



MAPPING MY COMMUNITY

Grade level: 9-12

Provincial curriculum links: Ontario

Subject: Geography; Methods of Geographic Inquiry

Keywords: Waypoint, route, multipath, GPS, urban land use, land-use planning

SPECIFIC LESSON GOALS

- ★ Demonstrate an understanding of the technologies used in geographic inquiry (e.g., Geographic Information Systems (GIS), hypermedia).
- ★ Select and use appropriate methods for displaying geographic data;
- ★ Demonstrate an understanding of the methods used to collect, organize, manipulate, and interpret geographic data;
- ★ Select and use appropriate technology (e.g., computer-generated maps, graphs, photos, digital maps) to present geographic information;
- ★ Map existing transportation, communication, and energy networks in order to plan and make decisions concerning a regional community.

DESCRIPTION

This lesson is designed to introduce students to GPS technology as they investigate urban land use in their community and learn about the role an urban planner plays the development of a town or city. Students will travel around every street in a specific corner of their community and identify and map all forms of land use in that area. Back in the classroom, students will create a digital map of their community from the data they collected during their fieldwork.

PREPARATION

Prior to Lesson: 20 minutes to prepare student worksheets, read educator notes (provided) and review references/resources (as noted below)

Length of lesson: 120 minutes, (this depends on length of "GPS walk"), for class discussions and field trip.

RESOURCES REQUIRED

- GPS receivers
- map of neighbourhood (optional)
- lesson worksheet **[Appendix 1]**

PROCEDURE

1. With your class, examine the role of urban planners in the city. What is an urban planner responsible for? Possible answers include:
 - Economic development
 - Park and green space development
 - Zoning
 - Assess problems surrounding traffic congestion
 - Location of landfills, new houses, schools, public buildings
 - Infrastructure updates (e.g. changes in road names, creation of new subway lines)
 - Timelines for implementation (including milestones at 5, 10, 15 years)
 - Regularly update their data (as city grows and changes, old maps must be updated).
2. What challenges do planners face within a city?
3. Brainstorm with students to find the best way to map the selected area in their community. How should the workload be divided among each group? For example, one group can map one side of a street, while another maps the opposite side. Keep in mind that the digital routes created by each group will be joined at the end of the exercise, therefore, try to eliminate overlap.
4. How are urban areas planned? Ask students which major features define an urban area. For example, major landmarks in Toronto are the CN Tower or the SkyDome. For the GPS exercise, try to select an urban area that contains a good mixture of major urban land uses such as parks, places of worship, government buildings, restaurants, city landmarks, residential dwellings, cemeteries, universities, etc.
5. Review the importance of proper care for the GPS receivers. They are expensive pieces of equipment and are costly to repair or replace.
6. Set up the GPS Receivers:
 - Students should ensure that their position format is in hddd°mm.mmm'.
 - Map datum should be set to WGS 84. Distance/Speed is Metric. Elevation in Meters. Vertical speed in meters/minute and depth set to metric.
 - The heading should be set to display Cardinal Letters and North Reference should be set to "True North".
 - Make sure that the GPS mode for the receiver is set to "on". If the students are getting poor satellite reception, they should ensure that WAAS (Wide-Area Augmentation System) is enabled.
 - Before departing, ask each group to ensure that their GPS receiver has adequate battery power.
7. Divide students into groups. Student groups should consist of no more than 6 members. Each student should be given a particular role in the group such as: group leader, equipment manager, data collector, identification coordinator and safety officer. You may wish to provide the group leader with a simple map of the area.

Special Task	Function
Group Leader	Responsible for overall performance of the group.
Equipment Manager	Prepares a list of the equipment, instructs others in its use and ensures that it is all returned undamaged.
Data Collector	Ensure that all data are recorded on the worksheets.
Navigator	Responsible for operation and proper usage of GPS receiver.
Safety Officer	Ensures that the group stays together and that safety regulations are followed.

8. Students are to locate and identify all areas of urban land use. As they walk through their assigned area (lot by lot), they are to take at least 5 waypoints for each building, recreational area, etc. The more waypoints, the higher the accuracy of the measurement. Remind students to hold the GPS receiver vertically, (antenna facing upward) to minimize the possibility of multipath errors. When taking waypoints, try to keep the GPS as still as possible to ensure greater accuracy. Name each point location as either residential, industrial, commercial, institutional, or open space. If possible, record the actual name of the location (i.e. name the waypoint). For example: High Park, McDonald's, The Bay, TD Bank.
9. While students are taking point information, they should also be mapping their route with the GPS. When taking points, stop navigating on the GPS. Once all the waypoints are recorded, continue navigating. When the group has completely surveyed their assigned area, they should save the route they created and give the route a meaningful name. For example: "King St - west side" or "Route_Group1".
10. After returning to the classroom, ask each group to calculate the percentage of buildings which were:
 1. Residential
 2. Industrial
 3. Commercial
 4. Institutional
 5. Open space/recreational.
11. Upload the information from the receiver to a computer and view the routes using GIS software such as ArcView or MapInfo. Join each group route to form one map of the community. AutoCAD is also a useful program to view and manipulate the data.
12. Ask students who would find this digital information useful. For example:
 6. Trucking company
 7. Public Transportation
 8. Taxi Services
 9. Retail chain managers (to find ideal location for next chain store such as a Starbucks)

