TO DRILL OR NOT TO DRILL
A case study in the Arctic National Wildlife Refuge

Developed by Cynthia Hall, Cassandra Runyon, and Robin Humphreys
Department of Geology and Environmental Geosciences
College of Charleston, Charleston, SC

To Drill or Not to Drill? Arctic National Wildlife Refuge

Case Study Abstract:
The Arctic National Wildlife Refuge (ANWR) is located in Northern Alaska, covering more than 20 million acres of pristine wilderness. Currently ANWR supports wildlife of more than 160 bird species, 36 kinds of land mammals, 9 marine mammal species and 36 types of fish. In addition, ANWR is a breeding ground and habitat for caribou, polar bears and other animals. The United States has proposed to open approximately 1.5 million acres for oil exploration and drilling. There is possibly between 5-10 billion barrels of oil beneath the coastal plain of ANWR. At this time, the United States, imports roughly 60 percent of its oil from foreign sources, especially those in the Middle-East.

Conceptual Summary:
To Drill or Not to Drill is a multidisciplinary problem based learning exercise, which intends to increase students' knowledge of a variety of topics through a real world environmental topic. In addition, drilling in the Arctic National Wildlife Refuge (ANWR) impacts students either directly (depending on the age level) or indirectly (through their parents) as gas prices soar to record high levels.

Ideally the topic would be taught in a team-teaching environment due to its multidisciplinary nature – ANWR and whether or not the United States should explore and drill there encompasses biological, physical, and environmental science, economics, environmental policy, and social sciences. This case study is designed for high school level students; however could easily be adapted for middle school.

Northern Alaska is considered part of a tundra ecosystem where the soil remains frozen for a large portion of the year, otherwise known as permafrost. The upper surface thaws only during the short summer months. As such no trees can grow in the area. Yet the wildlife has adaptations, which enable them to survive and thrive in these harsh conditions. Such adaptations include shallow roots, the ability to photosynthesize at low temperatures and low light intensities in plants and the ability in animals to form thick layers of fat in winter months and thick fur or feathers.

The Alaskan natives have predominantly relied on the land and wildlife within the Arctic for subsistence. Wildlife provides a means of food for the natives and animal hides/fur are used to generate cash flow for the native communities. However, the communities within ANWR remain conflicted on the issue. There are two main tribes in ANWR, the Gwich'in and the Inupiat. The Gwich'in have traditionally opposed the drilling due to the reduction of hunting areas, which they rely on for their daily sustenance. The porcupine caribou are an integral part of the Gwich'in tribe as stated by the tribe leader, "Our whole way of life as a people is tied to the Porcupine caribou. It is in our language, and our songs and stories." The Inupiat, on the other hand, have traditionally been in favor of drilling due to the boost in the Alaskan economy, the economic gain from their leasing the land to oil companies, and the increase in local jobs. However, even this community is becoming more

split due to changes in the landscape and hunting patterns in areas where drilling has been allowed.

ANWR was established in 1980 through the Alaska national Interest Lands Conservation and consists of approximately 19 million acres of land (roughly the size of South Carolina) on the northeastern slope of Alaska. 8 million acres of ANWR have been designated wilderness. Currently ANWR supports wildlife of more than 160 bird species, 36 kinds of land mammals, 9 marine mammal species and 36 types of fish. In addition, ANWR is a breeding ground and habitat for caribou, polar bears and other animals.

The Porcupine caribou are the most numerous mammals in ANWR and probably the most well known. ANWR plays a critical part in the caribou species' breeding habits. In the winter months, the caribou are found in the southern portion of the refuge. During this time, they serve as a key source of food for the native people of the area, the Gwich'in. In the spring, the caribou begin their migration to the northern coastal plain where the females give birth. The herd stays within the coastal plain foraging before heading back to the winter grounds in the south. The coastal plain provides the rich nourishment necessary for the calves to survive in the Arctic climate. In addition, the rich nourishment provides the energy and protein required for the female caribou to meet lactation demands.

