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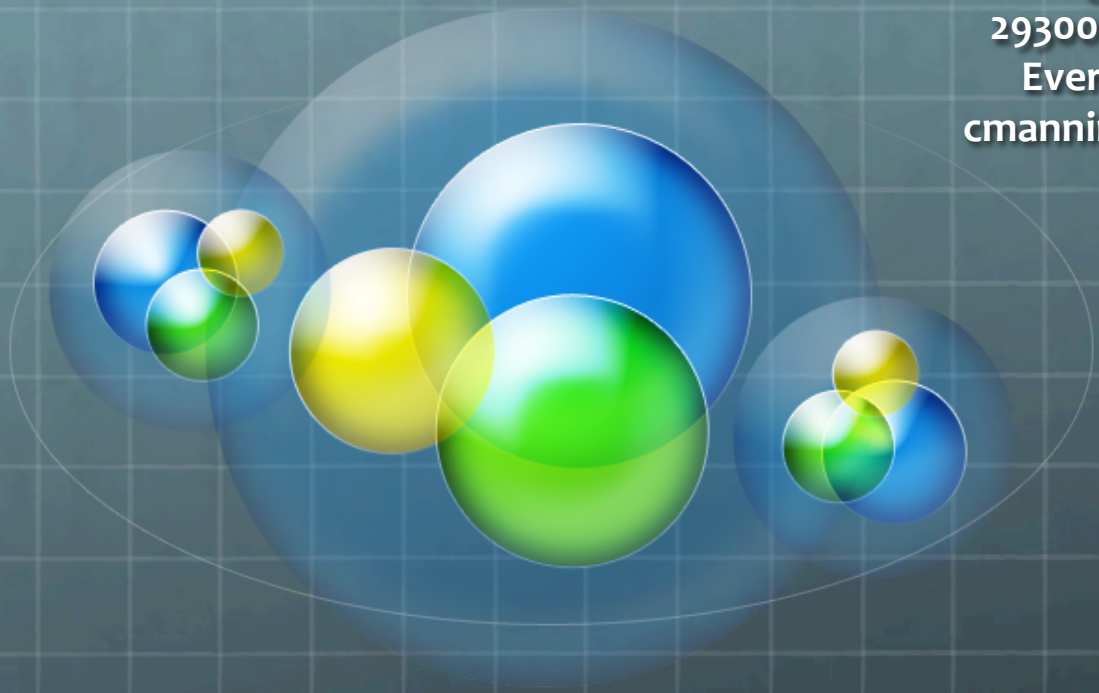


CREATING AN NGSS© EARTH-SPACE SCIENCE HIGH SCHOOL CURRICULUM

How NGSS addresses High School Earth & Space Science Differently

- Science and Engineering Practices – SEPs
  - Moving away from the classic model of a "Scientific Method"
  - Integration of Engineering
  - Emphasis on Models, Mathematics, and Communication
- Disciplinary Core Ideas – DCIs
  - K-8: Fundamentals of Earth & Space science are being learned
  - Coming into high school, students know more but misconceptions are pervasive and are best eliminated through accountable guided inquiry
- Crosscutting Concepts – CCs
  - 7 ideas knitting together sciences and engineering fields
  - Increase in complexity as students age and develop
  - Creating a common language

Challenges with Implementing NGSS

- The NGSS is daunting in both organization and depth and breadth
- Finding the connections with what has been done in the classroom and the changes that need to be made
- Making the NGSS work in different settings
  - Time, Materials, and Technology
  - Linking NGSS to State Standards and District Curriculum
  - Lack of Administrative Understanding
  - Potential curricular constraints by School Board

My Scope & Sequence

School district has a defined curriculum to which the NGSS DCIs have to be aligned

Autumn Semester

- Processes that influence Earth's Interior and Exterior
  - ESS1.5-6
  - ESS2.1, 2, 3, 5
  - ESS3.1
- Processes that Impact Life (Resources)
  - ESS2.6-7
  - ESS3.1-6*

