type in Florsheim Park, IL in “Feature names”.
   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 the toolbar above the topo map that you are looking at.
   b. Go to “Topo maps” and type in Linne Woods, IL in “Feature names”.
   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 “Topo maps” and type in Ogden Slip, IL in “Feature names”. Continue to follow Kinzie Avenue to the west when it becomes railroad tracks.

2. Fill in the elevation chart for the following locations:
<table>
<thead>
<tr>
<th>Location</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ogden Slip</td>
<td></td>
</tr>
<tr>
<td>Kinzie Avenue and Ashland Avenue</td>
<td></td>
</tr>
<tr>
<td>Kinzie Avenue and Sacramento</td>
<td></td>
</tr>
<tr>
<td>Kinzie Avenue and Kostner Avenue</td>
<td></td>
</tr>
<tr>
<td>Kinzie Avenue and Lockwood</td>
<td></td>
</tr>
<tr>
<td>Kinzie Avenue and Pine</td>
<td></td>
</tr>
<tr>
<td>Kinzie Avenue and Oak Park Avenue</td>
<td></td>
</tr>
<tr>
<td>Kinzie Avenue and Kenilworth</td>
<td></td>
</tr>
<tr>
<td>Kinzie Avenue and Franklin</td>
<td></td>
</tr>
<tr>
<td>Kinzie Avenue and GAR Woods</td>
<td></td>
</tr>
</tbody>
</table>

**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 “Topo maps” and type in McCormick Place, IL in “Feature names”.
2. Fill in the elevation chart for the following locations:

<table>
<thead>
<tr>
<th>Location</th>
<th>Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cermak at it’s beginning at the lakeshore</td>
<td></td>
</tr>
<tr>
<td>Cermak and Canalport</td>
<td></td>
</tr>
<tr>
<td>Cermak and Avers Avenue</td>
<td></td>
</tr>
<tr>
<td>Cermak and Pulaski</td>
<td></td>
</tr>
<tr>
<td>Cermak and Cicero</td>
<td></td>
</tr>
<tr>
<td>Cermak and Laramie</td>
<td></td>
</tr>
<tr>
<td>Cermak and Ridgeland</td>
<td></td>
</tr>
<tr>
<td>Cermak and Bur Oak Avenue (Woodlawn Cemeteries)</td>
<td></td>
</tr>
<tr>
<td>Cermak and DesPlaines River</td>
<td></td>
</tr>
</tbody>
</table>

**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.**
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? __________________________

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 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.

- 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: ________________
   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?”

*Backwards Goes It Does*
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.

![Diagram of Chicago River, Sewer Holes, and Sewer Tunnels]

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

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:
   - 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!)
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?
Location, Location, Location

As a place of business, its situation at the central head of the Mississippi Valley will make it the New Orleans of the North; and its easy and close intercourse with the most flourishing eastern cities will give it the advantage, as its capital increases, of all their improvements in the mode of living.

—Charles Fenn Hoffman
Early settler, January 10, 1834

If you were an early visitor, standing on a raised dune on the shore of what is now downtown Chicago, it would have been easy to describe the river scene: one stem, two tributaries, trees scattered in groves along the South Branch, denser forest to the north, marshland everywhere, and to the west, vast endless prairie until the eye spotted the distant line of trees on the east bank of the Des Plaines River.

Anyone delving into the real estate market learns that there are three major characteristics to consider about property: location, location, and location. Combining the advantages of transportation and rich natural history, Chicago's location at the head of the Great Lakes was, and is, unsurpassed. That the marshy land might be a problematic site for a great city with a population in excess of three million was far from the minds of the natives and early settlers who plied its waters with their primitive trade and vessels.

The Riddle of the Divide

If you were a westbound traveler or trader in any typical dry season, you boated five or six miles upstream from Lake Michigan along the South Branch of the river until you could boat no further. At this place, you would be at a sub-continental divide. This divide separates the Mississippi River/Gulf of Mexico drainage to the west and the Great Lakes/St. Lawrence River/Atlantic Ocean drainage to the east.

