Lesson Title: Modern Family

Grade Level: 9-12

Time Allotment: 1 – 2 45-minute class periods

Subject Area: Science

Overview
In this lesson, students will learn about an important but extinct branch of the hominid family tree – the Neanderthals. In the Introductory Activity, students will use a hands-on activity and a web interactive to learn about Neanderthals and how they fit into the scope of human evolution. In the Learning Activity, students will explore the similarities and differences between Neanderthals and modern humans using segments from the PBS series *The Human Spark*. As a Culminating Activity, students will conduct independent research on the factors leading to the extinction of the Neanderthals.

Media Resources

Video Clips

***The Human Spark: Becoming Us*,** selected segments

A Day in the Life of a Neandertal

A look at some of the similarities and differences between the Neandertal way of life and that of modern humans.

What's the Difference?

A discussion of how certain specific aspects of Neandertals' diet and development set them apart from modern humans.

A Social Network

An exploration of the relationship between social and technological change, specifically in Neandertal and modern human populations.

Websites

Human Evolution Timeline Interactive | The Smithsonian Institution's Human Origins Program
http://humanorigins.si.edu/evidence/human-evolution-timeline-interactive

Objectives
Students will be able to:

- Explain Neanderthals' relationship to homo sapiens on an evolutionary timeline
- Define physical and behavioral characteristics of Neanderthals
- Compare and contrast Neanderthals and modern humans
- List factors contributing to decline of Neanderthal population
- Analyze theories explaining why modern human populations overtook Neanderthal populations

Standards
National Science Education Standards
http://www.nap.edu/openbook.php?record_id=4962

Content Standard A
As a result of activities in grades 9–12, all students should develop

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

2. Scientists conduct investigations for a wide variety of reasons. For example, they may wish to discover new aspects of the natural world, explain recently observed phenomena, or test the conclusions of prior investigations or the predictions of current theories.

- Scientific explanations must adhere to criteria such as: a proposed explanation must be logically consistent; it must abide by the rules of evidence; it must be open to questions and possible modification; and it must be based on historical and current scientific knowledge.
- Results of scientific inquiry—new knowledge and methods—emerge from different types of investigations and public communication among scientists. In communicating and defending the results of scientific inquiry, arguments must be logical and demonstrate connections between natural phenomena, investigations, and the historical body of scientific knowledge. In addition, the methods and procedures that scientists used to obtain evidence must be clearly reported to enhance opportunities for further investigation.

Life Science
Content Standard C
BIOLOGICAL EVOLUTION

- Species evolve over time. Evolution is the consequence of the interactions of (1) the potential for a species to increase its numbers, (2) the genetic variability of offspring due to mutation and recombination of genes, (3) a finite supply of the resources required for life, and (4) the ensuring selection by the environment of those offspring better able to survive and leave offspring.
- Natural selection and its evolutionary consequences provide a scientific explanation for the fossil record of ancient life forms, as well as for the striking molecular similarities observed among the diverse species of living organisms.

POPULATION GROWTH

- Populations grow or decline through the combined effects of births and deaths, and through emigration and immigration. Populations can increase through linear or exponential growth, with effects on resource use and environmental pollution.
- Various factors influence birth rates and fertility rates, such as average levels of affluence and education, importance of children in the labor force, education and employment of women, infant mortality rates, costs of raising children, availability and reliability of birth control methods, and religious beliefs and cultural norms that influence personal decisions about family size.

NATURAL RESOURCES

- Human populations use resources in the environment in order to maintain and improve their existence. Natural resources have been and will continue to be used to maintain human populations.

NATURAL AND HUMAN-INDUCED HAZARDS

- Some hazards, such as earthquakes, volcanic eruptions, and severe weather, are rapid and spectacular. But there are slow and progressive changes that also result in problems for individuals and societies. For example, change in stream channel position, erosion of bridge foundations, sedimentation in lakes and harbors, coastal erosions, and continuing erosion and wasting of soil and landscapes can all negatively affect society.

Before the Lesson/Prep for Teachers

Prior to teaching this lesson, you will need to:

Preview all of the video segments and websites used in the lesson.

Download the video clips used in the lesson to your classroom computer(s) or prepare to watch them using your classroom's Internet connection.

Bookmark all websites that you plan to use in the lesson on each computer in your classroom. Using a social bookmarking tool such as delicious.com or diigo (or an online bookmarking utility such as portaportal) will allow you to organize all the links in a central location.