13. If time permits, have a class discussion on the benefits of using GPS to map a community.

Discussion and Questions

1. What are some challenges that city planners face when expanding a city?
2. Was there an obvious pattern in the location buildings? Do students think there was a particular strategy behind the location of commercial buildings in their study area?
3. Examine the distribution of urban land uses: which of the five categories was the most prevalent land use? Which was the smallest?
4. What are the benefits of using GPS when hiking and camping in wilderness areas?

Student Evaluation

- Completion of worksheets and quality of observations
- Observation
- Peer and self-evaluation

ENRICHMENT/ EXTENSION ACTIVITIES

- You may modify this lesson for an applied geography class by removing the GPS applications.
- Ask students to investigate how they could use GPS to find the optimal location for a retail chain store, such as Starbucks or HMV. What types of urban and demographic factors would they have to consider before selecting a location for their commercial building?
- Research delivery companies in your city. How many of them are using GPS technology? Investigate if there are certain types of delivery services which use GPS to track their vehicles. Why did they begin using GPS technology?
- Superimpose the class map on a digital plan of the city. Create a choropleth map showing the types of land use within the city.
- Using GPS and GIS technology, create a map that tourists can use when visiting your city. Highlight all the major points of interest, such as: historical sites, parks/gardens, stadiums/arenas, museums, art galleries, restaurants. As the owner of a touring company, create a route on which to take your tourists can take when visiting the city.
- Visit the city planning department.

EDUCATOR NOTES

- GPS stands for "global positioning system". This is a satellite navigation system which provides precise locational information based on data transmitted from a constellation of 24 satellites orbiting the earth. It provides specially coded satellite signals that can be processed in a GPS receiver, enabling the receiver to compute position, velocity and time.
- GPS was developed by the American military and was originally intended for military use only. The GPS system is still controlled by the United States Department of Defense.
- GPS signals are free to all. This means that no-cost locational/ navigational data is available to anyone with a receiver. GPS availability is worldwide, 24-hours per day, 365 days per year. Additionally, low entry cost means that user equipment can be relatively inexpensive, depending on how accurate the user requires their measurements to be.
- Uses for GPS are abundant. This technology can be used for recreational activities such as fishing, hiking, and geocaching as well as complex tasks such as navigation, surveying, mapping and vehicle tracking. Users of GPS technology can utilize any point as a reference to navigate to another point.

Setting up the GPS Receiver

- Students should ensure that their position format is in hddd°mm.mmm'
- Map datum should be set to WGS 84. Distance/Speed is metric. Elevation is in meters. Vertical speed is in meters/minute and depth is set to metric.
- The heading should be set to display Cardinal Letters and North Reference should be set to "True North"
- Make sure that the GPS mode for the receiver is set to "on". If the students are getting poor satellite reception, they should ensure that WAAS (Wide-Area Augmentation System) is enabled.
- The location of each point to which students will navigate are stored in the GPS receiver. The teacher/ leader may enter the points in each receiver ahead of time, however, it may be beneficial for students to enter the points themselves.
- GPS terminology students should be aware of are listed below:
 - Waypoints - points that are stored in the receiver.
 - Route - path created by traveling from one waypoint to another.
 - Coordinate - longitude/latitude values of each point.
 - WAAS - Wide-Area Augmentation System. It is a system of satellites and ground stations that provide GPS signal corrections to allow for better position accuracy. Enabling WAAS on a receiver improves accuracy by approximately 5 times (e.g. from an accuracy of 15 m to an accuracy of less than 3 m).

