

## Lesson plan – GPS exercise butchers and bakers – Worksheet

### Introduction:

In this exercise, you will use GIS to select the shortest route to the nearest butcher and baker and measure, or calculate, the distance from the school to the butcher and baker.

### Description of the exercise:

In order to be sure to make accurate calculations in ArcMap, you will use a detailed satellite image, from Google Earth, of the city centre of Geel. Secondly, most of the small, pedestrian only paths, that you can use as shortcuts, are not clearly indicated on the topographic map, so you need this detailed image to be able to draw your polylines on exactly the right spot. However, before you can use this satellite image in a GIS, you will need to georeference the image first.

If you want to georeference the image, you need coordinates of spots that are easily recognizable visually (see iNote 40 about georeferencing). You have a GPS device at your disposal, read the quick-start manual, and go into the city centre to find your subjects of research and get 4 coordinates (your GPS device will call it “Marking Waypoints”) for georeferencing your satellite image. Before you start your field trip, it is highly recommended that you read iNote 40 and the instructions of the exercise very well first, so that you get a good idea of the whole picture of the exercise, and know exactly what you need to do. Then go into the city centre.

<i>number</i>	<i>instruction</i>	<i>iNotes</i>	<i>Teachers' / Trainers' activity</i>	<i>Pupils' / participants' activity</i>
1	Open ArcMap from the windows start menu		<input type="checkbox"/>	X
2	Add the raster maps TOP17-5.tif and TOP16-8.tif	1	<input type="checkbox"/>	X
	Use Google Earth to find a detailed satellite image of the city centre of Geel. You should not take an image of an area larger than a range of 400 metres around the school. The nearest butchers and bakers are all located within this range.			
3	Open Google Earth, zoom in on Geel and find the church of St. Amandus. You can use the measuring tool and measure a distance of 300 metres to know how far you need to zoom in.  If you are confident with the image you have on your screen, save it by clicking File > Save > Save Image, or use the Ctrl+Alt+S key combination. Pay attention to where you save the image. You will need it later on in the exercise!		<input type="checkbox"/>	X
	<b>Fieldwork:</b> First study the Google Earth image and look for good visual landmarks. Agree on the four locations where you will collect the coordinates from which you will use to georeference your satellite image. Choose locations that are not collinear (points which are on a single straight line) and are equally distributed over the area covered by your satellite image. If you have reached an agreement, it is time to go into the field and pick up the coordinates of the four good visual landmarks you have selected. When you return with your coordinates, you will draw them on your map and use them as “anchor points” to georeference your satellite image.			
4	Once you have come back from collecting the coordinates, create a table (in ArcCatalog or in Excel), with an “X” and a “Y” column and enter the coordinates you collected.	2; 7; 30	<input type="checkbox"/>	X

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	Before you enter the coordinates, you might need to convert them from WGS 84 (the coordinate system in which your GPS device operates) to Belge 72 (the coordinate system in which your map is georeferenced). Use the tool on the following link to do this: <a href="http://zoologie.umh.ac.be/tc/tcbel.asp">http://zoologie.umh.ac.be/tc/tcbel.asp</a> .			
5	It is crucial to define the right coordinate system for your data frame, to make sure that in the next step, your coordinates will be drawn on the map on the correct location. Choose World > "Belge 1972" as geographic coordinate system You do not need to choose a projected coordinate system.	41	<input type="checkbox"/>	X
6	Draw the locations of your coordinates on the map, using the tool "add XY data".	24	<input type="checkbox"/>	X
7	Add the satellite image of Geel, that you created in Google Earth, to the table of contents.	1	<input type="checkbox"/>	X
Get ready to georeference your satellite image.				
8	Activate the georeferencing toolbar.	27	<input type="checkbox"/>	X
9	Start georeferencing your satellite image.	40	<input type="checkbox"/>	X
<p>Congratulations! You have a georeferenced your satellite image now. The scale and position of the image is perfectly aligned with the topographic map, and ready to be used for your investigation.</p> <p>You want to calculate the distance to the nearest butcher and baker. You can do this in ArcGIS in different ways. Depending on how many butchers and bakers you found in the city center of Geel, you can (A) either manually measure it, using the measuring tool (in the case you only found a limited number of butchers and bakers, which is likely in this exercise...) or you could (B) draw the routes to the butchers and bakers on a separate data layer, as polylines, let ArcGIS automatically calculate the length of the polylines and sort these from longest to shortest. The latter approach is probably only useful in cases where you found plenty of butchers and/or bakers. Nevertheless, both options are described below, it is up to you to decide which one you choose.</p>				
A10	Create a new information layer. You will use this layer to draw the points on, representing the locations of the butchers and bakers.	20	<input type="checkbox"/>	X
A11	Use the measuring tool to manually measure the distance from the school to the nearest butcher or baker. Use your satellite image to find shortcuts like e.g. pedestrian only paths.	16	<input type="checkbox"/>	X
<p>At this point you have found the answer to your question!</p> <p>Which routes are the shortest? How far is it to the nearest butcher and baker?</p> <p style="text-align: right;"><b>Congratulations for your persistence!</b></p>				
OR				
B10	Create two new information layers. You will use one layer to draw the points on, representing the locations of the butchers and bakers, and on the other one you will draw the route to the shops as polylines.	20	<input type="checkbox"/>	X

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B11	Draw the shops and routes on the information layers, using your satellite image as a detailed reference.	12	<input type="checkbox"/>	X
B12	Make sure the map units are set to meters.	15	<input type="checkbox"/>	X
B13	Let ArcMap calculate the length of the routes automatically and sort the routes from shortest to longest, to find the shortest route more easily.	8; 31	<input type="checkbox"/>	X
<p>At this point you have found the answer to your question!</p> <p>Which routes are the shortest? How far is it to the nearest butcher and baker?</p> <p style="text-align: right;"><b>Congratulations for your persistence!</b></p>				

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