Not only does the coastal plain serve as the breeding grounds for the porcupine caribou, but also in the center of biological activity from approximately May to June. Other animals rely on this area. Polar bears use the coastal plain as a den area; numerous species of bird use the area as a place of habitation, migration and nesting. The coastal plain of ANWR serves as home to other mammals such as the musk ox, wolves, arctic foxes, etc. Due to the abundance of wildlife found within ANWR, it has been referred to as America's Serengeti.

On the other hand, the geology of ANWR provides for a significant potential of oil and mineral resources. Oil deposits are typically found in organic-rich sediments that have undergone intense heat and pressure. The hydrocarbons are trapped by "caprocks" which do not allow seepage to the Earth's surface. Prudhoe Bay Field, west of ANWR, has this combination of source rocks and caprocks and so, the Unites States Geological Survey (USGS) anticipates the same within ANWR's coastal plain. Specifically, the USGS estimates within the ANWR coastal plain anywhere from 4.3 and 11.8 billion barrels (95- and 5-percent probability respectively) of recoverable oil. According to the Department of Energy, in 2004, the United States consumed around 20.7 million barrels of petroleum products per day.

With oil exploration and drilling comes disturbances to the ecosystem. The tundra ecosystem is extremely sensitive to modifications. For example, the removal of vegetation could cause increased thawing of the permafrost and further causing soil erosion and ground collapses. Due to the nature of the tundra soil, automobile traffic leaves gullies that persist. In addition, the loss of any of the wildlife through habitat fragmentation, changes in migration patterns or breeding routines could

potentially have dramatic impacts upon the entire ecosystem. The species within the tundra ecosystem are interdependent, making this ecosystem vulnerable to anthropogenic alterations in the environment.

Exploration and drilling in ANWR remains a heavily-debated topic. As such, it is essential to understand the importance of conserving wildlife within fragile ecosystems such as that in ANWR. Conservation biology seeks to preserve biodiversity in a species and within an ecosystem. Biodiversity is vital to human welfare as human survival is dependent on the interactions among various species and ecosystems. By decreasing biodiversity, humans risk their own survival.

However in American society, conserving species and ecosystems involves analyzing and weighing the benefits with the risks. The United States has developed two doctrines utilized in making policy decisions. The Trust Doctrine state, "That all our national resources are held in trust for the full benefit, use, and enjoyment of all the people of the U. S. not only for this generation but for all yet born." The Balancing Doctrine on the other hand, states, "The greatest good for the greatest number."

Through this case study, the overarching question posed to the learners is…" Is the economic benefit of the oil extracted from ANWR worth the social cost of the environmental damage such extraction would inflict? By attempting to answer this question, learners will begin to understand the interactions and dependencies of humans on various ecosystems as well as on nonrenewable resources, such as oil. The learners will raise their own awareness to the questions that must be answered in making a sound environmental policy instead of making rash decisions. Finally, this case study exposes students to a multi-disciplinary approach to learning, making it completely relevant within a real-world context.

Teacher Notes:
There are several key stakeholders with this issue, including Petroleum Companies, Environmentalists, Alaska Natives, and the American population. Below there are appropriate components for each of the above stakeholders, for insertion into the Department of the Interior letter to be submitted to students on the first day of the task. Note: A summary of the key questions below is provided at the end.

Petroleum Companies

Organization: Conoco/Philips and BP Exploration
Description: "the availability of oil in the 10-02 area of ANWR and the impacts, both positive and negative, that exploring and drilling the area would have socially and economically."
Date: Based on when your class will be holding the public debriefing
Questions:

1. How much oil is currently being extracted from North Slope Oil Fields in Alaska? How much more would drilling in ANWR produce?
2. What are the economic advantages to exploring and drilling? How many jobs will be available and how much revenue will this produce?
3. How much will the development and construction of the oil exploration and drilling cost?
4. What are the benefits to drilling and how does that compare with the benefits of not drilling but developing alternative fuel options?
5. Will opening ANWR decrease the US's dependence on foreign oil sources? With current rates of consumption, how long will the oil in ANWR last us?