- Multipath - caused when the GPS signal is reflected by some object or surface before being detected by the antenna on the receiver. The surface most prone to multipath is water, while sandy soil is the least. Multipath errors are common in densely wooded areas (due to the number of trees reflecting the satellite signal) and in cities (due to the number of buildings reflecting the satellite signal).
 - ZULU time - used in the military, navigation and computing generally as a term for Coordinated Universal Time (UTC), and often called (incorrectly) Greenwich Mean Time (GMT). In the strictest sense, ZULU time is NOT the same as GMT, because it is an ATOMIC time-scale, while GMT is tied to the rotation of the Earth (i.e. 'mean Sun' time). Traditionally, ship and aviation navigation is conducted using Zulu time. Zulu time is usually expressed in terms of a 24-hour clock using the Gregorian time divisions of hours and minutes. Note: For those that are not time professionals, using GMT is close enough for daily work.
- To select an appropriate area for study, travel around your local urban community and locate an area that has a diverse mixture of land uses (residential, commercial, industrial, etc).
 - There are 6 main categories of urban land use: residential, transportation, industrial, institutional, commercial and open spaces/recreational. Within residential land use, there are 5 types of dwellings:
 - **Single family home** - residential building for one family: lowest density.
 - **Semi-detached** - dwellings share common wall.
 - **Duplex** - a two-family house.
 - **Townhouse** - a series of single-family houses which are connected by common walls to form a continuous group.
 - **Apartment buildings** - multiple dwellings within one building: highest density.
 - This investigation can be conducted at any time during the school year. Given the fact that students will be outdoors for the duration of the investigation, it is preferable to do the fieldwork on warmer days before or after the snow melts.
 - SAFETY NOTE: Consult your school board's policy regarding safety precautions for outdoor excursions and plan your trip accordingly. Be aware of any students with allergies to insect bites and plants and ensure they carry the required medications. Students should wash their hands after handling soil, plants and equipment. Encourage students to wear sunscreen and appropriate clothing (e.g. hat, long-sleeved shirt) to minimize the damaging effects of sun exposure.

References

- For the Trimble home page (an innovator of GPS technology) featuring a thorough description of GPS technology, tutorials, GPS equipment for sale and a GPS glossary, visit: www.trimble.com
- For information on about urban planning and the role of planners, visit: http://www.fact-index.com/u/ur/urban_planning.html, or the Canadian Institute of Planners web site at www.cip-icu.ca
- For urban sprawl and health problems, visit: <http://www.msnbc.msn.com/id/3076958/>

[Appendix 1]
Student Worksheet

Date: _____

Group Members: _____

Route Boundaries: _____

GPS Accuracy (in metres): _____

Exact coordinates of my school (in latitude/longitude): _____

In this activity, you will use a GPS receiver to record the different types of land use, lot by lot, in an urbanized setting. Pay attention to how the buildings are grouped; this may give you some insight as to how city planners originally intended the area to be used. Every time you arrive at a new lot, record the type of land use on the tally chart. If the land use is residential, record which type of residential dwelling in the second chart.

Remember to take at least 5 waypoints for each location on your route. The more waypoints you collect, the better the accuracy of your position.

Table 1: Urban Land Uses in Study Area

Urban Land Use Category	Number of Occurrences (use tallies as you walk)	Category Total
Residential:		
Industrial:		
Institutional:		
Commercial:		
Open Space/Recreational:		
Unknown:		

TOTAL Lots Visited:	
<i>Satellites in view today (write each satellite number):</i>	
<i>Total distance (m) traveled today:</i>	

Table 2: Residential Dwelling Types in Study Area

Residential Dwelling	Number of Occurrences <i>(use tallies as you walk)</i>	Category Total
Single family home (<i>low density</i>) :		
Semi-detached (<i>low density</i>) :		
Duplex (<i>medium density</i>) :		
Townhouse (<i>medium to high density</i>) :		
Apartment (<i>high density</i>) :		

1. Fill out the tables by placing a tally for each type of land use (Table 1) or residential dwelling type (Table 2) in your assigned area. Once you have completed your tally charts, use the results to create a picture of the distribution of urban land use in the section of the city you visited. Draw a circle pie chart. Create a legend by selecting one colour for each category and include the percentage of land use for each.
2. Do you think the current type of land use in the area you investigated has changed from what was originally planned by urban planners? For example, you may notice that some buildings were originally houses but are now used for commercial purposes, or you may notice that some buildings were meant for industrial/commercial purposes, but are now converted into lofts. Justify your answer.
3. Look at the map that was compiled by the class. How do the results obtained by your group compare to the results of other groups? Is there an obvious pattern in the distribution of land use?
4. Check to see if any satellites are currently experiencing problems at the following web site: www.navcen.uscg.gov. These "problems" are called NANUS (notice advisory to navstar users). NAVCEN, (the United States Coast Guard's Navigation Center of Excellence), controls 78 DGPS sites and 24 LORAN stations across the United States. Apart from its many functions, NAVCEN is primarily responsible for the continued development of navigation technology. Click on "Active NANUS" and list the following:
 1. The number of satellites that are set to "unusable".
 2. The dates AND times during which the satellites are unusable.
 3. The NANU type (check here for a definition of the NANU codes: <http://www.navcen.uscg.gov/ADO/GpsActiveNanu.asp>)
 4. ZULU time is measured on an atomic time scale and is also known as Coordinated Universal Time (UTC). Convert the ZULU time listed on the NAVCEN website into your own time zone. Use the following web site to help you: <http://www.csgnetwork.com/timezncvt.html>. What is the time difference in hours?
 5. The date and time the web page was last updated.