Middle School Geology

Increasing Student Learning Through

Increasing Teacher Content Knowledge

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Presentation Goals

- Introduce and review the Middle School Science Research study
- Provide a brief view of geology activities used in the content arm of the research

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The Work

Can the application of cognitive science principles to existing curriculum materials make a difference in students' learning of science?

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The Work

Can the deepening of teacher content knowledge make a difference in students learning of science?

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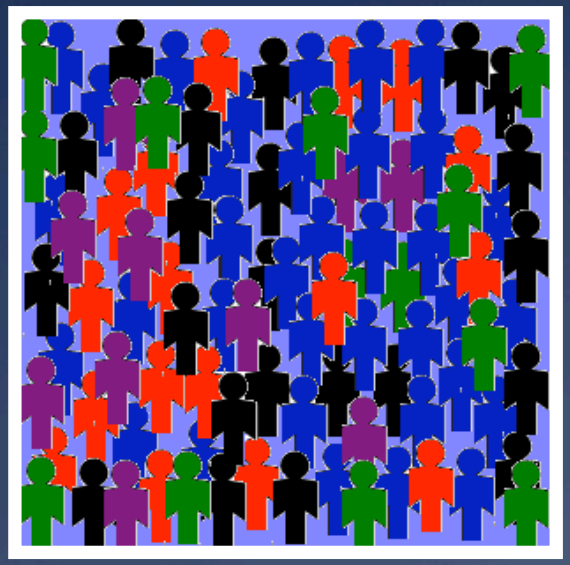
The Partners

Temple University

Randomization

- Assignment of a teacher to the experimental or control condition is equally likely by chance. A Randomized Control Study
  - Each district within the study was divided into thirds



Randomization

Experimental Condition 1 (content pd)

Experimental Condition 2 (content + cog sci pd)

Control Condition

Random assignment establishes fair comparisons.

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Experimental Design

Science Content Arm

- Does deepening teachers' knowledge of the science they are teaching lead to increased student achievement?

Cognitive Science Arm

- Does giving teachers science unit materials modified using cognitive principles and providing professional development on how to implement the modifications lead to increased student achievement?

Control Group

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Design Limitations

Science Content Arm

* PD is focused on ADULT learning. It does not include discussion of students or activities to use with students
* Teachers decide how to teach their lessons as a result of what they learned in PD

Cognitive Science Arm

* PD is focused on STUDENT learning. Discussion of student learning and activities to use with students are given
* Teachers must use the modified materials as they are given in PD

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Research Instruments

- All teachers in all three arms of the study will administer the end of unit test to their students.

* All teachers in all three arms of the study are paid to take:
* The Survey of Enacted Curriculum (SEC)
* The Teacher Content knowledge test
* A short spatial ability test

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Professional Development

PD Package

- These three days of intensive summer work as a beginning of the professional development

- Four important after school follow up sessions in Professional Learning Communities (PLCs) of teachers

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Baseline Measures/Covariates

Several measures will be collected at the start of the study to help improve our ability to estimate outcomes at the end of the study:

* Student demographic data
* Student achievement data in math and reading assessments will be collected for all participating students for the two years prior to the start of the study

