

Archives on the Arctic: Connecting to Global Issues with Primary Sources

Lesson Plan: *Geospatial Technologies and the Arctic — Past, Present, and Future*

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Description:

According to the U.S. Department of Labor, one of the hottest career areas lies in geospatial technologies. In addition, the world is in the middle of a geospatial revolution. Coupling this information with the new interest in the Arctic because of climate change, indigenous, resource, and shipping concerns, students with background in both geospatial technologies and the Arctic would be well-prepared to pursue a “hot” career and better understand the geospatial revolution. This lesson exposes students to geospatial technologies related to the Arctic by having them evaluate an Arctic digital mapping website.

In addition, maps are powerful visual tools used by all geographers. How can maps, be they old, hand-drawn paper maps or digital maps made on the fly, help students visualize a region? In addition, how can the geospatial revolution and digital maps help display the potential of solutions to issues in the Arctic?

Grade Level:

Grades 9-12

Subject(s):

- AP Human Geography
- World regional geography
- Alaska History and Cultural Studies (a required course for all high school students in Alaska)

Duration:

Two block periods of 85 minutes in duration are needed to complete this lesson.

Goal:

Students will explore historical maps of the Arctic and evaluate the Arctic digital mapping tools and websites.

Objectives:

- Students will use primary documents to explore how the Arctic was depicted on maps of the past.
- Students will evaluate present-day websites which use present-day geospatial technologies to depict the Arctic.

Standards:

- *Road Map for 21st Century Geography Education Assessment:*
 - Posing geographic questions
 - Acquiring Geography Information
 - Answering questions and designing solutions
 - Communicating with geographic information
- *Geography for Life, National Geography Standards, Second Edition*
 - How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information
 - That people create regions to interpret Earth's complexity

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- How to apply geography to interpret the past
- How to apply geography to interpret the present and plan for the future
- *College, Career, and Civic Life (C3) Framework for Social Studies State Standards: State Guidance for Enhancing the Rigor of K-12 Civics, Economics, Geography, and History*
 - Dimension 2: Applying Disciplinary Tools and Concepts (Geography)
 - Dimension 3: Gathering and Evaluating Sources

Background Information:

Mapping the Arctic has changed substantially since the era of the early days of Arctic exploration. This lesson combines an examination of the historical geography record with an examination of 21st century mapping tools and the record that is being created using those geospatial tools.

Primary Source Documents/Resources: (See lists in “Procedures” section)

Materials:

- Access to the Internet
- Enough computer access for students to work in partnerships

Procedures:

I. *Opening the Instruction*

Use your interactive white board to show some maps of the old maps which depict or hint at the Arctic such as these maps from the Library of Congress.

- 1 *Tartariae sive magni chami regni typus* <http://hdl.loc.gov/loc.ndlpcoop/mtfxmp.f58401>
- 2 *L'hémisphère septentrional pour voir plus distinctement les terres Arctiques (The northern hemisphere in order to see the Arctic lands more distinctly.)* <http://hdl.loc.gov/loc.ndlpcoop/mtfxmp.f74001>
- 3 *Map of the Northeast parts of Asia and Northwest parts of America, showing their situation with respect to Japan, taken from a Japanese map of the world brought over by Kaempfer and late in museum of Sr. Hans Sloane.* <http://hdl.loc.gov/loc.ndlpcoop/mtfxmp.f76104>
- 4 *North America divided into its III principall [sic] parts.* <http://hdl.loc.gov/loc.gmd/g3300.mf000041>
- 5 *A new & correct map of the whole World. (Zoom to the inset map of the Arctic.)* <http://hdl.loc.gov/loc.gmd/g3200.mf000001>
- 6 *Karta Sievernago Ledovitago okeana v granitsakh Rossijskoj Imperii : sostavlena na osnovanii russkikh gidrograficheskikh izsledovanij s 1734 po 1871 god* <http://www.loc.gov/item/92685396>
- 7 *Karta Ledovitago moria i Vostochnago okeana* <http://www.loc.gov/resource/g9780.mf000026>

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Let your students speculate on what the maps show. What is the story of the Arctic depicted in the map? (Don't worry about having "right" answers. This is a time to let students speculate and inquire. Encourage questioning and speculation. Those with some language skills may enjoy this part of the lesson.)

