

### GLOBE Investigation Area Concepts LINKED to GLOBE Classroom Assessments

ATMOSPHERE SCIENCE CONCEPTS	Primary	Elementary	Middle School	High School	Protocol Tests	NCTM activities	NCTE activities
1. Composition of the atmosphere; human influences on changes in the Earth's atmosphere							
2. Cloud formation (including water cycle) and identification	√	√					
3. Clouds can be used to forecast / predict the weather	√	√	√	√			
4. Clouds can have a cooling/warming effect; effects of wind	√	√	√	√			
5. Earth's heat transfer is influenced by movement of water in the atmosphere							
6. Density (of rain, snow)							
7. Change of state; energy changes and changes in state; heat capacity					3		e m h
8. Acids, bases, pH, pH measurement, buffers; acid precipitation and its effects							
9. Heat and temperature					2	e m h	m h
10. Heat transfer through radiation, conduction, and convection;							
11. Different substances transfer energy and heat at different rates; some materials are good conductors, some are good insulators							
12. Substances expand and contract as the temperature changes; coefficient of expansion							
13. Classification helps us organize and understand the natural world.	√						
14. Models and simulations allow you to: study a process or phenomenon that would be difficult to study in other ways; compare the predicted values (using the model) and the measured values; modify input parameters in order to predict realistic changes in output.							

1 = Rainfall

e = elem

2 = Air Temp.

m = m.s.

3 = Solid Ppt.

h = h.s.

## GLOBE Investigation Area Concepts LINKED to GLOBE Classroom Assessments

HYDROLOGY SCIENCE CONCEPTS	Middle School	High School	Protocol Tests	NCTM activities	NCTE activities
1. Surface water exists in many forms and has many observable characteristics, such as temperature, color, smell, flow and shape.	√	√			e h
2. Water characteristics are closely related to the characteristics of the surrounding land.					
3. Water moves from one location to another (including the hydrologic cycle); moving water erodes the land.					
4. The nature of a watershed is determined by the physical features of the land.					
5. A watershed guides all precipitation and run off to a common watercourse or body of water.					
6. Human activities (including land development) affects water sources and the watershed					
7. Each organism has a range of water characteristics needed for survival which dictate its adaptability to a changing environment.	√	√			m
8. Macro-invertebrates are sensitive indicators of water quality.					
9. Water transparency and its affects on the growth of photosynthetic plants.					
10. Water chemistry is an important aspect of habitat requirements and affects species diversity and annual survivability.	√	√			m
11. Water quality can be described using measurements that include temperature, dissolved oxygen, pH, salinity	√	√			e m h
12. Acids, bases, pH, pH measurement, buffers; the effect of acid rain, acid lakes and acid streams			1	e m h	
13. The role of water in chemical reactions; solutions, solvents, suspensions					
14. Temperature, heat, heat transfer			2		
15. Electrical resistance, conductivity, factors affecting conductivity					
16. Dissolved solids in water including: salinity, alkalinity, nitrates					
17. Dissolved oxygen and factors that affect dissolved oxygen in water					
18. Specific gravity					
19. High and low tides					
20. Models and simulations allow you to: study a process or phenomenon that would be difficult to study in other ways; compare the predicted values (using the model) and the measured values; modify input parameters in order to predict realistic changes in output.					
21. A map is a symbolic representation of a certain land area.					
22. Topographical maps provide 3-dimensional information about the land.					
23. Classification helps us organize and understand the natural world.					

1 = pH  
2 = water temp

e = elem  
m = m.s.  
h = h.s.

## GLOBE Investigation Area Concepts LINKED to GLOBE Classroom Assessments

SOILS SCIENCE CONCEPTS	High School	Protocol Tests	NCTM activities	NCTE activities
1. Soil is composed of minerals, organic matter and open spaces.				
2. Soils vary within a small local area; soil properties change over time.				e m h
3. There are many soil types including sand, silt, clay and loam				
4. Soil can be classified according to its properties and a soil profile-(horizon, color, texture, root distribution, pH of soil, particle size distribution, texture)				
5. Soil properties are related to soil forming factors including: moisture content, temperature, land use, organisms, general climate, parent material and topography	√	1, 2	e m h	e m
6. Soils hold moisture; soil properties affect flow rate, water holding capacity, nutrient filtering ability			e m h	e m
7. Infiltration is the rate at which water flows into the ground; the rate changes depending on the level of soil saturation; soil water content varies around the world.			e m h	
8. Decomposition in soil depends upon different environmental conditions.				
9. Soil fertility is a measure of stored nutrients (esp. N, P, K)				
10. Soil is an important building material.				
11. Different substances transfer energy and heat at different rates; some materials are good conductors, some are good insulators; soil is an insulating layer				
12. Acids, bases, pH, pH measurement, buffers				
13. Chemical reactions				
14. Specific gravity				
15. Density; bulk density				
16. Solutions, suspensions, particle size distribution, Stokes Law				
17. Electrical resistance				
18. Models and simulations allow you to: study a process or phenomenon that would be difficult to study in other ways; compare the predicted values (using the model) and the measured values; modify input parameters in order to predict realistic changes in output.				