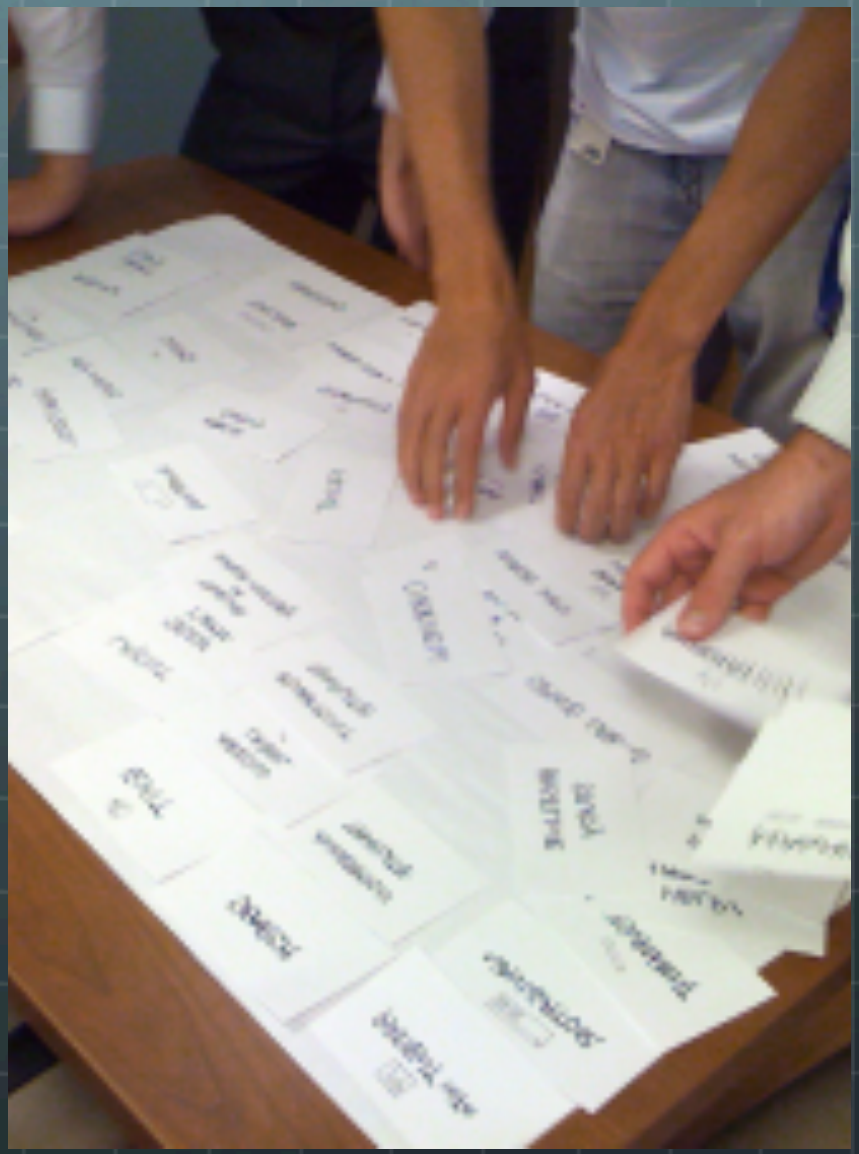
Spring Semester

- Processes that influence the Earth's Climate
  - ESS2.2, 4-7
  - ESS3.3-6*
- Processes that influence the Universe
  - ESS1.1-4

**Integration of Engineering*

My Approach…

- Scissors, Sticky Notes, and String
  - Cut apart the DCIs, CCs and SEPs
  - Organize them into categories
  - Make webs for each unit of study aligning NGSS to District Curriculum
- RESEARCH
  - Books & Articles
  - Videos
  - Peer Collaboration



Earth Science SEPs

Already Doing

- Asking Questions
- Using Models
- Planning & Carrying out Investigations
- Analyzing & Interpreting data
- Using Mathematics & Computational Thinking
- Constructing Explanations
- Obtaining, evaluating and communicating information

Needed to Integrate

Most of these are the "Engineering" Practices

- Defining Problems
- Developing Models
- Designing Solutions
- Engaging in Argument from Evidence

Defining Problems

- Natural Disaster Earth Systems Science Analysis
- Locating a Research Station in Yellowstone National Park
- Global Tectonic Hazards: How do literacy & poverty affect survival rates in natural disasters (Feedbacks)
- Fires, Flooding, & Water Quality
- Global Climate Summit
- Establishing a Mars Colony

Earthquake

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Earthquake-Secondary Hazards

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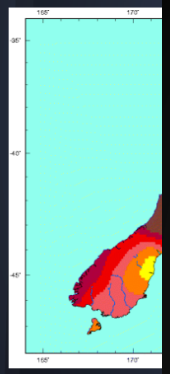
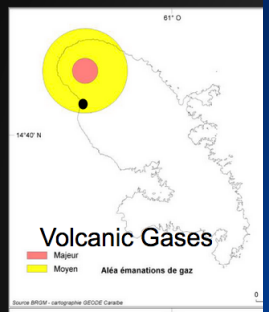
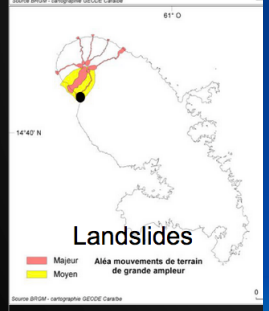
Hazards







How Ready are We?

