**Completed Geospatial Inquiry example**

**Teacher** POD Example

**Grade level(s)** Adult Learners

**Subject(s)** Earth and Environmental Science

**Existing lesson/unit to be *enhanced* by Geospatial Inquiry** Natural Hazards and Risks of Natural Disasters

**Anticipated timeframe** 10 hours

**Anticipated implementation (month, year)** Summer 2017



**Begin with the End in Mind**

What essential understanding will students gain from completing this Geospatial Inquiry-enhanced lesson/unit? A concept is an idea that can be applied in multiple contexts to explain and/or predict outcomes. Conceptual understanding is the ability to apply a big idea/concept in multiple contexts to explain and/or predict outcomes.

Earth system processes in the atmosphere, hydrosphere and geosphere (natural hazards) become disastrous when they occur near densely populated areas, natural resources, or critical infrastructure (vulnerable systems).

Studying past events can lead to better understanding of underlying causes and help predict risk of future events. Planning for mitigation and communicating risk to stakeholders can reduce effects of natural hazards on the vulnerable system and increase the system’s ability to respond appropriately and recover quickly.

* Some hazards are preceded by phenomena that allow for reliable predictions and others occur with no notice. Mapping and history in a region combined with understanding geological forces can help forecast future events.
* There are several natural phenomena that can become hazards. Whenever they occur, life or property may be lost. However, not all areas of the world are impacted equally by these natural hazards.
* Some natural hazards, such as volcanic eruptions and severe weather, are preceded by phenomena that allow for reliable forecasts of the probability of occurrence in a finite time period. Others, such as earthquakes, occur suddenly and with no notice, and thus they are not yet predictable. However, mapping the history of natural hazards in a region, combined with an understanding of related geological forces can help forecast the locations and likelihoods of future events. (ESS3.B 6-8)
* Natural hazards can be local, regional, or global in origin and impact, and their risks increase as populations grow. (ESS3.B 9-12)

*Have you written a statement that allows students to apply a broad idea in multiple contexts to explain and/or predict outcomes?*

Identify 2-3 key skills and/or cross-disciplinary practices students will learn or use during this Geospatial Inquiry-enhanced lesson/unit (e.g. collaboration, communication)

Critical thinking – analyzing and interpreting data to make claims based on geospatial evidence

Collaboration – working with others, participating in academically productive talk

Communication – arguing from evidence to a defined audience; participating in academically productive talk; displaying geospatial data in ways that make patterns evident

Which types of geospatial analyses will students conduct to find relationships and patterns in order to develop conceptual understanding?

For each item checked, what will students analyze, compare, and/or interpret (not specific datasets, but big ideas)?

Check all that apply:

X Finding where things are (in relation to other things)

For example: Locations of past major earthquakes in relation to plate boundaries and types of crust. For project of choice: locations of past natural hazard of choice in relation to factors that affect the natural hazard

X Finding what’s nearby

Major cities, critical infrastructure, natural resources, critical facilities

* Examining what’s inside
* Comparing most and least

X Finding areas of concentration (density)

For example: Of major earthquakes, of population. For project of choice: of natural hazard, of population.

* Examining change over time

**Ask Questions**

Craft a guiding question which provides a purpose for engaging in the Geospatial Inquiry-enhanced lesson/unit. The statement should encompass all content and outcomes and should require to answer a question, solve a problem or explain a phenomenon.

How can we predict if an area is at high risk for natural disaster?

* How can geospatial data be used to help explain where and why natural hazards occur?
* What patterns and relationships in geospatial data indicate high risk of disaster?
* How can geospatial data and tools be used as evidence to communicate risk?

*Have you posed an authentic problem or significant question that engages students and requires core subject knowledge to solve or answer?*

**Evidence of Student Learning**

Define the student products for the Geospatial Inquiry-enhanced lesson/unit.

Which of these (or other products) will you assess? Which products require feedback to enable students to refine their thinking?