As a class, discuss some questions such as the following:

- *In the past, how was the Arctic mapped?*
- *During the time period of the maps, what was the extent of the geographic information?*
- *How was the Arctic depicted?*
- *What was and was not depicted on the maps?*
- *What was known about the Arctic at the time these maps were created?*

If you want to focus on specifics of the maps, consider questions that use the TODALSIGss + SD mnemonic:

- **Title** *What is the Title of the map and what does that tell us about the map? If it is not in English, can we determine any of the words?*
- **Orientation** *What is the orientation of the map? Which way is North? What does the map orientation tell us?*
- **Date** *What is the date of the map? How does the date relate to the knowledge base about the Arctic at that time?*
- **Author** *Who made the map and how do we know? (The author may also be called the cartographer.)*
- **Legend** *Does the map have a legend that helps us out to determine the message of the map?*
- **Scale** *What is the scale of the map? Is this a large or small-scale map?*
- **Index** *Does the map have an index of places noted on the map?*
- **Grid** *Does the map use lines of latitude and longitude or some other grid system that helps us read the map?*
- **Situation** *Does the map have a small inset map that helps us determine information about the Arctic or is the Arctic itself an inset map?*
- **Source** *What is the source of the map? What does the bibliographic information tell us about the map?*
- **Spatial Data** *What is the spatial pattern of the map? What even just the borders that appear on the map tell us about how the author or cartographer viewed the Arctic?*

II. Developing the Instruction

Give students the list of Arctic mapping sites and assign each site to two students. Experienced teachers will know that it is often best to preview the websites and to pre-assign partnerships so that the classroom experience flows smoothly and to avoid the form of bullying where students are excluded if student pick partners. See *Arctic Websites and Mapping Sites* (Page 5).

Give students time to explore their website and to write up an evaluation. Be specific of how they will submit their work. It may be that students can submit electronically to your learning management system or to a class blog. This makes it easier when they present. See *Evaluation of Geospatial Technology Site: The Arctic* (Page 6).

III. Closing the Instruction

Have student partnerships present about their website to the class. If desired, each class member can "rate" each website as it is presented by the number of stars. Tally the numbers in the end to choose the top three websites overall. End by discussing how students envision that geospatial technologies will change over the next 50 years and how those geospatial technologies will present information at that time.

Evaluation/Assessment:

Have students self-assess before they submit their scoring guide. Students are often right on target with their performance. See *Scoring Guide* (Page 7).

Possible Extension:

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- If there is a class blog, website, or learning management system, students' electronic reviews can be posted there.
- Have students find more old maps of the Arctic or explore for other interactive GIS mapping sites.
- If you live in an Arctic region or place where a mapping agency exists, visit an office where the mapping occurs. For example, most universities have strong GIS programs and many community agencies within the Arctic region have GIS programs. A GIS expert can show students the behind the scenes action of some of the GIS sites.
- To explore geospatial technologies in general, have students explore the video segments at Geospatial Revolution at <http://geospatialrevolution.psu.edu/>.

References: (See also references within lesson.)

- Edelson, Daniel C., Shavelson, Richard J., and Wertheim, Jill A., editors. *A Road Map for 21st Geography Education: Assessment*. Washington, DC: National Geographic Society, 2013.
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- Heffron, Susan Gallagher and Downs, Roger M., editors. *Geography for Life: National Geography Standards, Second Edition*. Washington, DC: National Council for Geographic Education, for the Geography Education National Implementation Project (GENIP), 2012.
- Lucas, Matthew P. and Ragone, Diane. "Will Breadfruit Solve the World Hunger Crisis?" *ArcNews*, Summer 2012, pp. 6-7.
- National Council for the Social Studies (NCSS). *The College, Career, and Civic Life (C3) Framework for Social Studies State Standards: State Guidance for Enhancing the Rigor of K-12 Civics, Economics, Geography, and History*. Silver Spring, MD: NCSS, 2013.
- Smothers Marcello, Jody. *Teaching Map Skills: An Active Learning Approach*. Washington, DC: National Council for Geographic Education, 2008.
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Arctic Websites and Mapping Sites