Review spelling and pronunciation of "Neanderthal." Different sources will use both the "Neander**th**al" and "Neandertal" spellings – both are acceptable. "Neanderthal" is used consistently in this lesson as on the *Human Spark* website. No matter which spelling is used, the word is pronounced with a hard "T" sound – "Neander-**T**AL," as the word derives from the German word "*tal*," meaning "valley." The first Neanderthal remains were discovered in Germany's Neander Valley.

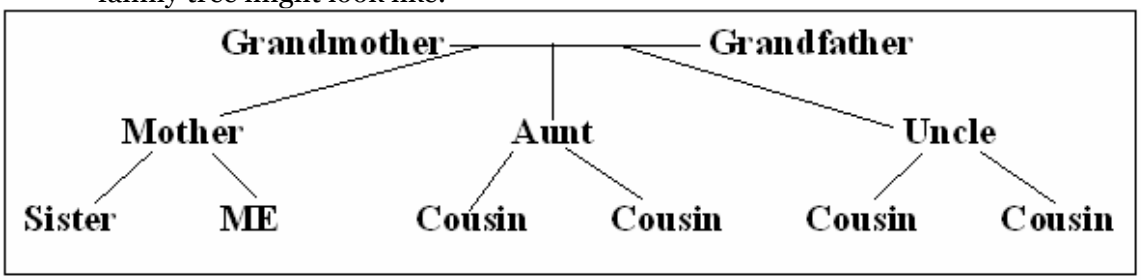
THE HUMAN SPARK

WNET NEW YORK PUBLIC MEDIA THIRTEEN

Introductory Activity

1. Begin class by asking students to think about evolution on a very small scale – the "evolution' of their own families. Each individual is – in a variety of large and small ways – a product of the generations that came before him or her. As physical and behavioral characteristics are passed down over time, each individual received a specific combination of traits, which is what makes each person unique. Some of these traits are inherited biological traits (*ask students for examples of what inherited biological traits might be, like eye color, hair color, height, etc.*), while others are more cultural and sociological (*ask students for examples of what these might be, such as food preferences and recipes, styles of clothing, accents and languages, traditions, etc.*). How does an individual get that combination of traits? (*Genes, nature v. nurture.)*

2. Ask students to think about their own families, and draw a sketch of a family tree. The tree should include at least three generations, and should include any known siblings, cousins, and aunts and uncles. Here is an example of what a basic family tree might look like:



(If you have students in your class who know very little about their family histories, or come from non-traditional families that would make this activity difficult to complete, encourage student to work in pairs or groups and share information with each other about their family trees.) As students look at their family trees, ask them to think of physical or behavioral characteristics they share with the individual members of their family. Now look at the differences between the members of the family. Are there more differences between you and your sibling, or you and your cousin? Are you more similar to your parents or your grandparents? Parents or aunts/uncles? Are the similarities/differences physical or behavioral? Even though there are differences between you and your siblings/cousins, how can you tell that you are related? How is it possible that relatives can come from the same ancestors but then develop in completely different ways?

3. Direct students to the Smithsonian Institution's Human Evolution Timeline Interactive (http://humanorigins.si.edu/evidence/human-evolution-timeline-interactive). As they can see, there are branches of the human family tree that grow from a common ancestor, but are not directly related to each other, like the branches of you and your cousins on your family tree. Ask students to look closely at the information regarding *homo heidelbergensis*, *homo neanderthalensis*, and *homo sapiens*. (Encourage students to use the magnifier to gain more information on individual specimens.) As with their own family

trees, ask students to note physical and behavioral characteristics shared by the three species, and those that are different.

4. Explain that while it is believed that both Neanderthals and modern humans descend from *homo heidelbergensis*, Neaderthals and modern humans are not believed to be directly related to each other. They are classified as separate species, just as dogs and wolves are separate species today, but are genetically similar, share some similar behavioral characteristics, and descend from a common ancestor, but would certainly not be considered to be part of the same species today.

5. Explain that scientists are learning more about Neanderthals every day, and that you are going to give them some background information on what we know about Neanderthals as of today (students can take notes, or you may wish to distribute this information as a handout):
    a. The first Neanderthal specimen was discovered in Germany's Neander Valley in 1856. Since then specimens have been discovered throughout Europe and Western Asia. It is believed that the Neanderthals lived in Europe and Asia between 200,000 and 30,000 years ago, although there is evidence to suggest that Neanderthals were in the region as recently as 24,000 years ago.
    b. Modern human and Neanderthal populations overlapped in Europe and Asia for approximately 15,000 years. Scientists have conflicting opinions about whether or not interbreeding occurred between the two species. Recent work on mapping the Neanderthal genome sheds some light on this controversy. Modern African humans share no DNA with Neanderthals, but modern Europeans and Asians share 1 – 4% of Neanderthal DNA, suggesting the possibility of some interbreeding. Modern humans share 99.5 – 99.9% of the Neanderthal genome sequence – which is only marginally more than modern humans share with chimpanzees.