1 = soil temp.  
2 = soil moisture

e = elem  
m = m.s.  
h = h.s.

## GLOBE Investigation Area Concepts LINKED to GLOBE Classroom Assessments

LAND COVER SCIENCE CONCEPTS	Middle School	High School	Protocol Tests	NCTM activities	NCTE activities
1. Earth systems have inputs including: sun's energy, water, carbon dioxide, oxygen, dust; and outputs including: water, carbon dioxide, oxygen, heat.	√	√			
2. Earth system science studies the interactions of the atmosphere (air), hydrosphere (water), geosphere (land), biosphere (living organisms) and cryosphere (ice masses).	√	√			
3. System boundaries differ depending upon the question your study is asking.					
4. The GLOBE Study Site is a system with energy-, water- and C, N, S, O and P biochemical cycles, and elements such as trees, water, soil, rocks, and animals.	√	√			
5. Characteristics of the GLOBE Study Site include: pixel Size, canopy cover, ground cover, tree height and circumference, grass biomass, dominant and co-dominant species, GPS location, field measurements/biometry	√	√	5, 6, 8	e m h	e m h
6. Biometry is the measurement of ground sites dominated by vegetation.			1,2,3,4,5,6		
7. Landcover can be divided into the study of the canopy and the study of ground cover			1,2,3,4,5,6,7	e h	
8. Most of the Earth's surface is covered by naturally vegetated ecosystems which evolved in response to local geographic and climatic conditions.	√	√			
9. Plants absorb and cycle nutrients and water.					
10. Plants form the basic foundation of food chains.					
11. Plants and animals have specialized body parts adapted to living in a particular environment and are affected when land cover types change.					
12. Humans have extensively modified and replaced natural vegetation and type of land cover					
13. Classification helps us organize and understand the natural world; dichotomous keys can be used to classify living organisms.			1, 4, 5	m	
14. Magnetism, magnets, magnetic compasses					
15. The field of view is the area your eye or camera's eye can perceive; it increases the higher the eye is relative to the ground.					
16. Student remote sensing involves observations made without touch i.e. using eyes, ears, nose and skin surface					
17. Satellite remote sensing uses cameras sensitive to different wavelengths.					
18. Thermal radiation photography uses sensors to read the amount of heat radiated by an object; then interpret and digitize the information into a code.					
19. Image display is accomplished by conversion of stored data to a user-defined by color-coded image and creating a picture based on differences in the reflectance of light.					
20. Models and simulations allow you to: study a process or phenomenon that would be difficult to study in other ways; compare the predicted values (using the model) and the measured values; modify input parameters in order to predict realistic changes in output.					
21. Maps are symbolic representations of land areas.			2	m	

1 = MUC      2 = Cluster      3 = Field Study      e = elem  
 4 = Biometry      5 = Trees      6 = Biomass      m = m.s.  
 7 = Densiometer      8 = Clinometer      9 = Compass      h = h.s.

## GLOBE Investigation Area Concepts LINKED to GLOBE Classroom Assessments

<b>SEASONS (Earth Systems: Phenology) SCIENCE CONCEPTS</b>	Primary	Elementary		Middle School	High School	Protocol Tests	NCTM activities	NCTE activities
1. Earth systems have inputs including: sun's energy, water, carbon dioxide, oxygen, dust; and outputs including: water, carbon dioxide, oxygen, heat.								
2. System boundaries differ depending upon the question your study is asking.								
3. The Earth's axis of rotation is inclined with respect to the plane of its orbit around the sun; this causes seasonal changes that are driven by changes in the amount of the sun's energy reaching the Earth's surface.								
4. Sun – Earth seasonal relationships (solstice, equinox)								
5. Seasons have distinct characteristics.	√	√	√	√	√			
6. Seasonal changes demonstrate the interconnections among Earth's systems.			√					
7. Seasonal patterns differ based on geographic locations.	√	√	√	√	√			
8. Seasonal changes follow an annual cycle which can change from year to year.								<b>h</b>
9. Seasonal temperature cycles vary.	√	√	√	√	√			
10. Seasonal patterns are influenced by latitude, elevation and geography.		√	√	√	√			
11. Seasonal changes impact the atmosphere, ecology (plant and animal adaptations), the soil and the hydrologic cycle		√	√	√	√			
12. Bud-break is the period in spring when leaf buds appear and grow.	√	√	√	√	√			<b>e m</b>
13. Senescence is the period in the fall when actively growing plant material dies.		√		√	√			<b>e m</b>
14. The Earth has many climate zones: polar, tropical, temperate, continental & marine.								
15. The amount of precipitation is affected by the amount of water vapor in the air and the temperature.								
16. The rising of heated air & sinking of cooled air drives atmospheric convection cells.								
17. Current weather conditions affect regional and global temperature patterns.								
18. Classification helps us organize and understand the natural world.								
19. Models and simulations allow you to: study a process or phenomenon that would be difficult to study in other ways; compare the predicted values (using the model) and the measured values; modify input parameters in order to predict realistic changes in output.								
20. Maps are symbolic representations of land areas.								

