Lesson Title	GIS Day – EARTHQUAKES!!
Length of Lesson	60 minutes
Created By	David Wilson, Bo Cherry, Hannah Box, Shane Irvin
Subject	Geosciences
Grade Level	7th Grade / 8th Grade
State Standards	1 (b, c, d, e) / 1 (d, f)
DOK Level	(1, 2, 3, 2) / (3, 3)
DOK Application	Discriminate, Collect and Display, Organize, Communicate / Analyze, Develop
National Standards	K-12: Unifying Concepts and Processes / 9-12: A: Science as Inquiry
Graduate Research Element	An understanding of the properties of water within hygroscopic crystals and solutions is essential to protein research.

Student Learning Goal:

State Standards: (7th Grade)

1) Design and conduct a scientific investigation utilizing appropriate process skills and technology.

b. Discriminate among observations, inferences, and predictions. (DOK 1)

c. Collect and display data using simple tools and resources to compare information. (DOK 2)

d. Organize data in tables and graphs and analyze data to construct explanations and draw conclusions. (DOK 3)

e. Communicate results of scientific procedures and explanations through a variety of written and graphic methods. (DOK 2)

State Standards: (8th Grade)

1) Draw conclusions from scientific investigations including controlled experiments.

d. Analyze evidence that is used to form explanations and draw conclusions. (DOK 3)

f. Develop a logical argument to explain why perfectly designed solutions do not exist. (DOK 3)

National Science Standards: (K-12)

Unifying Concepts and Processes:

As a result of activities in grades K-12, all students should develop understanding and abilities aligned with the following concepts and processes:

- Systems, order, and organization
- Evidence, models, and explanation

- Constancy, change, and measurement
- Evolution and equilibrium
- Form and function

National Science Standards: (5-8)

A: Science as Inquiry: Abilities necessary to do scientific inquiry.

- IDENTIFY QUESTIONS THAT CAN BE ANSWERED THROUGH SCIENTIFIC INVESTIGATIONS. Students should develop the ability to refine and refocus broad and ill-defined questions. An important aspect of this ability consists of students' ability to clarify questions and inquiries and direct them toward objects and phenomena that can be described, explained, or predicted by scientific investigations. Students should develop the ability to identify their questions with scientific ideas, concepts, and quantitative relationships that guide investigation.
- DESIGN AND CONDUCT A SCIENTIFIC INVESTIGATION. Students should develop general abilities, such as systematic observation, making accurate measurements, and identifying and controlling variables. They should also develop the ability to clarify their ideas that are influencing and guiding the inquiry, and to understand how those ideas compare with current scientific knowledge. Students can learn to formulate questions, design investigations, execute investigations, interpret data, use evidence to generate explanations, propose alternative explanations, and critique explanations and procedures.
- USE APPROPRIATE TOOLS AND TECHNIQUES TO GATHER, ANALYZE, AND INTERPRET DATA. The use of tools and techniques, including mathematics, will be guided by the question asked and the investigations students design. The use of computers for the collection, summary, and display of evidence is part of this standard. Students should be able to access, gather, store, retrieve, and organize data, using hardware and software designed for these purposes.
- DEVELOP DESCRIPTIONS, EXPLANATIONS, PREDICTIONS, AND MODELS USING EVIDENCE. Students should base their explanation on what they observed, and as they develop cognitive skills, they should be able to differentiate explanation from description—providing causes for effects and establishing relationships based on evidence and logical argument. This standard requires a subject matter knowledge base so the students can effectively conduct investigations, because developing explanations establishes connections between the content of science and the contexts within which students develop new knowledge.
- THINK CRITICALLY AND LOGICALLY TO MAKE THE RELATIONSHIPS BETWEEN EVIDENCE AND EXPLANATIONS. Thinking critically about evidence includes deciding what evidence should

be used and accounting for anomalous data. Specifically, students should be able to review data from a simple experiment, summarize the data, and form a logical argument about the cause-and-effect relationships in the experiment.

- COMMUNICATE SCIENTIFIC PROCEDURES AND EXPLANATIONS. With practice, students should become competent at communicating experimental methods, following instructions, describing observations, summarizing the results of other groups, and telling other students about investigations and explanations.
- FORMULATE AND REVISE SCIENTIFIC EXPLANATIONS AND MODELS USING LOGIC AND EVIDENCE. Student inquiries should culminate in formulating an explanation or model. Models should be physical, conceptual, and mathematical. In the process of answering the questions, the students should engage in discussions and arguments that result in the revision of their explanations. These discussions should be based on scientific knowledge, the use of logic, and evidence from their investigation.