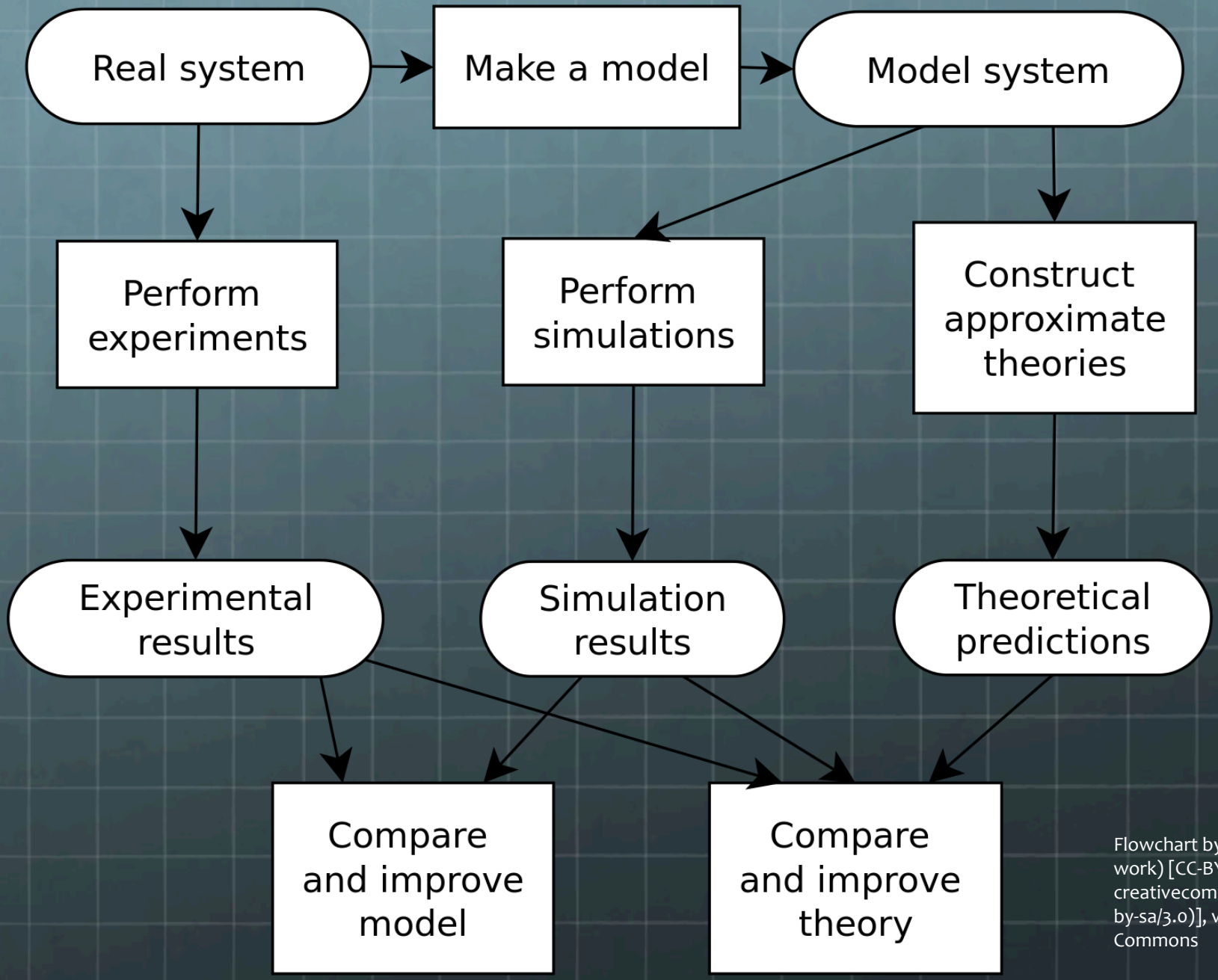
- HAZARDS!
  - Potential Volcanic Hazards: eruptions of gas & pyroclastic eruptions, lahars, landslides
  - Potential Secondary Earthquake Hazards- tsunamis, landslides, liquefaction, floods, fire, and building collapse
- Emergency Services include a hospital, fire station, police station, and relief services for emergencies.
- Update building codes
- Educate about earthquake & volcano preparedness and survival
- Have a plan