Environmentalists

Organization: Sierra Club
Description: "the environmental impact that exploring and drilling in the 10-02 area would have."
Date: Based on when your class will be holding the public debriefing
Questions:

1. What wildlife exists in the area?
2. What are the short-term and then long-term effects to wildlife, their habitats, and the landscape?
3. What are the costs and benefits to drilling and how does that compare with the costs and benefits of not drilling but developing alternative fuel options?
4. Will opening ANWR decrease the US's dependence on foreign oil sources? With current rates of consumption, how long will the oil in ANWR last us?

Native Alaskans

Organization: Gwich'in and Inupiat Communities
Description: "the impact that exploring and drilling in the 10-02 area would have on the economical and social constructs of your communities."
Date: Based on when your class will be holding the public debriefing
Questions:

1. For what purposes do your communities use ANWR and how would they be impacted by the development and construction of oil exploration and drilling methods?
2. Will drilling in 10-02 of ANWR change your cultural way of life? If so, how?

3. What are the economic advantages to exploring and drilling? How many jobs will be available to your local populations? Is this important to your community?
4. What are the costs and benefits to drilling from the standpoint of your community and how does that compare with the costs and benefits of not drilling?

Renewable Energy

Organization: National Renewable Energy Laboratory
Description: "the available renewable energy resources that would allow our country to promote a clean energy future and perhaps help diminish our dependence on foreign countries."
Date: Based on when your class will be holding the public debriefing
Questions:

1. What are nonrenewable versus renewable energy sources and describe the benefits to each one?
    a. Hydropower
    b. Wind Power
    c. Geothermal Power
    d. Solar Energy
2. What are some available renewable resources that could potentially provide for a more clean and secure energy future in the United States?
3. What are general costs versus benefits for long-term commitment to develop and utilize these renewable energy sources?

US Government

Government Officials: Alaskan Governor Sarah Palin, Texas Senator Kay Bailey Hutchinson, Alaskan Senator Lisa Murkowski
Description: "the availability of oil in the 10-02 area of ANWR and the impacts, both positive and negative, that exploring and drilling the area would have socially and economically for our country."
Date: Based on when your class will be holding the public debriefing
Questions:

1. What are the economic advantages to exploring and drilling? How many jobs will be available and how much revenue will this produce?
2. How much will the development and construction of the oil exploration and drilling cost?
3. What are the benefits to drilling and how does that compare with the benefits of not drilling but developing alternative fuel options?
4. Will opening ANWR decrease the US's dependence on foreign oil sources? With current rates of consumption, how long will the oil in ANWR last us?

Arbitrator Questions:

1. What is the trust doctrine?
2. What is the balancing doctrine?
3. How, if at all, do these doctrines apply to our case in ANWR?
4. Applying these two doctrines to what you have learned about potential oil exploration in ANWR, do you think exploration and drilling should be allowed?

Goals and Objectives:
The students will gain a deeper understand of the tundra ecosystem and the Arctic.

- Examine the Arctic wildlife, habitats and animal migration patterns
- Develop an initial understanding of the interactions and interdependencies within ecosystems
- Examine the native people and how they relate to the environment.

The students will gain a deeper understanding of conservation biology.

- Understand species conservation and protection
- Understand the implications of habitat loss and fragmentation
- Grasp the changes in species migration patterns due to exploration and drilling in ANWR

The students will consider the economics and policy decisions that come with hot political issues.

- Identify economic problems, alternatives, benefits, and costs
- Compare benefits of drilling with costs of drilling on both local (i.e. increase in jobs) and global (i.e., price of oil) scale
- Understand public policy decisions relating to the environment to include management of renewable resources and management of nonrenewable resources
- Understand the Trust Doctrine versus Balance Doctrine

The students will understand the personal and social perspectives of drilling in a pristine environment.

- Understand how human actions affect ecosystems, both directly and indirectly
- Understand that natural ecosystems provide an array of basic processes that affect humans
- Examine supply/demand of natural resources and increasing human consumption of resources
- Discuss the US's primary source of energy and whether it is sustainable
- Discuss possible alternative sources of energy

Secondary goal (up to teacher): The student will examine the Arctic's role in global climate change and how drilling in the Arctic could impact the climate on a global scale.