Geologically speaking, a divide is usually thought of as high land that separates two watersheds. For example, the major North American continental divide, which separates the Atlantic and the Pacific drainages, runs along the Rocky Mountains. But here, at what was to become Chicago, the divide was low, very low. During times of high water levels in the rivers, it was barely visible, and at other times, non-existent. Even so, it is still among the most important drainage divides in North America.

For a traveler in a boat, the importance of a divide is that there is usually dry land between watersheds. To get from one to the other, you have to portage. If you were an early native or fur trader on your way west to the vast, rich interior of the continent along Lake Michigan, you would boat your goods.
Bird's eye view of yesterday's Chicago, looking to the west. Low sand dunes line the lakeshore. A sandbar diverts the route of the Main Branch of the Chicago River to the south before it empties into Lake Michigan. Sloughs drain the lowland into the river. The slough coming from the north is under today's Merchandise Mart. The North and South Branches meet at Wolf Point and flow into the Main Branch. The South Branch flows from the west from the direction of the Des Plaines River. The South and West Forks of the South Branch are not pictured but are just beyond the illustration's northwest border.

as far as you could, following the Main Stem of the Chicago River, the South Branch, then called the Portage River, and continue up what was later named the West Fork. If you were lucky and the season was wet, the low divide would be completely covered by water and you could sail right along and soon find yourself in the Des Plaines River, on your way to the Illinois River and then the Mississippi.

But if it were a dry season, usually in summer, you could only go so far up-river before your boat would run aground, probably around present-day Leavitt Street. There, you would be forced to lift your craft and cargo out of the water and carry, or portage, them over a slight rise of land in order to reach the Des Plaines watershed where you could again float your boat. Usually you would follow the Portage Road for some distance around a marsh known as Mud Lake.

Alternatively, a traveler could get his boat back in the water sooner by dragging it through Mud Lake, a large, leech-infested puddle filled with dense grasses. Gurdon Hubbard, a young fur trader making his first trip through
Chicago in 1818, described this “shortcut” in graphic detail:

Our empty boats were pulled up the channel, and in many places, where there was no water and a hard clay bottom, they were placed on short rollers, and in this way moved along until the [Mud] lake was reached, where we found mud thick and deep, but only at rare intervals was there water. Forked tree branches were tied upon the ends of the boat poles, and these afforded a bearing on the tussocks of grass and roots, which enabled the men in the boat to push to some purpose. Four men only remained in a boat and pushed with these poles, while six or eight others waded in the mud alongside, and by united efforts constantly jerking it along, so that from dawn to dark we succeeded only in passing a part of our boats through to the Aux Plaines [Des Plaines] outlet. . . . While a part of our crew were thus employed, others busied themselves in transporting our goods on their backs to the river; it was a laborious day for all.

Those who waded through the mud frequently sank to their waist, and at times were forced to cling to the side of the boat to prevent going over their heads; after reaching the end and camping for the night came the task of ridding themselves from the blood suckers.

The lake was full of these abominable black plagues, and they stuck so tight to the skin that they broke in pieces if force was used to remove them; experience had taught the use of a decoction of tobacco to remove them, and this was resorted to with good success.

Having rid ourselves of the blood suckers, we were assailed by myriads of mosquitoes, that rendered sleep hopeless. . . . Those who had waded the lake suffered great agony, their limbs becoming swollen and inflamed, and their sufferings were not ended for two or three days.

It took us three consecutive days of toil to pass all our boats through this miserable lake. . . .

