

Teacher Notes

Changing Technology and Factory Location

(adapted from ARGWorld Activity I – Association of American Geographers)

Students choose sites for iron factories at several times in history. The quality of their choices depends on how well they understand a basic principle of location theory:

Factories that use heavy materials should be located close to the source of those materials.

When technology changes, the inputs and outputs can also change. These changes can have an effect on the locational decision. That decision, in turn, affects the prosperity of places that depend on the industry.

Learner outcomes and curricular links

After doing this Activity, a student should be able to:

- 1) analyze the inputs and outputs of a factory and choose a location that minimizes the total cost of transporting materials (National Geography Standard 11, patterns of economic interdependence);
- 2) evaluate various modes of transportation (wagon, canal boat, railroad, highway, and airplane) in terms of availability and relative cost in the 1700s, 1800s, and 1900s (Standard 11, above, and standard 17, using geography to interpret the past);
- 3) appreciate that a place may lose its locational advantage as a result of changes in transportation or industrial technology. As a result, people may be unable to compete, *through no fault of their own* (Standard 16, changes in the meaning, use, distribution, and importance of resources);

This Activity can fit a geography unit on the old industrial core of Europe or the United States, a history unit on the Industrial Revolution, or an economics unit on regional differences. If the unit is extended by graphing, it can also meet some mathematics standards.

Resources

Time: 30-60 minutes, depending on whether students prepare materials to defend their choices in class.

Readings, answer sheet, criteria ranking table, and two maps.

Multimedia presentations on Changing Technology, Migration to Germany, and Two Turkish Student.

Classroom procedures

- 1) Ask questions about factory locations, either local, national, or in another country.
- 2) Hand out the descriptions of iron/steel technology; ask students to read them and to speculate/hypothesize about the correct date for each one and/or use the multimedia unit.
- 3) If desired, run the animations in the multimedia presentation on Changing Technology.
- 4) Have students complete the Response Sheet and/or the Locational Considerations table.
How would the locations of necessary materials influence the location of factories?
- 5) Hand out the map and have students, individually or in groups, choose locations for factories.
- 6) Conclude by discussing what might be done about places where factories have to close because they have lost their locational advantage. A simulated town meeting (see Extension) can be a powerful conclusion.

Setting up the activity

Show satellite images or photos of a steel mill or oil refinery.

- ? How much do you think this all costs? (Pause, but don't expect much answer.) I don't know exactly how much, but it's a lot. Look how big it is, all that pipe and concrete.
- ? How do they decide where to locate the factory? After all, you'd hardly want to make all that investment in a bad location.

A note about perspective

As with many important principles of economic geography, the process of industrial location can be taught almost equally well by looking at the process from either direction:

Where should we locate a new factory? or Should we close an existing factory?

One or the other of those perspectives, however, might fit the conditions in your community better. Pick one and see how it works!

Alternative introductions

Ask students to write down words they associate with some cities you name:

- ? What comes to mind if I say Denver? (typical responses: Colorado, mountains, Broncos, vacation)
- ? What about New York? (Broadway, banks, Yankees, Harlem, etc.) Paris? (France, art, cathedral)
- ? Pittsburgh or Birmingham? (Steelers, coal, factories, etc.)

Obviously, different cities have different public images. Consider Pittsburgh. Some years ago, "Steelers" was a good name for its football team, because Pittsburgh was one of the biggest steel-producing areas in the world. It's not any more. This Activity is about how that came to be.

One could also start the Activity by describing a local industry. Why is this here? (People sometimes answer this question by describing the decision-making process, e.g., "because that's where Mrs. Jones and Mr. Smith decided to put it." That simply begs the basic locational question, and the proper response is just to repeat the question: "and why did they decide to put it here, as opposed to somewhere else?")

The answer to that question is the key to successful restructuring of old industrial areas in Europe and other industrial regions. The main part of the activity is set in northern Europe, but the principles apply to any industrial area that had its greatest growth during the age of coal-fired blast furnaces.

From Pittsburgh, Pennsylvania, to Shenyang, China, these old industrial areas all faced economic upheaval as technological changes took away their locational advantage, and they had to find other ways of competing in the world economy.

If a local industry is chosen as the introduction, therefore, students might try to make diagrams or readings like to show the major inputs and outputs of the industry. These help clarify the locational problem by showing the relative importance of various factors, and it also makes it easier to "climb" out of a local context and see how the principle applies in other parts of the world.

Background information

In the late 1700s, iron-making tended to locate in forested areas close to cities. Logical locations for charcoal furnaces in the United States included New Jersey, eastern Pennsylvania, and (to a lesser degree) Connecticut, coastal Virginia, or the area around Boston. Even if people had known how to use coal from western Pennsylvania, Kentucky, or West Virginia in iron-making, the product would have been prohibitively expensive to ship from those places to the Atlantic coast. In Europe, people built charcoal ovens in many places. The political fragmentation of the continent makes it even harder to see patterns with this decentralized technology. That is why the CD uses the United States as an example for the 1790s and moves to Europe for the 1890s, the core of the Industrial Revolution.

By the late 1800s, coal-fired blast furnaces had driven most charcoal furnaces out of business. Steel-making tended to locate where coal was nearby and iron ore could be hauled in by rail or boat. In the United States, steel industry became important in western Pennsylvania, northeastern Ohio, around Chicago, Detroit, and Birmingham, Alabama. Of these, only Birmingham had nearby sources of both coal and iron ore. The other places had to bring at least one raw material to the factory, usually by water transport. Birmingham, Alabama, was named for an English city with similar resources. The Ruhr Valley of north-central Germany was the lowest-cost place to make steel.