National Standards:
This activity was initially written for introductory level college classrooms; however, it has been successfully implemented in upper level high-school classrooms.

Life Science > Structure and function in living systems; Regulation and behavior; Populations and ecosystems; Diversity and adaptations of organisms
Physical Science > Transfer of energy
Social Studies > People, Places, and Environments

Activity Outline:
Each session could be done in one class period of approximately 1-1.5 hours.
Session 1

- Introductory trailer – general overview, National Geographic's Alaska's Black Gold (http://www.natgeoeducationvideo.com/film/159/alaskas-black-gold)
- Show video footage of both sides, pro-drilling in ANWR (http://www.anwr.org/Video/View-our-ANWR-Flash-Movie.php) and anti-drilling in ANWR (http://www.natcapsolutions.org/Treasure_America/drawingtheline/ or http://www.oilonice.org/watch/playshort-large.php)
- Begin general discussion of the Arctic and specifically ANWR to see what the students know and how they know. List these topics so that you can revisit them after the session

Session 2

- Divide class into four groups with teacher being the fifth group:
    - Teacher as scientists - unbiased
    - Group 1: Conoco Philips and BP Exploration
    - Group 2: Sierra Club
    - Group 3: Alaskan Natives
    - Group 4: National Renewable Energy Laboratory
    - Group 5: Arbitrators
    - Group 6: United States Government Pro-Drilling
- Teacher, representing the scientific community, provides facts regarding the Refuge and the wildlife found within – their migration patterns, habitats, etc.
    - Background Questions:
        - What geologic conditions set the stage for oil formation?
        - How does oil form and how is it trapped?
        - How do we know that ANWR has oil resources?
        - What is the Arctic Tundra, ecologically?
        - What types of wildlife live in the Arctic Tundra?
- Teacher presents two US doctrines that the arbitrators will use:
    - Trust Doctrine: "That all our national resources are held in trust for the full benefit, use, and enjoyment of all the people of the U. S. not only for this generation but for all yet born."
    - Balancing Doctrine: The greatest good for the greatest number
- Teacher also discusses bias and exaggeration in heavily political issues such as this, and so it is important to weigh the facts with the suggested.
- Teacher hands out letter from the Department of the Interior

Session 3

- The students research the topics within their group, answering questions from the secretary of the Interior…
    - Conoco/Philips and BP Exploration > Drilling in ANWR, potential oil there, looking at Northern Alaska currently being drilled, etc.
    - Sierra Club > No drilling in ANWR, destruction of habitats, changes to migration patterns, impact on land, etc.
    - Alaskan natives >
    - NREL > renewable energy sources, benefits, costs

    - Arbitrators > compile unbiased research/presentation from scientists, look into the two US doctrines
- Students turn in a position paper with their research

Session 4

- Students prepare an opening statement and each group gives their opening statement to the class
- Students debate the issue, in a formal debate
- Arbitrators discuss in front of the class the issue relating what they just heard from each organization to the trust and balance doctrines.
- Arbitrators make a recommendation to the Secretary of the Department of the Interior

Resources

Pro-Drilling

Lieberman, B. (2005, March 17). Opening ANWR: Long Overdue. *Energy and Environment*. Retrieved March 12, 2008, from http://www.heritage.org/Research/EnergyandEnvironment/wm692.cfm.

Arctic Power. (2008). Arctic National Wildlife Refuge. Retrieved March 12, 2008, from http://www.anwr.org.

Carlisle, J. (2001, January). Environmentalists' Opposition to Oil Exploration in the Arctic National Wildlife Refuge Is Unfounded. *National Center for Public Policy Research's National Policy Analysis*. Retrieved April 12, 2008, from http://www.nationalcenter.org/NPA324.html.

Knight, P. (2005, December). ANWR: To Drill or Not to Drill? There is No Question. *National Center for Public Policy Research's National Policy Analysis*. Retrieved April 12, 2008, from http://www.nationalcenter.org/NPA535ANWR.html.

Anti-Drilling

National Resources Defense Council. Arctic Wildlife Refuge. Retrieved April 12, 2008, from http://www.savebiogems.org/arctic/.