The Chicago portage route of the natives, at the short, low divide between the Great Lakes and the Mississippi River system, has been called one of the “five keys to the continent.” Chicago is located where it is today because native tribesmen introduced the French explorers Marquette and Jolliet to this portage route. They took the path around, not through, the marsh. Jolliet, a Frenchman born in New France but knowledgeable about hydrology, immediately envisioned a little canal to breach this portage, eliminating the need to get out of your canoe even in dry times. He reported that, with just a little work, a canal would end the need for a portage and open up an easy route to the Mississippi. To Jolliet, the watersheds of the Des Plaines and Chicago Rivers were tantalizingly close, separated by but “half a league” (one and one-half miles).

Jolliet estimated his distance in September, 1673, the only time he crossed the portage. It must have been a very wet summer, judging by what two travelers, R. Graham and Joseph Phillips, subsequently wrote:

The route by Chicago as followed by the French since their discovery of the Illinois presents at one season of the year an uninterrupted water communication for boats of six to eight tons burthen [sic] between the Mississippi and the Michigan lake; at another season a portage of two miles; at another, a portage of seven miles, from the bend of the Plein [Des Plaines] to the arm of the lake; at another a portage of fifty miles, from the mouth of
Fifty miles! Fifty miles of carrying your boat and supplies to the west, or 50 miles of dragging your boat and your precious cargo of furs east. Even though this longest of detours was probably the exception, the more usual seven-plus miles is a great deal of carrying. If, in 1673, crossing the portage had required that much walking, Jolliet might not have imagined that digging a canal would be so simple. Hubbard, whose experience in Mud Lake was so disagreeable, was employed by the American Fur Company, which moved large heavy boats and trade goods across the portage. It should not come as a surprise to learn that he became a leading proponent of a canal.

"The Old Continental Divide and the Modern City." Albany Avenue and Leavitt Street have been darkened to show the location of Knight and Zeuch’s mysterious rise of land that created the divide. Vierling based his map on Knight and Zeuch’s “Map of the Old Chicago Portage,” which did not show the “original” West Fork. Vierling has added it, showing it rising at the railroad tracks on the eastern slope of the “divide.”
IS CHICAGO A SWAMP?

A New Orleans View of It-Chicago

Dirt and What Will She Do With It?

*New Orleans Times, Aug. 28, 1881*

She is Chicago and she is dirt. Chicago is positively the dirtiest city extant in any civilized or Christian country. A clean level lies behind her, without a rise, to the foot of the Rocky Mountains. A broad, clean inland sea lies in the front of her, or her people would have died with pestilence ten times over. She used to be scourged with cholera regularly in the old days, and her frightened citizens fled by thousands to Milwaukee and the towns down the lake. It was hoped that by sewerage the place and getting lake water to drink it might be made healthy if not clean. But the enormous death rate of the last half-year is double to treble that of New Orleans is causing doubt upon this subject.

There is a well-built and comparatively clean centre in Chicago, but the city sweeps off, on all sides but the front, to a swamp. They call it a prairie there, in Louisiana they call it swamp. The outskirts of the city are built up with shanties, squatted in this swamp, or stuck upon posts to keep them out of it. Coming in on nearly all the railroads, notably the Michigan Southern or the Northwestern, the traveler passes through miles of those shanties, scarcely superior to the cabins on a rack-rented estate in Ireland, where naked babies and pigs tumble promiscuously. Chicago's face is far enough, but, like Milton's monster, she ends "foul in many a scabby fold." She is the draggle-tall of all cities.

The centre nucleus and the parts where the rich dwell are sewer'd. There are foul, slimy ditches for the draining of the rest. The sewerage is emptied into the river. The river has no current. It is a stagnant ditch. It is not a large ditch either, and divides as it crawls its foul way through the city into two branches, which are very small ditches indeed. These ditches are the open main sewers of the strong-smelling city. Into them are dumped the horrid abominations of several hundred thousand people.

Some years ago, these ditches could be smelled when the wind was favorable, ten miles it is said. They were simply sewers, and nothing else. Schooners, propellers, canalboats, all the craft of the harbor, lay lumber-like in this foul hell-broth, and the busy tugs, darting back and forth through the slap abominations, stirred up unspeakable stenches for the noses of mankind.