Early on (diagnostic):

* Group consensus on definitions of hazard, risk, disaster
* Need to know, data to acquire charts

In the middle (formative):

* Evidence based arguments about the reasoning behind natural hazards (e.g. relationship of depth, magnitude, and intensity of earthquakes) presented in ArcGIS Online presentation (peer feedback and opportunity to revise)
* Evidence based arguments about the risk of natural hazards (e.g. major seismic event) in a particular region presented in ArcGIS Online Story Map (peer feedback and opportunity to revise)
* Academically productive talk with peers during activities (instructor intervention as appropriate)
* Academically productive talk with whole group during summary table discussions at end of each session (instructor intervention as appropriate)
* Academically productive talk with whole group during discussions of homework assignments/readings (instructor intervention as appropriate)

Final product (summative):

* Evidence based arguments about the risk of natural hazard of their choice in their region within a deliverable of their choosing based on intended audience (peer feedback and opportunity to revise)

*Do students have multiple opportunities to ask questions, analyze and interpret geospatial data, argue from evidence, present their arguments, and revise their thinking?*

*Consider ways to assess content knowledge and skills, communication skills, and process. Consider both formal products and informal assessments (conversations, observations, etc.).*

**Quality of Evidence**

State the criteria for exemplary performance for each product above:

Early on (diagnostic):

Product: Group consensus on definitions of hazard, risk, disaster

Criteria: n/a

Product: Need to know, data to acquire charts

Criteria: students identify need to acquire datasets from natural (e.g. plate boundaries, historic seismic events with attributes such as depth and magnitude) and vulnerable systems (e.g. population, infrastructure)

In the middle (formative):

Product: Evidence based arguments about the reasoning behind natural hazards presented in ArcGIS Online presentation

Criteria: Notes are present for numerous locations to reference patterns in the data. Claim should reference patterns in attributes of the hazards (e.g. relationship of depth, magnitude, and intensity of earthquakes; location and type of plate boundaries). Symbology should convey patterns in the data.

Product: Evidence based arguments about the risk of natural hazards (e.g. major seismic event) in a particular region presented in ArcGIS Online Story Map

Criteria: Claims should be illustrated with multiple examples of data from both natural (historic hazard data and magnitude of events) and vulnerable systems (population, infrastructure) and should draw upon prior claim about why natural hazard occurs in certain regions (e.g. convergent plate boundaries). Symbology should convey patterns in data and be supported by written arguments.

Final product (summative):

Evidence based arguments about the risk of natural hazard of their choice in their region within a deliverable of their choosing based on intended audience

Criteria: Hazard should be introduced with reasoning for choice and explanation of where this hazard occurs, why, how frequently, and whether it can be accurately predicted. Claims should be illustrated with multiple examples of data from both natural (e.g. historic hazard data and magnitude of events) and vulnerable systems (e.g. population, infrastructure). Symbology should convey patterns in data and be supported by written arguments. Potential mitigation or warning systems should be identified.

*Do the products and criteria align with identified outcomes?* *Do the products and tasks give all students the opportunity to demonstrate what they have learned not only through visual representations, but also through writing and speaking? Do assessments enable you to determine how well a student understands? Do formative assessments reveal student thinking behind mistakes so you can intervene?*

**Examine Geospatial Data**

What maps or data could students explore to spark questions and engage them in the investigation? Is a video or news story appropriate to introduce these maps or data?

* Anchor videos
* Global natural hazards from USGS “global earthquakes above 5.7”
* “Tectonic Plate Boundaries” from “Esri\_TESS”
* “*World Volcanoes*” from “*Earth Science Atlas*”
* EarthquakesGlob\_57
* TectonicPlateBoundaries
* USGS earthquake Hazards program and the National Seismographic Network
* Data buckets

**Map the Geospatial Inquiry**

You have defined the problem or question and the student products for a Geospatial Inquiry-enhanced lesson/unit above. What knowledge and skills do students need in order to make the decision, explain the phenomenon, or answer the guiding question? What additional learning activities (hands on investigations, readings, etc.) must be completed to accompany the Geospatial Inquiry in order to help students explain the reasoning for their claims, why this phenomena occurs, or why the geospatial evidence is relevant?