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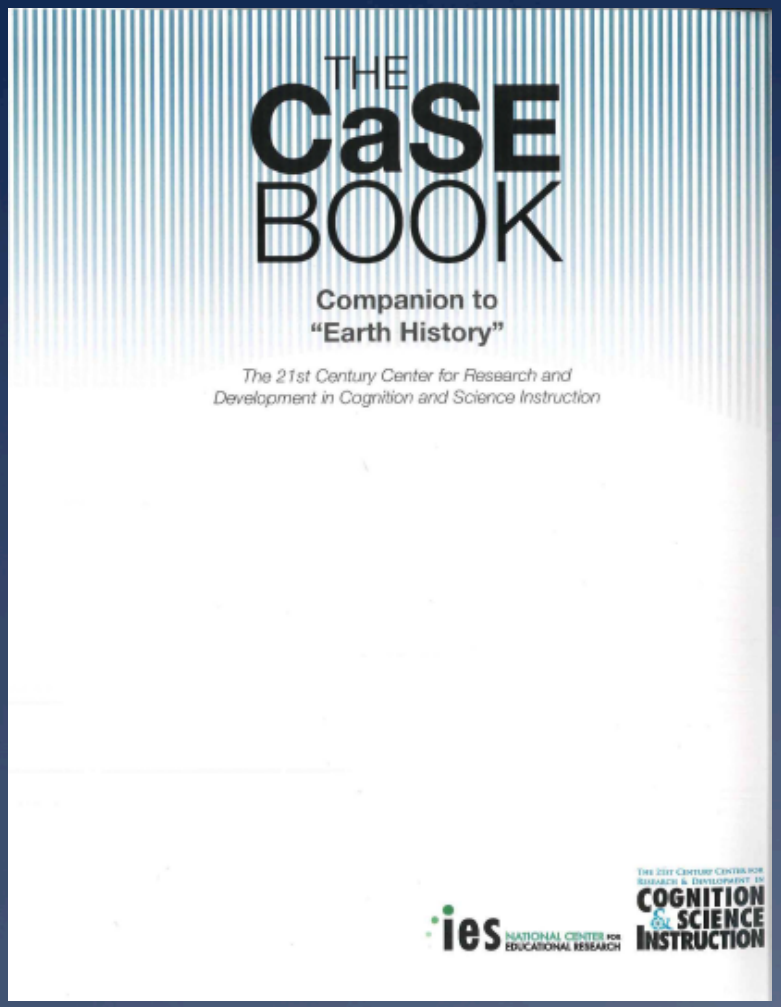
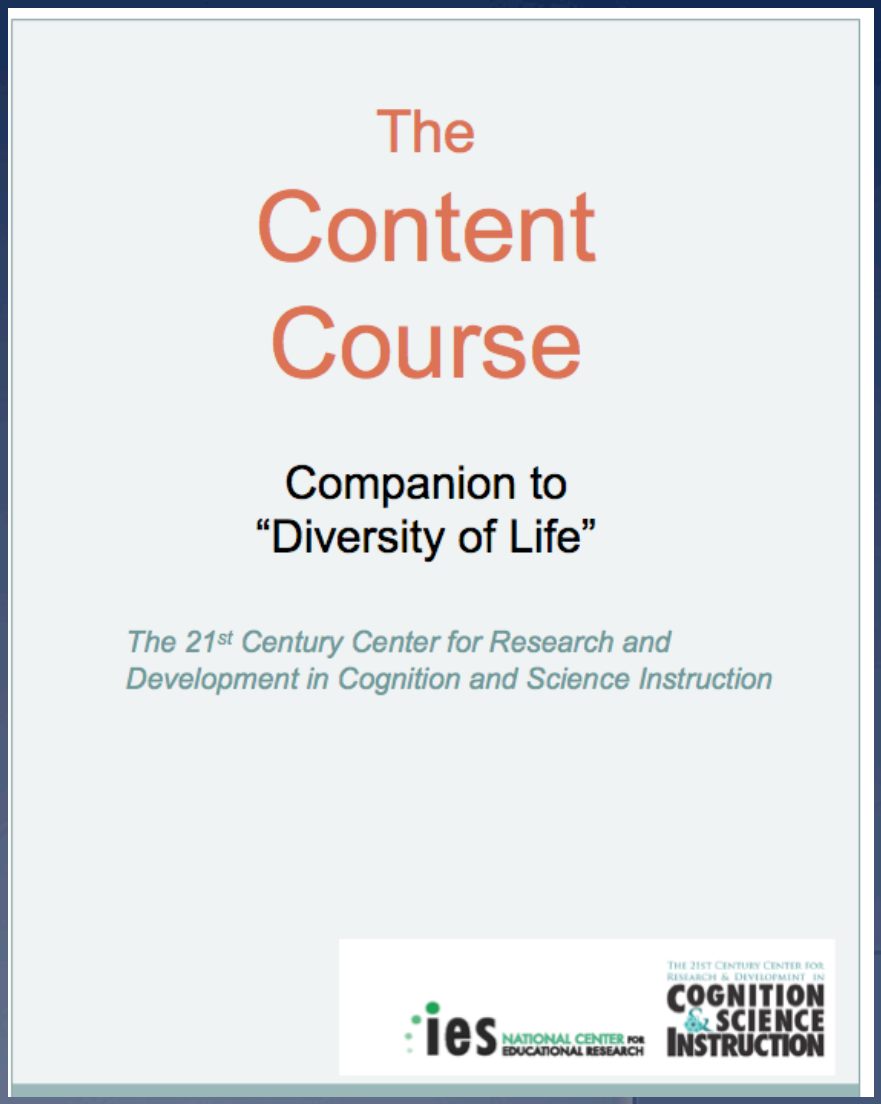
Binders