And here comes in our question, which is the question of our dirty sister of the loud-scented ditches. Is it sought to help the city to a little whiff of decent air by turning the so-called river end for end, add making it think its tail was its head? It was a daring undertaking, but the Chicagoese are a daring people. So they dug out the Illinois Canal (which connects Chicago with the Illinois River), and thought the Chicago ditches would empty into that, since they wouldn't empty into the lake.

Some of the horrid stuff did drain off in the canal, and occasionally some clean lake water would run into the main river for a short distance, but the proportion of the sewage draining out was small compared to what remained, and the city is scarce better. Meanwhile the towns along the canal and the Illinois River are having their air and water polluted by the terrific dejections of Chicago.
From The Chicago River, Hill 1800 Sanitary and Ship Canal.

On January 3, 1900, The Chicago Tribune brought alive, in great detail, the previous day’s activities:

"Water was let in the drainage canal from the Chicago River yesterday [January 2] morning, and last night a thin coating of the murky fluid covered the bottom of the channel as far as Willow Springs. The opening of the greatest ship canal ever constructed in America and the informal completion of one of the engineering feats in the world’s history was accomplished without ceremony. The nine Sanitary Trustees with their engineer, Isham Randolph, simply went to the Kedzie avenue [sic] connection of the West Fork of the South Branch of the Chicago River and the canal and saw the thin ridge of earth cut through.

The consummation of the project, on which the people of Chicago have expended upwards of $33,000,000, was free from the formalities which marked “shovel day,” when the work was inaugurated on Sept. 3, 1892. But there was no fear of injunctions on “shovel day.” The enemies of the project by which Chicago gives to the State a ship canal were not so persistent on that day as they have grown to be as the canal, in spite of all obstacles, has neared the time when water should fill its banks. 

While the turning in of water was simple and business-like, it was attended by much nervousness among the trustees for fear of injunctions. Two belated newspaper reporters who came rushing across the earth piles caused a small panic until it was seen they carried no injunctions with them. It was with a feeling of relief that the water finally was seen pouring down the sluiceway without a legal bill having been called.

The trustees started in the gray light of dawn, and their coming was unannounced except to a few friends and two newspapermen; who at midnight had received a tip that the canal was to be opened.

B.A. Eckhart was the first to reach the narrow watershed at Kedzie avenue and Thirty-fifth street. He jumped out of his carriage, dragging with him a set of new shovels for the trustees. The shovels were of the common kind with no silver handles.

“I had an awful time getting these shovels at this time of day,” said Mr. Eckhart, as he deposited them on the bank, just above the place where a dredge was already hard at work throwing up the clay from the cut. 

Before long trustees Carter, Braden, Jones, Wenter, Kelly, and Mallette arrived. Seizing the shovels, the trustees jumped down the embankment and began throwing the loose earth out of the cut. Loud shouts of approval greeted their efforts, but a few shovelfuls apiece sufficed to cover the honor of opening the canal. It was plain that the Big Dredge No. 7, when it came to throwing earth, was worth several hundred of the most distinguished trustees ever produced. The trustees crawled back and waited. By this time there were fifty or more people gathered around the cut.

After a while the dredge gained a point where its great arm could reach no further. Large chunks of ice and frozen clay blocked the way. Less than eight feet separated the waters of the lakes from the waters of the Mississippi, but the solid nature of the soil made the obstacle almost as great as if the distance had been as many miles. Some one set up a plea for blasting out the ridge. Soon a dozen brawny arms were driving in the bars which were to make the holes for the blasts. It was exceedingly slow work, for the clay was like a rock in its hardness. Four large charges of dynamite were placed in the ridge. The crowd, which by this time had grown to a hundred or more, beat a retreat and hid behind timbers or sought shelter [behind] a stationary dredge.
near by. It was expected that the earth would yawn as by magic under the power of the explosive and the drainage canal would be opened amid salvos of dynamite and the rush of flying clay. President Boldenweck, who had arrived sometime previously in company with Trustees Smyth, claimed it as a prerogative of his office that he and he alone should touch the button. Thereby he cut short a controversy between Trustees Carter and Braden as to which one should have the honor.