Learning Activity:

1. As students have seen, the evolutionary path taken Neanderthals and homo sapiens was very similar – but obviously, at some point it diverged. It is the differences between the two species that allowed one to thrive, and one to perish. Tell students you are going to show them a video clip about some of what scientists have observed about what made Neanderthals different from modern humans. Ask students to note one major difference between the two species as they watch the clip. Play "A Day in the Life of a Neanderthal" clip. Ask students to share their observations of the major difference between Neanderthals and modern humans? (*Lack of innovation/advancement in technology*.) Explain to students that Neanderthals and homo sapiens lived alongside each other in Europe for approximately ten thousand years. Why do students think Neanderthals did not change their way of life or way of making and using tools in all this time?

2. Explain that scientists, like Svante Pääbo at Max Planck Institute, who is featured in the next video clip, have done extensive research on Neanderthal remains to learn about their biology as well as their way of life. Ask students to note some of the similarities and differences between Neanderthals and modern humans as they watch the video clip. Play "What's the Difference" clip. Ask students to share some of their observations. Ask students how they think learning about Neanderthal characteristics helps scientists learn more about modern humans?

3. As students saw in the clip, scientists believe that the length of childhood is a significant factor that differentiates Neanderthals from modern humans. Ask students to think back to their family trees, and the physical and behavioral traits that they inherited from their ancestors. Ask students to think about when in their lives they fist saw those traits begin to develop. Some of them may have been right away (if you have bright green eyes like your grandmother, that may have been apparent at birth), while some might have taken longer to show up (if you have a great sense of humor like your cousin you didn't know that until you could talk and learned words; if you are a great cook like your dad you didn't know that until you were old enough to use the stove). What are the advantages and disadvantages to these traits showing up right away or being delayed? (*Biological traits that show up right away let parents know that their children belong to them. Sociological and cultural traits allow you to relate to community members and/or be self sufficient, which you may not want to develop before you are biologically developed enough to set out on your own.*)

4. Ask students to look once again at their family trees, and think about physical and behavioral characteristics that they share with their family members that are not necessarily inherited, but learned. What characteristics, skills, or knowledge do you have that came from older generations of your family not as a result of genetic inheritance, but from the time you spent interacting with those family members? Are you good at math because your parents are naturally good at math, or because of the hours your dad spent helping you with your math homework? Are you a naturally good basketball player, or did your big sister always make you play pickup games with her and develop your skills? Are you a naturally good cook, or did your grandmother teach you all of her recipes? Modern humans have a very long period of childhood and development, especially when compared to the Neanderthals. Ask students if, considering the shorter childhood of Neanderthals, they think Neanderthals had the same opportunity to learn skills and knowledge from older generations? (*Probably not.*) What effect might this have had on the Neanderthals' ability to change and adapt to changing surroundings and conditions, as compared to modern humans? Would either species have had an evolutionary advantage? Encourage students to discuss.

Culminating Activity

1. As students can see by looking around, eventually Neanderthals went extinct and homo sapiens – modern humans- became the dominant human species. There are several theories as to why this occurred, and none have been definitively proven yet. Tell students they are about to watch a video clip discussing some of

theories as to why the modern humans outlasted the Neanderthals. Ask them to note what advantages the homo sapiens had over the Neanderthals as they watch the clip. Play "A Social Network" clip. Ask students to share their observations.

2. Ask students to list any theories they may have as to why the Neanderthals went extinct, based on their knowledge from class and the video clips, and write them on the board or overhead projection screen. Add the following to the list, if students have not offered them as suggestions:
    a. Neanderthals were wiped out by climate change while Homo sapiens survived.
    b. Homo sapiens and Neanderthals engaged in violent conflict, and Neanderthals lost.
    c. Volcanic eruptions created environment-destroying ash clouds over Europe and Asia.
    d. Neanderthals' low population density prevented them from thriving.
    e. Homo sapiens' development of social constructs allowed groups to specialize and outcompete Neanderthals.
    f. Neanderthals' narrow diet prevented them from adapting to changing environments.
    g. Neanderthals' inferior tools and technological knowledge allowed homo sapiens to advance.
    h. Neanderthals were absorbed into homo sapiens population through interbreeding.
    i. Homo sapiens and Neanderthals had to compete for food, Neanderthals lost.

3. Assign topics to groups/pairs/individuals and ask students to research topic during remainder of class time or as homework. Each should come up with one researched argument for and one argument against their assigned argument. Have students present to the class.