Developing & Using Models

- Topographic Map Making & Analysis
- Creating Computer Simulations using NetLogo or Google SketchUp
- Using Computer Simulations such as PhET & EarthObserver
- Physical Models: Topography, Fault-Blocks, Stream Tables, and Groundwater
- Mathematical Models using Excel & Plot.ly

Re-thinking the Stream Table Lab

- Students read about recent flooding events
- Identify the factors that contributed to the flooding
- Investigate possible solutions using the stream table
  - Develop a research plan
  - Test variables, collect data, and analyze results
  - Develop & Test possible solutions
  - Present best solution & evaluate the solutions designed by other student groups



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Designing Solutions to Real Problems

- Representing Topography
- Designing Bridges and Buildings to survive Earthquakes
- Locating a research station in Yellowstone National Park
- Modeling the impacts of Fires, Flooding, & Water Quality – Stream Table
- Water Filtration Project
- Developing Energy Technologies
- Establishing a Mars Colony

Filtering Water

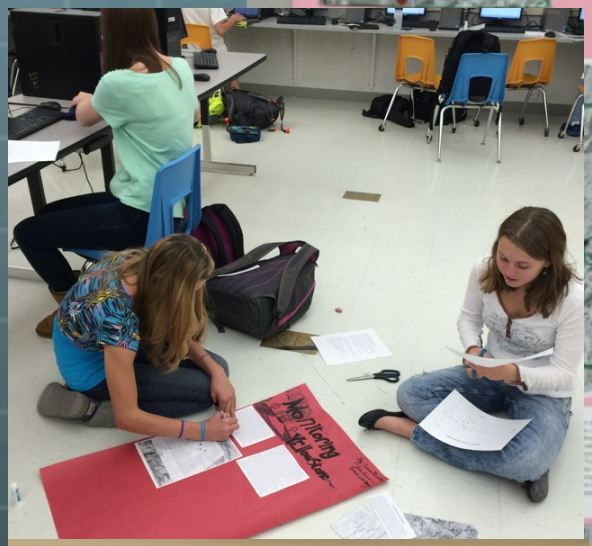
- Collaborative Problem-Solving
- Real-world emphasis on engineering
- Local speakers readily available
- Integration of chemistry and biology
- Cost/Benefit Analysis
- Comparison of natural and designed solutions

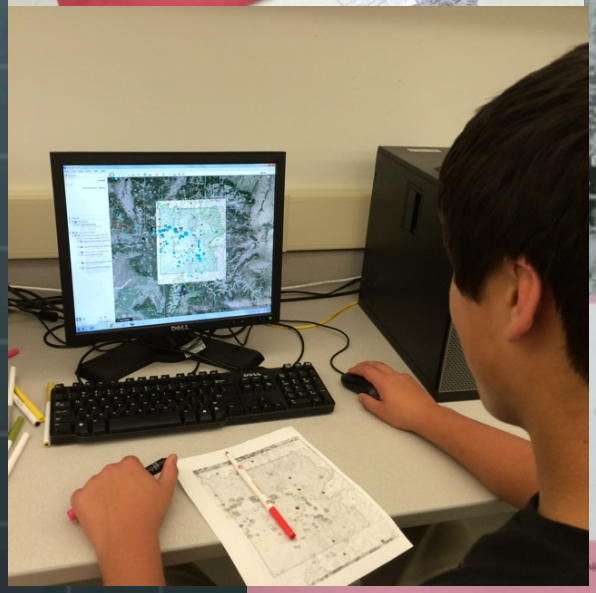
Engaging in Argument from Evidence

- Natural Disaster Earth Systems Science Analysis
- Analyzing & defending graphed data
- Designing Bridges & Buildings to survive Earthquakes
- Locating a research station in Yellowstone National Park
- Modeling the impacts of Fires, Flooding, & Water Quality – Stream Table/Water Filtration Project
- Global Climate Summit
- Developing Energy Technologies
- Establishing a Mars Colony (cross-curricular with Language Arts)

Yellowstone Research Station

- Problem-based Learning
- Collaborative
- Limited time
- Data-driven using files in Google-Earth
  - Geothermal Features
  - Volcanic History
  - Ground Deformation
  - Seismicity





In Conclusion…

- Get to know all the components of the NGSS
  - Science and Engineering Practices
  - Disciplinary Core Ideas
  - Cross-cutting Concepts
- Identify the strengths and weaknesses of existing curriculum and reach out to others for help
- Use NGSS to strengthen weaknesses and fill in gaps
- Integrate Problem-Based Learning and Technology
- Take risks and try new activities and projects
  - Messy, loud, and “controlled chaos”
  - Invigorating and fun

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