B: Physical Science: Structure of the Earth System

- Lithospheric plates on the scales of continents and oceans constantly move at rates of centimeters per year in response to movements in the mantle. Major geological events, such as earthquakes, volcanic eruptions, and mountain building, result from these plate motions.

E: Science and Technology: Abilities of Technological Design

- DESIGN A SOLUTION OR PRODUCT. Students should make and compare different proposals in the light of the criteria they have selected. They must consider constraints—such as cost, time, trade-offs, and materials needed—and communicate ideas with drawings and simple models.
- EVALUATE COMPLETED TECHNOLOGICAL DESIGNS OR PRODUCTS. Students should use criteria relevant to the original purpose or need, consider a variety of factors that might affect acceptability and suitability for intended users or beneficiaries, and develop measures of quality with respect to such criteria and factors; they should also suggest improvements and, for their own products, try proposed modifications.

E: Science and Technology: Understandings about Science and Technology

- Perfectly designed solutions do not exist. All technological solutions have trade-offs, such as safety, cost, efficiency, and appearance. Engineers often build in back-up systems to provide safety. Risk is part of living in a highly technological world. Reducing risk often results in new technology.
- Technological designs have constraints. Some constraints are unavoidable, for example, properties of materials, or effects of weather and friction; other constraints limit choices in the design, for example, environmental protection, human safety, and aesthetics.

F: Science in Personal and Social Perspectives: Natural Health

- Internal and external processes of the earth system cause natural hazards, events that change or destroy human and wildlife habitats, damage property, and harm or kill humans. Natural hazards include earthquakes, landslides, wildfires, volcanic eruptions, floods, storms, and even possible impacts of asteroids.

F: Science in Personal and Social Perspectives: Risks and Benefits

- Risk analysis considers the type of hazard and estimates the number of people that might be exposed and the number likely to suffer consequences. The results are used to determine the options for reducing or eliminating risks.
- Students should understand the risks associated with natural hazards (fires, floods, tornadoes, hurricanes, earthquakes, and volcanic eruptions), with chemical hazards (pollutants in air, water, soil, and food), with biological hazards (pollen, viruses, bacterial, and parasites), social hazards (occupational safety and transportation), and with personal hazards (smoking, dieting, and drinking).
- Individuals can use a systematic approach to thinking critically about risks and benefits. Examples include applying probability estimates to risks and comparing them to estimated personal and social benefits.
- Important personal and social decisions are made based on perceptions of benefits and risks.

F: Science in Personal and Social Perspectives: Science and Technology in Society

- Science influences society through its knowledge and worldview. Scientific knowledge and the procedures used by scientists influence the way many individuals in society think about themselves, others, and the environment. The effect of science on society is neither entirely beneficial nor entirely detrimental.

Materials Needed (supplies, hand-outs, resources):

1) Website: arcgis.com
    a. Map: http://www.arcgis.com/home/item.html?id=2c2c141f8a694b85b1d76c287870f430
2) Worksheet: Attached

Lesson Performance Task/Assessment:

1) Evaluate the relative risk posed to nuclear power plants by potential earthquakes.
2) Evaluate the relative risk of a nuclear disaster on populated areas near failed nuclear power plants.
3) Evaluate the potential cost of operating a nuclear plant based on geologic, geographic, and topographic data.

4) Determine the best location to build a new nuclear power plant in Mississippi based on the least risk and most efficient operating expense.

Lesson Relevance to Performance Task and Students:
The students will experience a meaningful way in which science and technology affect the life of an average person. The students will use science and technology to solve a real-world problem while determining how best to safeguard the public. Finally, students will use what they learned from their analyses to evaluate some of the decisions made by the contemporary scientific, engineering, and political communities.

Anticipatory Set/Capture Interest:
Fellows will review the implications of the Fukushima Daiichi disaster and the Haiti disaster before using data from those disasters to make scientific decisions with great social implications.

Guided Practice:
Students will evaluate the safety and cost-effectiveness of ten different nuclear plants in the U.S.

Independent Practice:
Students will determine the "best" location in Mississippi for building the next nuclear power plant.

Remediation and/or Enrichment:
Remediation: Individual IEP.
Enrichment: (I can't think of anything for this. I'm not good at this part.)

Check(s) for Understanding:
Students will make presentations to the entire group detailing how they arrived at their judgments and decisions.

Closure:
The presentations.

Possible Alternate Subject Integrations:
Earth science, physical science, physics.

Teacher Notes: