

GLOBE Key Concepts – Chapter by Protocol

GLOBE Key Concepts - Atmosphere	Cloud Type	Cloud Cover	Rainfall	Solid Ppt.	Precipitation Acids, bases, pH, pH measurement, buffers	Max, Min and Current Temp
1. Composition of the atmosphere; human influences on changes in the Earth's atmosphere						
2. Cloud formation (including water cycle) and identification	X	X	X	X		
3. Clouds can be used to forecast / predict the weather						
4. Clouds have a cooling/warming effect; effects of wind			X	X		
5. Earth's heat transfer is influenced by movement of water in the atmosphere						
6. Density (of rain, snow)				X		
7. Change of state; energy changes and changes in state; heat capacity				X		
8. Acids, bases, pH, pH measurement, buffers, buffers; acid precipitation and its effects					X	
9. Heat and temperature						
10. Heat transfer through radiation, conduction, and convection						X
11. Different substances transfer energy and heat at different rates; some materials are good conductors, some are good insulators						X
12. Substances expand and contract as the temperature changes; coefficient of expansion						X
13. Classification helps us organize and understand the natural world.	X	X				
14. Models 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.						

GLOBE Key Concepts – Chapter by Protocol

GLOBE Key Concepts - HYDROLOGY	Collecting Your Water Sample	Water Transparency	Water Temperature	Dissolved Oxygen	Acids, bases, pH, pH measurement, buffers	Electrical Conductivity	Salinity	Optional Salinity	Alkalinity	Nitrate
1. Surface water exists in many forms and has many observable characteristics, such as temperature, color, smell, flow and shape.										
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										

GLOBE Key Concepts – Chapter by Protocol

GLOBE Key Concepts - HYDROLOGY	Collecting Your Water Sample	Water Transparency	Water Temperature	Dissolved Oxygen	Acids, bases, pH, pH measurement, buffers	Electrical Conductivity	Salinity	Optional Salinity	Alkalinity	Nitrate
7. Each organism has a range of water characteristics needed for survival and dictate its adaptability to a changing environment.										
8. Macro-invertebrates are sensitive indicators of water quality.										
9. Water transparency and its affects on the growth of photosynthetic plants.		X								
10. Water chemistry is an important aspect of habitat requirements and affects species diversity and annual survivability.										
11. Water quality can be described using measurements that include temperature, dissolved oxygen, Acids, bases, pH, pH measurement, buffers, salinity		X	X	X	X	X	X	X	X	X

GLOBE Key Concepts – Chapter by Protocol

GLOBE Key Concepts - HYDROLOGY	Collecting Your Water Sample	Water Transparency	Water Temperature	Dissolved Oxygen	Acids, bases, pH, pH measurement, buffers	Electrical Conductivity	Salinity	Optional Salinity	Alkalinity	Nitrate
12. Acids, bases, pH, pH measurement, buffers; the effect of acid rain, acid lakes and acid streams					X					
13. The role of water in chemical reactions; solutions, solvents, suspensions										
14. Temperature, heat, heat transfer			X							
15. Electrical resistance, conductivity, factors affecting conductivity						X				
16. Dissolved solids in water including: salinity, alkalinity, nitrates							X	X	X	X
17. Dissolved oxygen and factors that affect dissolved oxygen in water				X						
18. Specific gravity							X			
19. High and low tides							X	X		

GLOBE Key Concepts – Chapter by Protocol

GLOBE Key Concepts - HYDROLOGY	Collecting Your Water Sample	Water Transparency	Water Temperature	Dissolved Oxygen	Acids, bases, pH, pH measurement, buffers	Electrical Conductivity	Salinity	Optional Salinity	Alkalinity	Nitrate
20. Models 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.										

GLOBE Key Concepts – Chapter by Protocol

GLOBE Key Concepts - SOILS	Field Measurements	Lab Measurements	Soil Moisture & Temperature	Gravimetric Soil Moisture	Optional Gypsum Block Soil Moisture	Infiltration	Soil Temperature
1. Soil is composed of minerals, organic matter and open spaces.							
2. Soils vary within a small local area; soil properties change over time.							
3. There are many soil types including sand, silt, clay and loam.	X						
4. Soil can be classified according to its properties and soil profile (horizon, color, texture, root distribution, pH of soil, particle size distribution)	X						
5. Soil properties are related to soil forming factors including: moisture content, temperature, land use, organisms, general climate, parent material and topography	X						
6. Soils hold moisture; soil properties affect flow rate, water holding capacity, nutrient filtering ability			X	X	X	X	
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.						X	
8. Decomposition in soil depends upon different environmental conditions.							
9. Soil fertility is a measure of stored nutrients (esp. N, P, K)		X					
10. Soil is an important building material.							