e = elem  
m = m.s.  
h = h.s.

## GLOBE Investigation Area Concepts LINKED to GLOBE Classroom Assessments

GPS SCIENCE CONCEPTS	NCTM activities
1. A map is a symbolic representation of a certain land area; latitude and longitude are used to map locations.	
2. Latitude and longitude can be measured indirectly using mathematical calculations that compare it to a nearby location whose latitude and longitude are known.	
3. The spatial relationship between Earth and celestial objects can be used to determine location on Earth; time and sun angle measurements can be used to determine the differences in latitude and longitude between two locations	<b>m</b>
4. The Global Positioning System (GPS) consists of a series of satellites, their ground control stations and users with GPS receivers; GPS receivers measure latitude and longitude with an accuracy of 30 meters using angles measured in degrees and minutes.	
5. Levels of measurement include mathematical techniques to determine the degree of accuracy of the measurement.	<b>m* h*</b>
6. Speed of sound	
7. Local time vs. Universal time	
8. Formation of shadows	
9. Magnetism, magnets and magnetic compasses; the Earth has a magnetic field; and magnetic variations	
10. Sun – Earth seasonal relationships (solstice, equinox)	
11. Sun – Earth daily relationships	
12. Relative and absolute direction	

m = middle school

m\* = middle school NCTM activities found in Hydrology, Soils and LandCover

h\* = high school NCTM activities found in Hydrology, Soils and LandCover

**GLOBE Inquiry Concepts LINKED to GLOBE Classroom Assessments**

ATMOSPHERE Inquiry Concepts	Primary	Elementary	Middle School	High School	Protocol Tests	NCTM activities	NCTE activities
1. Students set up a new, appropriate problem/application			√	√			
2. Students design an experiment							
3. Students specify measurements/variables to investigate							
4. Students pose relevant questions			√	√			
5. Observations and measurements are accurate and appropriate	√	√	√	√	1 2 3	e m h	
6. Equipment is used properly					1 2 3		
7. Measurement Quality - Errors are detected			√	√	1 2 3		
8. Measurement Quality - Quality assurance procedures are employed (multiple, repeated readings, re-calibration)			√	√	1 2 3		
9. Identify data components			√	√			
10. Identify similarities and differences	√						e m h
11. Explain reasons for differences							
12. Use appropriate mathematical procedures		√	√	√	1 3	e m h	e m h
13. Infer patterns, trends	√	√	√	√			e m h
14. Explain data and relationships	√	√	√	√			
15. Create multiple formats for representing data		√	√	√			e m h
16. Compose informal and informal discourse to inform, explain, persuade	√	√	√	√			e m h
17. Create and make presentations of key conclusions and findings	√		√	√			

1 = rainfall

e = elem

2 = air temp  
3 = solid ppt.

m = m.s.  
h = h.s.

### GLOBE Inquiry Concepts LINKED to GLOBE Classroom Assessments

HYDROLOGY Inquiry Concepts	Middle School	High School		Protocol Tests	NCTM activities	NCTE activities
1. Students set up a new, appropriate problem/application	√	√	√			
2. Students design an experiment						
3. Students specify measurements/variables to investigate						
4. Students pose relevant questions	√	√	√			
5. Observations and measurements are accurate and appropriate				1 2	e m h	
6. Equipment is used properly				1 2		
7. Measurement Quality - Errors are detected	√	√	√	1 2	h	
8. Measurement Quality - Quality assurance procedures are employed (multiple, repeated readings, re-calibration)				1 2	e m h	h
9. Identify data components						
10. Identify similarities and differences						m h
11. Explain reasons for differences						h
12. Use appropriate mathematical procedures				2	e m h	
13. Infer patterns, trends	√	√	√			e m h
14. Explain data and relationships	√	√	√		h	h
15. Create multiple formats for representing data	√	√	√			e m h
16. Compose informal and informal discourse to inform, explain, persuade	√	√	√			e m h
17. Create and make presentations of key conclusions and findings						

1 = pH  
2 = water temp.