In the late 1900s, electric "mini-mills" were taking an increasing share of the market, and blast furnaces ("big steel") were in serious trouble. In theory, the new electric mills could locate almost anywhere, but in practice they tended to favor places with large population (more scrap metal around) and a sizeable under-employed work force. In the United States, important factories were in western North Carolina, central Indiana, and east-central Texas. Meanwhile, many blast furnaces in the old steel areas were closing. The steel industry of Alabama was almost dead, and many factory towns in Ohio, Pennsylvania, England, Germany, China, and Japan had shifted to other products.

Extension and enrichment

As an extension, students could graph the steel made at various times in history. These figures show United States steel production as a percentage of the world total at various times:

1900	37	1935	35	1955	39	1990	11
1910	44	1940	43	1960	26	2000	9
1920	59	1945	64	1970	20	2010	7
1930	44	1950	47	1980	14		

The influence of the two World Wars and the Depression of the 1930s is obvious. The long-term decline in the relative importance of American steel production is also clear. These numbers could be used for a comparative graphing activity: students could depict them with line graphs, bar graphs, and pie charts, and see which method(s) are most effective.

The Activity is fairly easy to adapt for other important industries. The mix of inputs and outputs, however, may be different for industries with products or materials that are not as heavy as steel.

Clothing factories try to locate close to inexpensive labor.

Oil refineries are often near producing wells, major markets, or ports.

Aluminum refining needs plenty of cheap energy – large hydroelectric dams or local gas reserves.

Computers need skilled designers and inexpensive assemblers.

A motion-picture industry needs to be close to interesting scenery and skilled workers.

Students could pick an industry, do some research to identify the major inputs and outputs, make maps of conditions that affect its location, suggest alternative sites, and defend their recommended location.

A second and very important extension is to get students to wrestle with the complicated situation of factory closing. Have them write an editorial in a newspaper or a letter from a factory owner to the community, explaining why a particular factory should be closed and what can be done to soften the blow. Another valuable activity is to run a simulation of a town meeting – different students can play roles such as mayor, shopkeeper, labor union organizer, hospital administrator, theater owner, etc.

Concluding the activity

- 1) One important takehome message from this activity is the simple fact that some locations are better than others for any economic activity. Putting a factory or other economic enterprise in an unfavorable location will inevitably impose a cost, in time, money, and/or quality of life.
- 2) A given site may not remain the best location for a particular economic activity, whether it is a factory, office, concert hall, amusement park, or whatever. Technological change can make another location preferable. Attempts to continue using a non-optimal site will inevitably impose a cost on the economy as a whole.
- 3) It is not necessarily the fault of the people in an area if a change in technology, transportation, or consumer preference makes their location non-competitive. This raises the touchy question of how society should treat people who have the "bad luck" of being in the wrong place at the wrong time. Human suffering can be reduced if people anticipate changes and think about ways to lessen the adverse impact.

This can easily lead to a general discussion about humane ways of abandoning places that no longer have locational advantages. That discussion, in turn, can help prepare students for the likelihood that they will have to change jobs and/or residences during their working lives, perhaps for reasons related to technological change in their occupation.

Here's a website where you can find out about some of the latest developments in the steel industry, from the perspective of the factory owners: <http://www.worldsteel.org/>

Changing Iron/Steel Technology

Glossary of key terms

- bituminous coal:** a type of coal that is good for blast furnaces
- blast furnace:** a method of producing iron by burning coal to heat iron ore and limestone
- bog iron:** yellow, iron-rich mud found in swampy areas, especially where glaciers covered the land long ago
- charcoal:** a form of fuel made by heating wood to drive off gases and leave pure carbon
- coal:** mineral formed when ancient swamps were buried under layers of rock
- de-industrialization:** closing of factories, which often occurs when technological change makes another location better for producing the product
- electric hearth:** a method of producing iron by using electricity to heat iron ore and limestone
- exports:** goods or services sold to a different country
- glacier:** a huge mass of ice that slowly flows over the land; glaciers were responsible for the formation of lakes, bogs, and swamps in many places.
- hematite:** iron oxide ore formed at the bottom of ancient oceans
- hydroelectric dam:** a dam that has a generator to convert the energy from the downhill flow of a river to electricity
- immigrants:** people who move in to a country (see the multimedia presentations on Migration to Australia, Migration to Germany, and/or Modern Migrants)
- imports:** goods or services bought from a different country (see the multimedia unit on Trade)
- iron ore:** a mineral or rock that can be transformed into iron through industrial processing
- kiln:** a container, usually lined with brick, that can be heated to high temperatures
- limestone:** a rock made of calcium carbonate, which helps remove impurities from iron in a blast furnace
- site:** the conditions of place (see the multimedia unit on Site and Situation)
- situation:** the connections between a place and other places (ditto)
- textile mill:** a factory that produces cloth from wool, cotton, polyester, or other thread
- Weber theory of industrial location:** idea that industries are most efficient when they are located close to the input resource (raw material, energy, skill, labor, etc.) that is most difficult or expensive to ship. Sometimes, the most expensive thing to ship is the product of the factory, in which case the factory should be located close to the consumers.