Alaska Wilderness League. (2008). Arctic National Wildlife Refuge Fact Sheets. Retrieved March 12, 2008, from http://www.alaskawild.org/news-and-events/fact-sheets/.

Sierra Club. (2008). Save America's Arctic: Chill the Drills and Fight Global Warming. Retrieved March 12, 2008, from http://www.sierraclub.org/arctic/.

United States Fish and Wildlife Service. Arctic National Wildlife Refuge. Retrieved April 12, 2008, from http://arctic.fws.gov/.

McGrath, S. (2001, September). The Last Great Wilderness. *Audubon*. Retrieved April 12, 2008, from http://magazine.audubon.org/features0109/arctic.html.

Native Alaskans

Arnold, E. and Chadwick, A. (2005, November 8). ANWR Community Split on Oil Exploration. National Public Radio Broadcast. Retrieved on April 29, 2008, from http://www.npr.org/templates/story/story.php?storyId=4994291.

Nageak, B. Inupiat Eskimos First, Best Environmentalists. Retrieved April 29, 2008, from http://www.anwr.org/people/nageak.html.

Gwich'in Steering Committee. (2005). A Moral Choice for the United States. Retrieved April 29, 2008, from http://www.gwichinsteeringcommittee.org/index.html.

Renewable Energy

National Renewable Energy Laboratory. Learning about Renewable Energy. Retrieved March 23, 2009 from http://www.nrel.gov/learning/.

U.S. Department of Energy. Energy Efficiency and Renewable Energy. Retrieved March 23, 2009 from http://www.eere.energy.gov/.

The National Atlas. Renewable Energy Sources in the United States. Retrieved March 23, 2009 from http://www.nationalatlas.gov/articles/people/a_energy.html.

State Environmental Resource Center. Clean Energy. Retrieved March 23, 2009 from http://www.serconline.org/cleanenergy.html.

California Energy Commission. The Energy Story. Retrieved March 23, 2009 from http://energyquest.ca.gov/story/index.html.

US Government

Sarah Palin Press Releases (Google Search Results). ANWR. Retrieved March 27, 2009 from http://google.state.ak.us/search?gov=yes&sort=date%3AD%3AL%3Ad1&output=xml_no_dtd&ie=UTF-8&oe=UTF-8&client=GOV&site=GOV&proxystylesheet=GOV&q=anwr&submit.x=8&submit.y=16.

Representative Don Young (AK) Press Releases (Search Results). Retrieved April 3, 2012 from http://donyoung.house.gov/News/DocumentQuery.aspx?CatagoryID=5005.

Senator Lisa Murkowski (AK) Issues and Priorities (Search Results). Retrieved April 3, 2012 from http://www.murkowski.senate.gov/public/index.cfm?p=IssuesPriorities.

General

Environment Canada. (2007, June 12). The Arctic Ecosystem. Retrieved April 3, 2012, from http://www.ec.gc.ca/envirozine/default.asp?lang=En&n=DB93E6EF-1.

United States Geological Survey. (2008, April). Arctic National Wildlife Refuge (ANWR) 1002 Area. Retrieved April 27, 2008, from http://energy.usgs.gov/alaska/anwr.html.

University Corporation for Atmospheric Research. (2007, February 6). Tundra Ecosystem. Retrieved April 29, 2008, from http://www.windows.ucar.edu/tour/link=/earth/tundra_ecosystem.html.

US Energy Information Administration. Oil Formation. Retrieved April 3, 2012 http://www.eia.gov/kids/energy.cfm?page=oil_home-basics.

Essentials of Geology Forming Mineral Resources. Retrieved April 3, 2012 from http://www.wwnorton.com/college/geo/animations/15.htm.

Freudenrich, C. (2008) How ANWR Works. *HowStuffWorks.com*. Retrieved March 23, 2009 from, http://science.howstuffworks.com/anwr.htm.

Doctrines

Brull, S. (2004). Versatile by Nature: Exploring the Law of the American Wilderness. *Vermont Journal of Environmental Law*. Retrieved April 15, 2008 from, http://www.vjel.org/roscoe/roscoe04a.html.