* Cognitive Science



* Content



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Outcomes

- At end of each targeted unit, there will be an end of unit student achievement test with two components: (1) science content that conforms with the district's expectations for student learning and (2) items related to cognitive science principles. Student results will be sent to teachers to use for student evaluation purposes.
- Will also use 8th grade state science (PSSA or AIMS) scores as a measure of student learning.

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School Districts Involved with Study

* Holt Text Book
* School District of Philadelphia
* Approx. 90 total schools – 30 in each arm of the study
* Grades 7 & 8

Each Content Unit/Grade will be done for two consecutive years

* Foss Science Kits
* Pittsburgh Public Schools
* Phoenix Area School Districts
  * Dysart, Deer Valley, Madison, and Buckeye
* Tucson Area School Districts
  * Tucson Unified SD, Sunnyside
* Approx. 90 total schools – 30 in each arm of the study
* Grades 6 & 7

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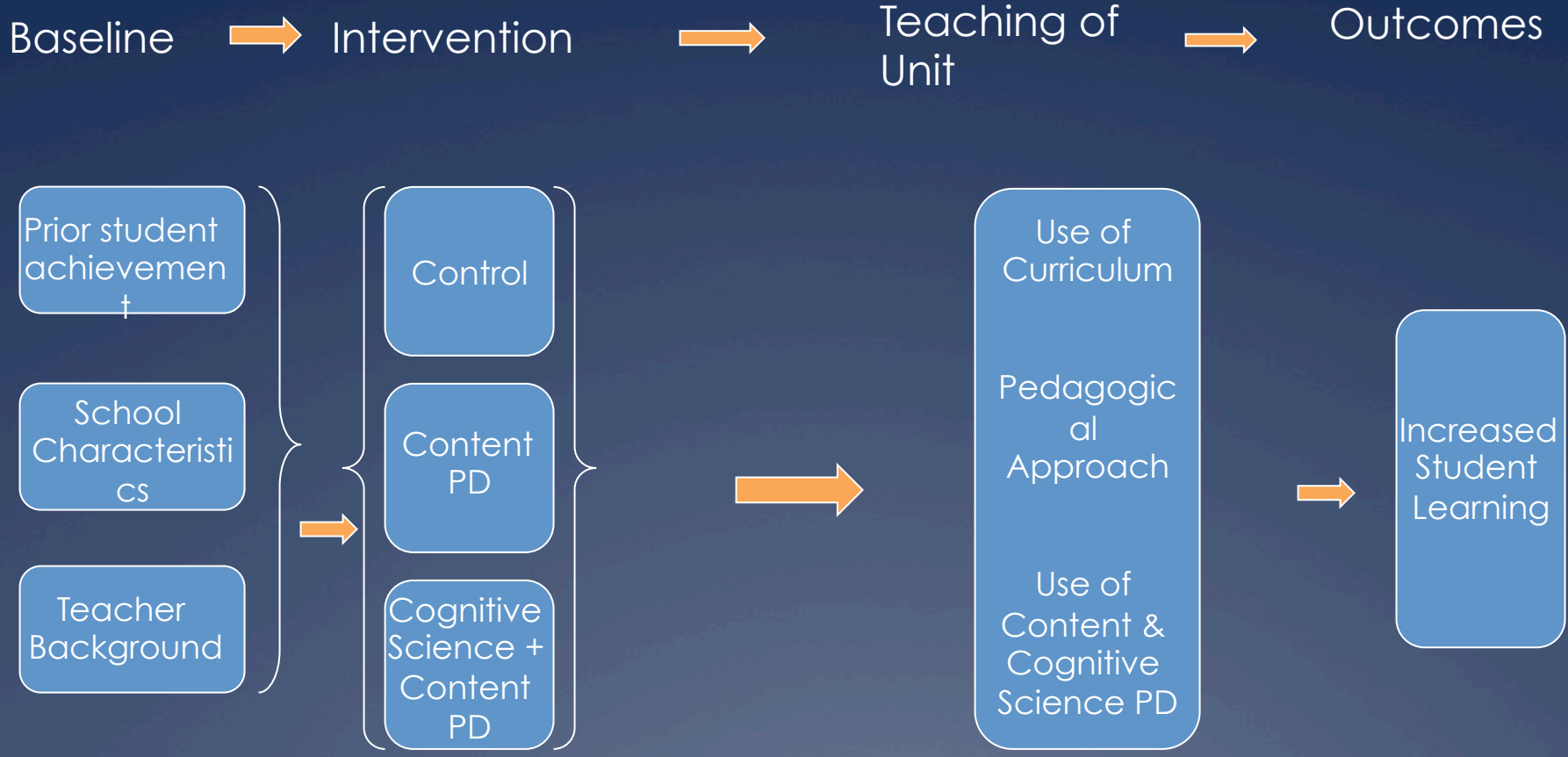
Study Overview