Please describe the major activities for the entire lesson/unit, before, during, and after the Geospatial Inquiry, as appropriate.

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| **Activity Description** | **Learning Goal** | **How it helps students address the guiding question** |
| Anchor video of impact from natural disaster | Provides a purpose for engaging in a Geospatial Inquiry  | Introduces question: *How can we predict if an area is at high risk for natural disaster?* and *How can geospatial data be used to help explain where and why natural hazards occur?* |
| Consider definition of hazard, risk, disaster Consider need to know and data we need to acquireExamine global natural hazards dataCraft evidence based arguments about where major seismic events occur, present to peers, receive feedback and reviseLab stations (plate tectonics) and readings  | Agree on common understanding of differences so we can engage as a learning community to answer the question; equity and access to ideasInvest in question and start to think about geospatial data as resourcesRecognize relationships in spatial data by thinking about where things are in relationships to other things and find areas of concentrationArgumentation from evidence, communication, evaluation, and reflectionExplore and better understand reasoning behind seismic events | We need to understand the difference and relationship between these terms before we can determine risk.This list of possible data can be expanded throughout the activities and serve as a resource when participants choose their own natural hazard to explore.Engaging in an example together will familiarize participants with a process and tools for analyzing and interpreting geospatial data and the factors that contribute to risk determination.Multiple opportunities to practice crafting and presenting evidence based arguments, providing feedback to peers, and revising based on peer feedback will ensure participants are prepared to succeed when they complete the investigation of their choice.Participants will gain practice with multiple tools for displaying variability and patterns in geospatial data and for communicating with geospatial data. |
| Examine relationships and variability in earthquake data as it relates to plate boundariesLab stations (plate tectonics) and readingsCraft evidence based arguments about relationships, present to peers, receive feedback and revise | Recognize relationships in spatial data by finding what’s nearby and examining most and leastExplore and better understand reasoning behind seismic eventsArgumentation from evidence, communication, evaluation, and reflection | Engaging in an example together will familiarize participants with a process and tools for analyzing and interpreting geospatial data and the factors that contribute to risk determination.Multiple opportunities to practice crafting and presenting evidence based arguments, providing feedback to peers, and revising based on peer feedback will ensure participants are prepared to succeed when they complete the investigation of their choice.Participants will gain practice with multiple tools for displaying variability and patterns in geospatial data and for communicating with geospatial data. |
| Homework readings, pre readings, and lectures  | Deepen geology content understanding | These readings and lectures can help participants better understand why earthquakes occur where they do. They may help participants explain why the geospatial evidence is relevant and/or explain the reasoning for their claims. They also provide equity and access to science ideas for all participants. |
| Examine vulnerable systems dataCraft evidence based arguments about risk, present to peers, receive feedback and revise | Recognize relationships in spatial data by finding areas of concentration and finding what’s nearbyArgumentation from evidence, communication, evaluation, and reflection | Engaging in an example together will familiarize participants with a process and tools for analyzing and interpreting geospatial data and the factors that contribute to risk determination.Multiple opportunities to practice crafting and presenting evidence based arguments, providing feedback to peers, and revising based on peer feedback will ensure participants are prepared to succeed when they complete the investigation of their choice.Participants will gain practice with multiple tools for displaying variability and patterns in geospatial data and for communicating with geospatial data. |
| Determine the risk of choice of natural disaster in region of choice.  | Demonstrate understanding of the relationship between vulnerable systems and natural hazards. |  |

Identify activities which require scaffolds for writing or participation.

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| **Activity**  | **Type of Scaffold** |
| Crafting evidence based arguments | CER framework |
| Academically productive talk | Role cards |
| Metacognition | Focus questions |
| Presenting | LDC protocols and rubrics |
| Providing peer feedback | LDC protocols and rubrics |
| ArcGIS Online Tasks: adding data, changing styles, using analysis tools, creating presentations | Task cards |

*Have you identified opportunities to promote productive talk?*

What challenges or problems might arise in this Geospatial Inquiry-enhanced lesson/unit? How will you overcome these challenges?