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### GLOBE Inquiry Concepts LINKED to GLOBE Classroom Assessments

SOIL Inquiry Concepts	High School	NCTM activities	NCTE activities
1. Students set up a new, appropriate problem/application	√		
2. Students design an experiment			
3. Students specify measurements/variables to investigate			
4. Students pose relevant questions			
5. Observations and measurements are accurate and appropriate		e m h	e m h
6. Equipment is used properly			
7. Measurement Quality - Errors are detected	√	m h	e m h
8. Measurement Quality - Quality assurance procedures are employed (multiple, repeated readings, re-calibration)		e m h	e m h
9. Identify data components			
10. Identify similarities and differences			e m h
11. Explain reasons for differences			e m h
12. Use appropriate mathematical procedures		e m h	e m h
13. Infer patterns, trends	√		e m h
14. Explain data and relationships	√		e m h
15. Create multiple formats for representing data	√		e m h
16. Compose informal and informal discourse to inform, explain, persuade	√		e m h
17. Create and make presentations of key conclusions and findings			

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### GLOBE Inquiry Concepts LINKED to GLOBE Classroom Assessments

LAND COVER Inquiry Concepts	Middle School	High School	Protocol Tests	NCTM activities	NCTE activities
1. Students set up a new, appropriate problem/application	√	√		m	
2. Students design an experiment					
3. Students specify measurements/variables to investigate				m	
4. Students pose relevant questions	√	√	√		
5. Observations and measurements are accurate and appropriate			1,3,4,5,6,7,8,9	m h	m
6. Equipment is used properly			3, 4, 5, 7, 8, 9		
7. Measurement Quality - Errors are detected	√	√	√		
8. Measurement Quality - Quality assurance procedures are employed (multiple, repeated readings, re-calibration)			3, 5, 6, 8, 9	e m h	
9. Identify data components	√	√	√		
10. Identify similarities and differences	√		√	1, 4, 5	m
11. Explain reasons for differences					e
12. Use appropriate mathematical procedures			3, 5, 6, 8	e m h	e
13. Infer patterns, trends	√	√		1, 4, 6	e m
14. Explain data and relationships			√	m	
15. Create multiple formats for representing data	√	√	√	2, 4	e m h
16. Compose informal and informal discourse to inform, explain, persuade	√	√	√		e m h
17. Create and make presentations of key conclusions and findings					

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### GLOBE Inquiry Concepts LINKED to GLOBE Classroom Assessments

SEASONS Inquiry Concepts	Primary	Elementary		Middle School	High School	NCTM activities	NCTE activities
1. Students set up a new, appropriate problem/application							
2. Students design an experiment							
3. Students specify measurements/variables to investigate		√		√	√		
4. Students pose relevant questions		√		√	√		
5. Observations and measurements are accurate and appropriate	√		√				
6. Equipment is used properly							
7. Measurement Quality - Errors are detected				√	√		
8. Measurement Quality - Quality assurance procedures are employed (multiple, repeated readings, re-calibration)							
9. Identify data components							
10. Identify similarities and differences	√	√		√	√		h
11. Explain reasons for differences							
12. Use appropriate mathematical procedures						e h	
13. Infer patterns, trends	√	√	√	√	√		h
14. Explain data and relationships		√		√	√		
15. Create multiple formats for representing data			√				
16. Compose informal and informal discourse to inform, explain, persuade	√	√	√	√	√		e m h
17. Create and make presentations of key conclusions and findings							

e = elem  
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### GLOBE Inquiry Concepts LINKED to GLOBE Classroom Assessments

GPS Inquiry Concepts	Primary	Elementary	Middle School	High School	Protocol Tests	NCTM activities	NCTE activities
1. Students set up a new, appropriate problem/application	NONE						
2. Students design an experiment							
3. Students specify measurements/variables to investigate							
4. Students pose relevant questions							
5. Observations and measurements are accurate and appropriate							
6. Equipment is used properly							
7. Measurement Quality - Errors are detected							
8. Measurement Quality - Quality assurance procedures are employed (multiple, repeated readings, re-calibration)							
9. Identify data components							
10. Identify similarities and differences							
11. Explain reasons for differences							
12. Use appropriate mathematical procedures							
13. Infer patterns, trends							
14. Explain data and relationships							
15. Create multiple formats for representing data							
16. Compose informal and informal discourse to inform, explain, persuade							
17. Create and make presentations of key conclusions and findings							