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Units Under Study
Holt Text Book

Biological Science Unit	Earth Science Unit	Physical Science Unit
Cells, Heredity and Classificatio	Inside Restless Earth	Introduction to Matter

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Units Under Study
Foss Kits

Biological Science Unit	Earth Science Unit	Meteorological Science Unit
Diversity of Life	Earth History	Weather & Water

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Content Curriculum Covered

- **Holt Text Book – Inside Restless Earth**
- Minerals
- Rock Cycle
- Fossil Record/Geologic Time
- Plate Tectonics/Faults and Folds
- Earthquakes
- Volcanoes
- **Foss Kit – Earth History**
- Inference
- Geology & History of the Grand Canyon/Weathering-Erosion, Mass Wasting
- Sedimentary Rocks
- Geologic Time
- Fossil Record
- Igneous and Metamorphic Rocks

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SMILE ☺

* YOU ARE IN A RESEARCH STUDY

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QUESTIONS or CONCERNS??

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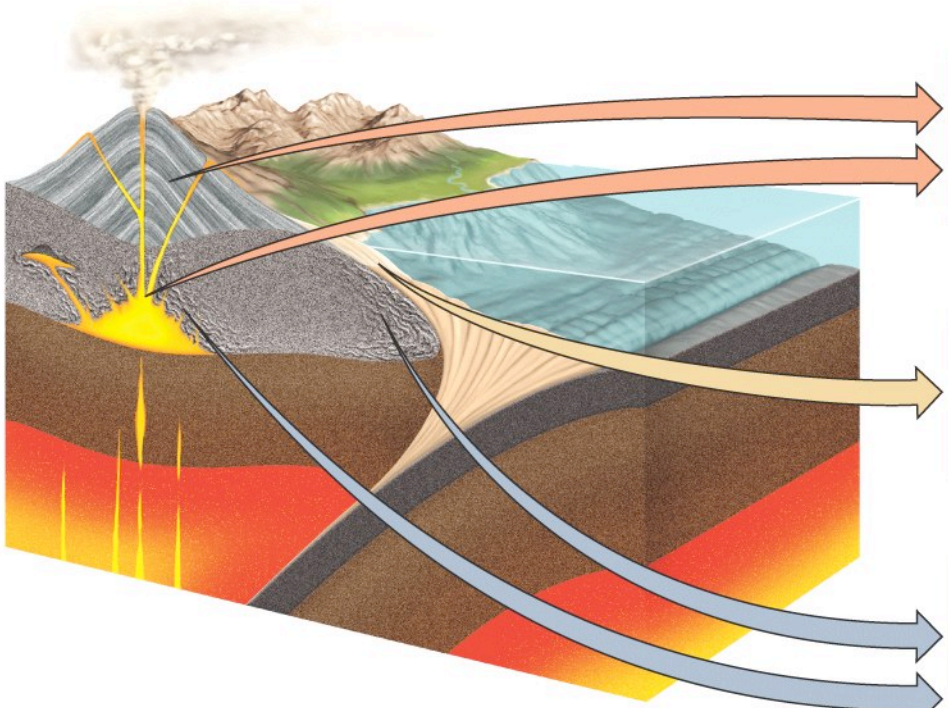
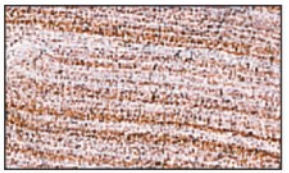
Stories in Stone

* Stories in Stone
* Take Home messages:
* Rocks are aggregates of mineral grains
* Rocks are the forensic evidence of earth history and geologists are the detectives
* The texture (the way grains are put together) and composition together allow a rock to be identified
  * Igneous rocks can be coarse grained (solidified slowly –intrusive rocks) or very fine grained for the most part (solidified quickly – volcanic rocks)
  * Volcanic rocks may be glassy instead of crystalline and the glass may be solid (obsidian), full of bubbles (pumice) or blown into fragments (ash)
  * Sedimentary rocks are mostly made of settled particles (clastic), but some are precipitated from water by inorganic or organic means
  * Clastic particles are often somewhat abraded or rounded during transport
  * Metamorphic rocks have recrstalization textures consisting of packed polyhedral grains (thermal metamorphism), aligned platy or elongate grains (thermal metamorphism with deformation), or tiny, often elongated, grains (deformation alone).
  * Minerals in igneous and metamorphic rocks depend on the temperature and pressure history and the source rock
  * Minerals in sedimentary rocks are most often resistant to weathering or the products of weathering.
*

Three Types of Rocks



Type of rock and source material	Rock-forming process	Example
IGNEOUS Melting of rocks in hot, deep crust and upper mantle	Crystallization (solidification of magma)	Coarsely crystallized granite
SEDIMENTARY Weathering and erosion of rocks exposed at surface	Deposition, burial, and lithification	 Bedded sandstone
METAMORPHIC Rocks under high temperatures and pressures in deep crust and upper mantle	Recrystallization in solid state of new minerals	Gneiss

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Modeling Shield Volcanoes

Making and Mapping a Volcano

(Original activity is from *Exploring the Moon*, a Teacher's Guide with Activities for Earth and Space Sciences, NASA Education Product EP-306 1994.)

Part 1—

Volcano Construction Experiments

About This Lesson

The focus of this activity is on the sequence of lava flows produced by multiple eruptions. Baking soda, vinegar, and play dough, are used to model fluid lava flows. Various colors of play dough identify different eruption events. Students will be asked to observe where the flows travel, make a model, and interpret the stratigraphy.

Objectives

Students will:

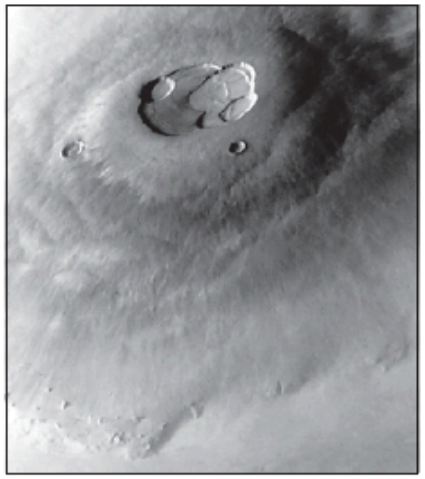
- construct a model volcano.
- follow a procedure to produce a sequence of lava flows.
- observe, draw, record, and interpret the history of the volcano.