- 1 *Earth Observatory (NASA)* <http://earthobservatory.nasa.gov> (Search on Arctic)
- 2 *Atlas Canada* <http://atlas.nrcan.gc.ca/site/english/maps/thenorth.html>
- 3 *National Atlas Mapmaker (US)* <http://nationalatlas.gov/mapmaker>
- 4 *Center for Coastal and Ocean Mapping Joint Hydrographic Center* <http://ccom.unh.edu/theme/law-sea/arctic-ocean/arctic-ocean-obliques>
- 5 *The Arctic Institute* <http://www.thearcticinstitute.org/p/maps.html>
- 6 *Anthropolis* <http://www.athropolis.com/map.htm>
- 7 *Arctic Weather Support from NOAA* <http://arctic.arh.noaa.gov/index.php>
- 8 *Arctic Portal* <http://portal.inter-map.com/#mapID=49&groupID=&z=1.0&up=586.1&left=2001105.4>
- 9 *UN Environment Programme Arctic Environmental Atlas* <http://maps.grida.no/arctic/>
- 10 *ERMA (Environmental Response Management Application)* <https://www.erma.unh.edu/arctic/erma.html#x=-158.52172&y=69.38032&z=5&layers=12959+12913+12921+12920>
- 11 *Toolik Arctic Geobotanical Atlas* <http://www.arcticatlas.org/maps/browser/browserRegion.php?queryID=cp&fieldname=region>
- 12 *Indigenous Peoples of the Arctic Countries* <http://ansipra.npolar.no/image/Arctic04E.jpg>
- 13 *UArctic Atlas* <http://www.uarctic.org/AtlasFront.aspx?m=637>
- 14 *Canadian Arctic E-Atlas* <http://www.sfu.ca/geog351fall02/gp2/>
- 15 *National Snow and Ice Data Center* http://nsidc.org/data/google_earth/
- 16 *The Arctic (Russian Geographical Society)* <http://arctic.ru/maps>
- 17 *European Space Agency: CryoSat* http://www.esa.int/Our_Activities/Observing_the_Earth/CryoSat/CryoSat_reveals_major_loss_of_Arctic_sea_ice
- 18 *Woods Hole Research Center* http://www.whrc.org/global/arctic_system/index.html
- 19 *National Geographic MapMaker Interactive* http://education.nationalgeographic.com/mapping/interactive-map/?ar_a=1
- 20 *National Geographic: Arctic Shrinkage Image (an excellent static map with a time sequence of Arctic sea ice at the bottom of the unique map)* http://education.nationalgeographic.com/education/photo/11northpole-graphic/?ar_a=1

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Evaluation of Geospatial Technology Site: The Arctic

Examine and explore your assigned Arctic website. Evaluate it according to the criteria below. Write your answers in complete sentences. Be prepared to share your website and evaluation with the class.

1	Website. <i>What is the website name and URL?</i>	
2	Authorship and Credibility. <i>Who maintains this site? Given the authorship, is this a credible site?</i>	
3	The Arctic. <i>What type of data about the Arctic does this website contain? What geographic questions does the data answer?</i>	
4	Maps. <i>What types of maps can you retrieve from this site? Are they static or interactive? Does that make a difference in their usefulness?</i>	
5	Story. <i>What story do the maps available through the website tell? For example, do they tell the story from a homeland (i.e. home to an indigenous group) or territorial (i.e. part of the Earth's surface to be taken, controlled, or exploited) paradigm? Is it a story of people or of physical geography? What is the central message of the maps?</i>	
6	Issues. <i>Does the set of maps or maps that you can make at the website help to lead to solutions of any issues of the Arctic (i.e. indigenous, political, environmental, economic)?</i>	
7	Geospatial Technology. <i>What types of geospatial technical skills do you need to retrieve maps or geospatial data from this website?</i>	
8	Careers. <i>Consider the how the data for your maps was collected, what it takes to create maps like the ones you created, and what it takes to maintain geospatial data websites such as the one you are viewing. Would working in a geospatial technology mapping career appeal to you? Would doing fieldwork in the Arctic appeal to you? Would working for a government or international agency appeal to you?</i>	
9	Rating. <i>How many stars would you give your website for providing geospatial information about the Arctic?</i>	☆☆☆☆☆

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Scoring Guide for Arctic Websites and Mapping Sites

	Beginning	Progressing	Meets the Standard	Exemplary
	1	2	3	4
<ul style="list-style-type: none"> • <i>How to use maps and other geographic representations, geospatial technologies, and spatial thinking to understand and communicate information</i> • <i>That people create regions to interpret Earth's complexity</i> • <i>How to apply geography to interpret the present and plan for the future</i> 	<ul style="list-style-type: none"> ○ Student begins to explore the given website and/or mapping site & begins to evaluate, in a cursory manner, its effectiveness in presenting the Arctic region in maps ○ Not all questions are answered or all questions are answered but in a highly limited way ○ Student demonstrates very limited understanding of the role of geospatial technologies in today's world 	<ul style="list-style-type: none"> ○ Student explores, in a cursory fashion, the given website and/or mapping site & evaluates its effectiveness in presenting the Arctic region in maps ○ All questions are answered but in a cursory fashion ○ Student understands, in a general manner, the role of geospatial technologies in today's world 	<ul style="list-style-type: none"> ○ Student explores the given website and/or mapping site & evaluates its effectiveness in presenting the Arctic region in maps ○ All questions are answered completely and thoroughly ○ Student understands the role of geospatial technologies in today's world 	<ul style="list-style-type: none"> ○ Student explores the given website and/or mapping site & evaluates its effectiveness in presenting the Arctic region in maps; may provide insight that goes beyond the obvious ○ All questions are answered completely, thoroughly, and answers are of publishable quality ○ Student is highly explicit about the role of geospatial technologies in today's world

Student comments regarding self-assessment:

Teacher comments regarding assessment scores: