

## Item 1 Volcanic Data

### Supplement 2: Scoring Rubric: Volcanic Activity Data

#### Item 1: List three types of geologic data that are used to monitor volcanoes.

*Item 1 Score Explanation: Respondents get 1 point for each data type listed up to a maximum of 3 points, using terms from the "Data Type" or "Key Terms" columns below. Responses with scores of 0 in item 1 receive a score on item 1b below.*

0	1	2	3
<b>None Correct</b> Blank OR Student declines to answer (e.g. "I don't know"/"IDK"/"No Idea"/"N/A") OR Nonverbal answer (e.g. ":("/"??") OR answer refers to NONE of the data types from the list below	<b>One Correct</b> Answer refers to ONE of the data types from the list below OR probably refers to data types but uses terms not in the list below	<b>Two Correct</b> Answer refers to TWO of the data types using terms from the list below OR probably refers to data types but uses terms not in the list below	<b>All Correct</b> Answer refers to THREE of the data types using terms from the list below

Data Type	Key Terms (spelling not important; at least one other group	Used in Module
Seismicity	Seismic; Earthquake; RSAM; Vibration; Tremor; Shaking;	Yes
Gas Emissions	Gas; Sulfur Dioxide; SO <sub>2</sub> ; Emissions; Sulfur	Yes
Tilt	Tilt; Tiltmeter; Inflation; Angle; Bulge; Swelling	Yes
GPS	GPS; Position; Global Positioning System; Geodesy; Movement;	Yes
Temperature	Temperature; Heat; Heat Flow; Thermal; Hotter; Infrared; IR; TIR	USGS Site
Hydrothermal Activity	Hydrothermal; pH; Fluid (discusses chemistry/temperature);	USGS Site
Visual	Swelling; Bulge; Inflation (similar to tilt/gps); Image analysis;	In Video
Ash	Ash	Yes

*Item 1b Score Explanation: To distinguish a blank or "IDK" response from a student who provides an incorrect explanation, scores that receive a 0 in the first coding are scored again for "1b" as follows:*

0	1
<b>No Response</b> Blank OR Student declines to answer (e.g. "I don't know"/"IDK"/"No Idea"/"N/A") OR Nonverbal answer (e.g. "-"/"??")	<b>All Incorrect/ Inappropriate</b> Answer refers to NONE of the data types from the list above

## Item 2 Volcanic Activity

### Supplement 2: Scoring Rubric: Volcanic Activity Indicators

**Item 2: For each of the three types of data you list above, describe the pattern(s) that would indicate an eruption was about to occur.**

*Item 2 Score Explanation: Respondents get 1 point for each data type listed up to a maximum of 3 points, using concepts from the "Activity Indicators" column below. Responses with scores of 0 in item 2 receive a score on item 2b below.*

0	1	2	3
<b>No Response</b> Blank OR Answer refers to NONE of the activity indicators from the list below OR Student declines to answer (e.g. "I don't know"/"IDK"/"No Idea"/"N/A") OR Nonverbal answer (e.g. ":",("/?")	<b>One Correct</b> Answer refers to ONE of the data types from Item 1 using indicators from the list below (order does not matter if student clearly states correspondence).	<b>Some Correct</b> Answer refers to TWO of the data types using indicators from the list below AND all indicators of activity are associated with data types from Item 1 (order does not matter if student clearly states correspondence).	<b>All Correct</b> Answer refers to THREE of the data types using specific indications of activity AND all indicators of activity are associated with data types from Item 1 (order does not matter if student clearly states correspondence).

Data Type	Key Terms (from item 1 list, spelling not important)	Activity Indicators
Seismicity	Seismic; Earthquake; RSAM; Vibration; Tremor; Shaking; Seismogram; Seismometer; Seismograph	Increase in (or large amount of) activity; Earthquakes become shallower (Change is not enough)
Gas Emissions	Gas; Sulfur Dioxide; SO <sub>2</sub> ; Emissions	Increase in (or large amount of) emissions; Increase in (or large amount of) emissions followed by decrease; Change in emissions
Tilt OR Visual	Tilt; Tiltmeter; Inflation; Angle; Bulge; Swelling	Tilt increases on flanks of volcano (optional: away from volcanic center; radial tilt); Inflation (Change is not enough)
GPS	GPS; Position; Global Positioning System; Geodesy; Movement; Ground deformation	Points on opposite sides of the volcano move away from each other (optional: away from volcanic center); Inflation; Line length increases; distance between GPS stations increases; changes in elevation indicate inflation (change is not enough)
Hydrothermal Activity	Hydrothermal; pH; Fluid (discusses chemistry/temperature); Water (discusses chemistry/temperature); Hydrology; Hydrogeology; Groundwater; Sulfur	Similar to gas; Increase in suspended sediment
Temperature	Temperature; Heat; Heat Flow; Thermal; Hotter	Increased heat flow or ground temperature
Ash	Ash	(Small) ash plumes

*Item 2b Score Explanation: To distinguish a blank or "IDK" response from a student who provides an incorrect explanation, scores that receive a 0 in the first coding are scored again for "2b" as follows:*

0	1
<b>No Response</b> Blank OR Student declines to answer (e.g. "I don't know"/"IDK"/"No Idea"/"N/A") OR Nonverbal answer (e.g. "-"/"?:")	<b>All Incorrect/ Inappropriate</b> Answer refers to NONE of the activity indicators from the list above

Supplement 2: Scoring Rubric: Seismic Vulnerability Characteristics

Item 3: List three characteristics of a school building and/or site of a school building that would increase or decrease that building’s vulnerability during an earthquake.

Item 3 Score Explanation: Respondents get 1 point for each chracteristic listed up to a maximum of 3 points, using terms from the "Characteristic" column below. Notes provide additional guidance. Responses with scores of 0 in item 3 receive a score on item 3b below.

0	1	2	3
No Response	One Correct	Some Correct	All Correct
Blank OR Answer refers to NONE of the characteristics from the list below OR Student declines to answer (e.g. "I don't know"/"IDK"/"No Idea"/"N/A") OR Nonverbal answer (e.g. ":("/"?"")	Answer refers to ONE of the characteristics from the list below.	Answer refers to TWO of the characteristics from the list below.	Answer refers to THREE of the characteristics from the list below.

CHARACTERISTIC	<u>I</u> Ncreased vulnerability	<u>D</u> Ecreased vulnerability
Building materials Composition of building What building is built of (including walls, foundation)	Un-reinforced masonry or concrete Rigid materials Weak, substandard, and/or damaged building materials Wood (context needs to be described)	Steel (iron)-reinforced concrete Flexible materials, links Strong building materials Wood (context needs to be described)
Slope of ground, geography	Steep slope, cliff	Shallow slope, flat ground
Architecture Design, plan, shape of building Height of building Types of building levels, stories Foundation (if refers to base of building) Infrastucture, structure Frame*	Uneven walls, profile Vertical or plan irregularity Multiple roof heights	Even walls Regular profile Similar roof heights
	No reinforcing beams, reinforcement No cross-bracing, shear walls Retrofit*	Reinforcing beams, Reinforcement Cross-bracing, shear walls
	Soft stories, open stories Empty stories (e.g. garages, auditoriums) Unsupported areas, pancaking	No soft stories no open stories
	Unyielding building	Shock absorbers Yielding building
	Unconsolidated, loose, loosely packed, soft sediment, gravel, soil Artificial fill Fractured rock Water-saturated, liquefaction, liquidify	Rock, bedrock Unfractured rock Natural sediment, dry fill, dry sediment
Composition or type of material, soil, substrate Land on which building is built Foundation (if refers to subtrate) Geology		
Secondary effects	broken gas lines, fires, landslides, tsunamis, large waves	

NOTES

Responses with \* require consultation with at least one additional group member

Respondant can list more than one item of a characteristic. E.g. vertical irregularity AND soft stories would count as two characteristics, even though both listed under "architecture"

Age of building not sufficient (i.e. "old" and/or "new" without specifics).

"Foundation" can refer to either the substrate or a component of building design, depending on context.

If terms in Item 3 are vague, can look to Item 4 for clarification but not substitution or addition of terms.

For Item 3, "cliff" or "mountain" alone is not sufficient, but needs further clarification (e.g. landslides, unstable land).

For Item 4, can use explanations from Item 3.

For Item 4, Some soils (materials, architecture, etc.) are better than others is not sufficient. Must provide an appropriate effect, mechanism and/or directionality.

Geographic proximity to water not sufficient for either Item 3 or Item 4, without further explanation (e.g. waves, tsunami, saturated sediment).

"Earthquake codes" or "regulations" alone is not sufficient without some mechanism, effect or directionality.

If something demonstrably wrong in item 3 or item 4, even if a valid characteristic is identified or a valid term is used, the error negates the characteristic or term.

Item 3b Score Explanation: To distinguish a blank or "IDK" response from a student who provides an incorrect explanation, scores that receive a 0 in the first coding are scored again for "3b" as follows:

0	1
No Response	All Incorrect/ Inappropriate
Blank OR Student declines to answer (e.g. "I don't know"/"IDK"/"No Idea"/"N/A") OR Nonverbal answer (e.g. "-"/"?"")	Answer refers to NONE of the characteristics from the list above

Supplement 2: Scoring Rubric: Seismic Vulnerability Explanation

Item 4: For each characteristic you list above, explain how that characteristic would affect the building’s vulnerability during an earthquake.

Item 4 Score Explanation: Respondents get 1 point, up to a maximum of 3 points, for each appropriately corresponding description of how each of the characteristics they list in Item 3 can either increase or decrease the vulnerability of a building (e.g. school) during an earthquake, using terms from the "INcreased" and "DEcreased" columns below. Notes provide additional guidance. Responses with scores of 0 in item 4 receive a score on item 4b below.

0	1	2	3
<b>No Response</b> Blank OR Answer refers to NONE of the increased/decreased vulnerability factors from the list below OR Student declines to answer (e.g. "I don't know"/"IDK"/"No Idea"/"N/A") OR Nonverbal answer (e.g. ":("/"?"")	<b>One Correct</b> Answer refers to ONE of the increased/decreased vulnerability factors from the list below.	<b>Some Correct</b> Answer refers to TWO of the increased/decreased vulnerability factors from the list below.	<b>All Correct</b> Answer refers to THREE of the increased/decreased vulnerability factors from the list below.

CHARACTERISTIC	<u>IN</u> creased vulnerability	<u>DE</u> creased vulnerability
<b>Building materials</b> <b>Composition of building</b> <b>What building is built of (including walls, foundation)</b>	Un-reinforced masonry or concrete Rigid materials Weak, substandard, and/or damaged building materials Wood (context needs to be described)	Steel (iron)-reinforced concrete Flexible materials, links Strong building materials Wood (context needs to be described)
<b>Slope of ground, geography</b>	Steep slope, cliff	Shallow slope, flat ground
<b>Architecture</b> <b>Design, plan, shape of bulding</b> <b>Height of building</b> <b>Types of building levels, stories</b> <b>Foundation (if refers to base of building)</b> <b>Infrastructure, structure</b> <b>Frame*</b>	Uneven walls, profile Vertical or plan irregularity Multiple roof heights	Even walls Regular profile Similar roof heights
	No reinforcing beams, reinforcement No cross-bracing, shear walls Retrofit*	Reinforcing beams, Reinforcement Cross-bracing, shear walls
	Soft stories, open stories Empty stories (e.g. garages, auditoriums) Unsupported areas, pancaking	No soft stories no open stories
	Unyielding building	Shock absorbers Yielding building
	Unconsolidated, loose, loosely packed, soft sediment, gravel, soil Artificial fill Fractured rock Water-saturated, liquefaction, liquidify	Rock, bedrock Unfractured rock Natural sediment, dry fill, dry sediment
<b>Secondary effects</b>	broken gas lines, fires, landslides, tsunamis, large waves	

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Responses with \* require consultation with at least one additional group member

Respondant can list more than one item of a characteristic. E.g. vertical irregularity AND soft stories would count as two characteristics, even though both listed under "architecture"

Age of building not sufficient (i.e. "old" and/or "new" without specifics).

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For Item 3, "cliff" or "mountain" alone is not sufficient, but needs further clarification (e.g. landslides, unstable land).

For Item 4, can use explanations from Item 3.

For Item 4, "Some soils (materials, architecture, etc.) are better than others" is not sufficient. Must provide an appropriate effect, mechanism and/or directionality.

Geographic proximity to water not sufficient for either Item 3 or Item 4, without further explanation (e.g. waves, tsunami, saturated sediment).

"Earthquake codes" or "regulations" alone is not sufficient without some mechanism, effect or directionality.

If something demonstrably wrong in Item 3 or Item 4, even if a valid characteristic is identified or a valid term is used, the error negates the characteristic or term.

Item 4b Score Explanation: To distinguish a blank or "IDK" response from a student who provides an incorrect explanation, scores that receive a 0 in the first coding are scored again for "4b" as follows:

0	1
<b>No Response</b> Blank OR Student declines to answer (e.g. "I don't know"/"IDK"/"No Idea"/"N/A") OR Nonverbal answer (e.g. "-"/"?"")	<b>All Incorrect/ Inappropriate</b> Answer refers to NONE of the increased/decreased vulnerability factors from the list above