Background

Volcanoes and/or lava flows are prominent features on all large rocky planetary bodies. Even some asteroid fragments show evidence of lava flows. Volcanism is one of the major geologic processes in the solar system. Mars has a long history of volcanic activity from the ancient volcanic areas of the southern highlands to the more recent major volcanoes of the Tharsis bulge. Olympus Mons is a volcanic mound over 20 km above the surrounding plains. This one volcano would cover the entire state of Arizona!

Where volcanic heat and water interact here on Earth, scientists are finding life. In the hot springs of Yellowstone Park they have found abundant life forms including some very small bacteria. There is a possibility that life may have found a place in the ancient volcanic terrain of Mars.

Some of the volcanoes on Mars are basaltic shield volcanoes like Earth's Hawaiian Islands. Interpretations of photographs and soil analyses from the Viking and Pathfinder missions indicate that many of the lava flows on Mars are probably basalt. Scientists believe that basalt is a very common rock type on all the large bodies of the inner solar system, including Earth.



Olympus Mons, a martian shield volcano, as seen by the Viking Orbiter.

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Playdoh Volcanoes

Playdoh Volcanoes

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Eruptive Styles and Landforms

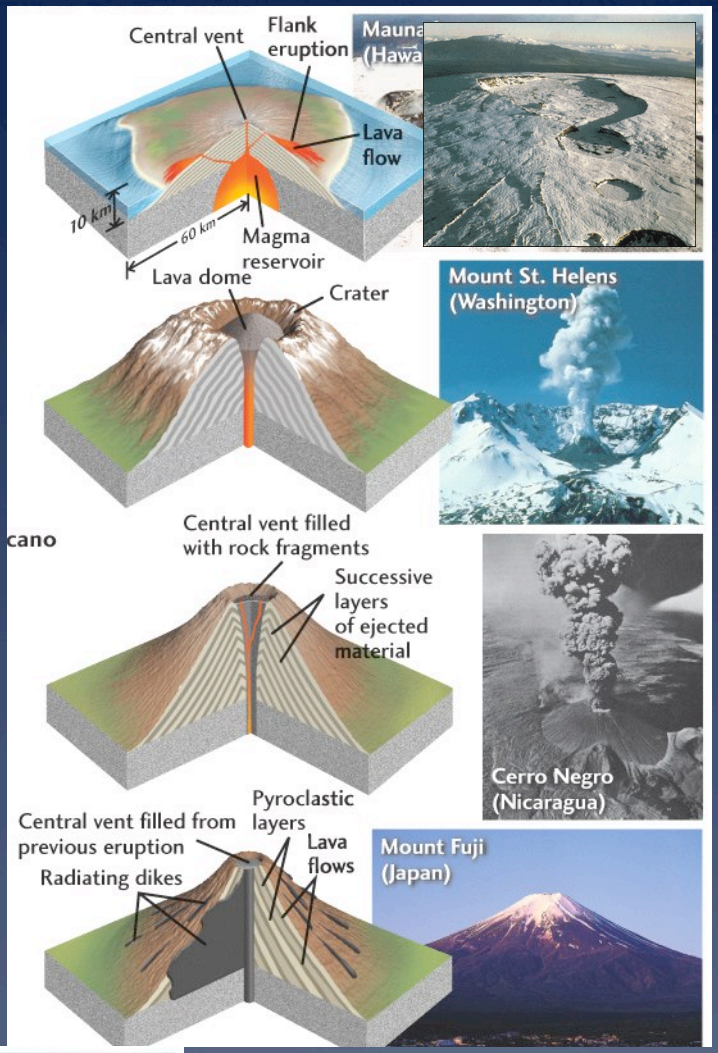
Shield Volcano

Volcanic Dome

Cinder Cone Volcano

Composite Volcano

Crater



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