The button was officially touched and a sullen roar was the answer. A few fugitive pieces of clay did fly into the air, but as a grand opening it was a failure. When the crowd rushed back to the cut it looked about as it did before. Then the ambitious trustees, armed with their shovels, descended into the cut and began to push away the pieces of clay and ice which held back the lakes. President Boldenweck was particularly active in the futile endeavor. Chief Engineer Randolph watched the rivulets of ice water trickle through the breaches the official shovels had made in the ridge and bethought himself of the dam, or sluice gate, which had been made at such expense and foresight to keep back the waters he was now so anxious to see pouring through. A gang of workmen was ordered to remove the dam before it ever had been used. The trustees gave up their feeble endeavors to keep the blocks out of the cut and fell on that dam with vigor.

For an hour previously some of the spectators had maintained a fire with old timbers and the general riff-raff of canal building. The fire in no small degree had kept the crowd from freezing in the bitter wind from the western prairies.

"Put the dam in the fire," commanded Mr. Jones, and into the fire went the structure which for so many days had been pointed out as evidence of good faith in not opening the canal until the State commission had given its consent.

Then the crew of the dredge renewed their efforts to get within range of the cut. If its great arm could not cut a hole through the narrow ridge of clay and ice the day would end in another defeat of the trustees. The crew tugged and pulled to get their unwieldy craft into the breach. At last the 'spuds' went down to the bottom of the river again and the long arm was extended towards the Mississippi. It reached. A great shout went up when the dipper brought up as much earth as a team of horses could have hauled away.

"It is but a question of a few more shovelfuls now," exclaimed Mr. Wenter, as the long arm swept to the westward and dropped its load on the spoil bank. With the regularity of a pendulum the arm of the dredge swung back and forth. Each time it carried a load of clay from the fast-disappearing watershed. The ice from the river rolled in and blocked the channel which had been cut through by the dredge.

"Push the ice gorge away with the arm," shouted the foreman to the man who controlled that mechanism. The arm dropped behind the ice gorge, and then with irresistible motion swept the whole of it into the Mississippi Valley.

"... It is open! It is open!" went up from scores of throats as the water at last, after two hours of constant endeavor, had been made to start down the toboggan slide into the canal. The fall from the surface of the collateral branch, as it is called, of the West Fork of the South Branch of the Chicago River, to the bottom of the drainage canal was 24½ feet. The cut through the bank of the canal was about twelve feet wide and was planked up for some ten feet. The cut ran nearly straight almost to the bottom, and then shot eastward until, where it emptied into the canal, it was nearly at right angles to the channel. This was to avoid washing away the banks on the other side by the
rush of water.

"It is the Niagara of Chicago," Mr. Eckhart said, as he stood watching the waters of the West Branch, together with the ice and clay bowlders [sic], sweep down the chute and drive far into the wide canal, whose surface already was beginning to take on a rich mahogany brown as the river water covered the boy's skating pond.

The consummation of the great event was celebrated by the trustees by gathering on the timbers at the end of the chute and having their pictures taken in a group. Engineer Randolph stood at the end of the structure and waved his hat triumphantly. The flooding waters sent heavy spray over the feet of the men on the pier, and threatened to carry the group, the pier, and all the rest into the canal beneath. Like school boys on a vacation, the drainage officials waved their arms and shouted. It was soon over, however, and the crowd returned to the dredge, whose clicklike motion was steadily widening the cut through the watershed. As each dipperful was taken out the flow of water was increased and the spray at the foot of the chute went higher and higher."