Summary of Key Questions:

- How much oil is currently being extracted from North Slope Oil Fields in Alaska? How much more would drilling in ANWR produce?
    - Northern Alaska has approximately 15 billion barrels of oil
    - In 1996, the North slope oil field produced about 1.5 billion barrels per day
    - The 1002 area of ANWR is expected to have anywhere from 4.3 to 11.8 billion barrels of oil
- What are the economic advantages to exploring and drilling? How many jobs will be available and how much revenue will this produce?
    - Federal revenues would be enhanced by billions of dollars from bonus bids, lease rentals, royalties and taxes. According to Arctic Power, the development of the North Slope oil field contributed over $50 billion to the nation's economy.
    - Between 250,000 and 735,000 jobs are estimated to be created through oil exploration and drilling within ANWR, according to Arctic Power.
- How much will the development and construction of the oil exploration and drilling cost?
    - Oil corporations could utilize infrastructure put in place with Prudhoe Bay, such as the pipeline, support facilities, and skills and knowledge of employees currently there.
    - It would still cost millions of dollars to lease the land and update technology associated with drilling.
- What wildlife exists in the area?
    - Currently ANWR supports wildlife of more than 160 bird species, 36 kinds of land mammals, 9 marine mammal species and 36 types of fish. In addition, ANWR is a breeding ground and habitat for caribou, polar bears and other animals.
- What are the short-term and then long-term effects to wildlife, their habitats, and the landscape?
    - Possibility of oil spills would greatly harm the natural environment.
    - Development of additional pipeline and road infrastructure would potentially alter migration patterns, fragment existing habitats, etc.
- What are the benefits to drilling and how does that compare with the benefits of not drilling but developing alternative fuel options?
    - It is important to develop research methods that gauge the value the American people place on the environment and methods for quantifying that value and therefore the cost of environmental degradation.
- Will opening ANWR decrease the US's dependence on foreign oil sources? With current rates of consumption, how long will the oil in ANWR last us?

    - The expected recovery oil in ANWR is orders of magnitude smaller than the global supply of oil, and therefore the world oil price is independent of any sort of activity in ANWR.
    - Due to the current consumption of oil by humans, drilling in ANWR would not decrease the United States' dependence on foreign oil.
- For what purposes do your communities use ANWR and how would they be impacted by the development and construction of oil exploration and drilling methods? Will drilling in 10-02 of ANWR change your cultural way of life? If so, how?
    - The Gwich'in tribe subsists mainly on land animals, especially the caribou, and would be adversely impacted by the effects oil drilling would have on these species.
    - The porcupine caribou plays an integral part in the Gwich'in way of life – it is part of the language, their stories, etc.
    - The Inupiat support drilling because the money it would bring in to the area. Their diet is primarily from the ocean and so onshore drilling would not pose as great a problem as that with the Gwich'in.
    - Exploration and drilling would offer an increase in jobs; however this would a only be temporary and the jobs would cease to exist once oil was gone.
    - The Inupiat live directly within the coastal plain and so would benefit from leasing the land to large oil corporations, increasing their revenue.

Rubric

CATEGORY	4	3	2	1
Understanding of Topic	The team clearly understood the topic in-depth and presented their information forcefully and convincingly.	The team clearly understood the topic in-depth and presented their information with ease.	The team seemed to understand the main points of the topic and presented those with ease.	The team did not show an adequate understanding of the topic.
Information	All information presented in the debate was clear, accurate and thorough.	Most information presented in the debate was clear, accurate and thorough.	Most information presented in the debate was clear and accurate, but was not usually thorough.	Information had several inaccuracies OR was usually not clear.
Rebuttal	All counter-arguments were accurate, relevant and strong.	Most counter-arguments were accurate, relevant, and strong.	Most counter-arguments were accurate and relevant, but several were weak.	Counter-arguments were not accurate and/or relevant
Organization	All arguments were clearly tied to an idea (premise) and organized in a tight, logical fashion.	Most arguments were clearly tied to an idea (premise) and organized in a tight, logical fashion.	All arguments were clearly tied to an idea (premise) but the organization was sometimes not clear or logical.	Arguments were not clearly tied to an idea (premise).