GLOBE Key Concepts – Chapter by Protocol

GLOBE Key Concepts - SOILS	Field Measurements	Lab Measurements	Soil Moisture & Temperature	Gravimetric Soil Moisture	Optional Gypsum Block Soil Moisture	Infiltration	Soil Temperature
11. Different substances transfer energy and heat at different rates; some materials are good conductors, some are good insulators; soil is an insulating layer							X
12. Acids, bases, pH, pH measurement, buffers		X					
13. Chemical reactions		X					
14. Specific gravity		X					
15. Density; bulk density	X	X					
16. Solutions, suspensions, particle size distribution, Stokes Law		X					
17. Electrical resistance					X		
18. Models 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.							

GLOBE Key Concepts – Chapter by Protocol

GLOBE Key Concepts - LAND COVER	Qualitative Land Cover sample site	Quantitative Land Cover sample site	Biometry	MUC System	Manual Interpretation Land Cover Mapping	Unsupervised Clustering Land Cover Mapping	Accuracy Assessment
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, O, and P biogeochemical cycles and elements such as trees, water, soil, rocks, and animals.	X	X	X	X	X	X	X
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	X	X	X	X	X	X	X
6. Biometry is the measurement of ground sites dominated by vegetation.	X	X	X	X	X	X	
7. Landcover can be divided into the study of the canopy and the study of ground cover	X	X	X	X	X	X	
8. Most of the Earth's surface is covered by naturally vegetated ecosystems which evolved in response to local geographic and climatic conditions.	X	X	X				
9. Plants absorb and cycle nutrients and water.			X				
10. Plants form the basic foundation of food chains.							

GLOBE Key Concepts – Chapter by Protocol

GLOBE Key Concepts - LAND COVER	Qualitative Land Cover sample site	Quantitative Land Cover sample site	Biometry	MUC System	Manual Interpretation Land Cover Mapping	Unsupervised Clustering Land Cover Mapping	Accuracy Assessment
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.	X	X	X	X	X	X	X
14. Magnetism, magnets, magnetic compasses	X						
15. A map is a symbolic representation of a certain land area.	X	X	X	X	X	X	X
16. 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.							
17. Student remote sensing involves observations made without the use of touch i.e. using eyes, ears, nose and skin surface							
18. Satellite remote sensing uses cameras sensitive to different wavelengths.					X	X	X
19. Thermal radiation photography uses sensors to read the amount of heat radiated by an object; then interpret and digitize the information into a code.					X	X	X
20. 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.					X	X	

GLOBE Key Concepts – Chapter by Protocol

GLOBE Key Concepts - LAND COVER	Qualitative Land Cover sample site	Quantitative Land Cover sample site	Biometry	MUC System	Manual Interpretation Land Cover Mapping	Unsupervised Clustering Land Cover Mapping	Accuracy Assessment
21. Models 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.					X	X	X

GLOBE Key Concepts – Chapter by Protocol

GLOBE Key Concepts - SEASONS	no protocols in the Seasons Investigation Area	Some like it hot! (LandCover)
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 its orbital plane around the sun; this causes seasonal changes 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.	X	
7. Seasonal patterns differ based on geographic locations.	X	
8. Seasonal changes follow an annual cycle which can change from year to year.		
9. Seasonal temperature cycles vary.	X	
10. Seasonal patterns are influenced by latitude, elevation and geography.		
11. Seasonal changes impact the atmosphere, ecology, the soil and the hydrologic cycle		
12. Bud-break is the period in spring when leaf buds appear and grow.		
13. Senescence is the period in the fall when actively growing plant material dies.		
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.		

GLOBE Key Concepts – Chapter by Protocol

<p style="text-align: center;">GLOBE Key Concepts - SEASONS</p>	<p>no protocols in the Seasons Investigation Area</p>	<p>Some like it hot! (LandCover)</p>
<p>20. A map is a symbolic representation of a certain land area.</p>		

GLOBE Key Concepts – Chapter by Protocol

GLOBE Key Concepts - GPS	Basic GPS measurement	Offset GPS measurement
1. A map is a symbolic representation of a certain land area; latitude and longitude are used to map locations.	X	X
2. Latitude and longitude can be measured indirectly using mathematical calculations that compare it to a nearby location whose latitude and longitude are known.		X
3. The spatial relationship between Earth and celestial objects can be used to determine location on Earth; time & sun angle measurements can be used to determine the differences in latitude and longitude between two locations.		
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.	X	X
5. Levels of measurement include mathematical techniques to determine the degree of accuracy of the measurement.		
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; magnetic variations		
10. Sun – Earth seasonal relationships (solstice, equinox)		X
11. Sun – Earth daily relationships		
12. Relative and absolute direction		

GLOBE Inquiry Concepts – Chapter by Protocol

Inquiry Concepts within the ATMOSPHERE Investigation Area	Cloud Type	Cloud Cover	Rainfall	Solid Precipitation	Precipitation Acids, bases, pH, pH measurement, buffers	Max, Min and Current Temp
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	X	X	X	X	X	X
6. Equipment is used properly			X	X	X	X
7. Measurement Quality - Errors are detected			X	X	X	X
8. Measurement Quality - Quality assurance procedures are employed (multiple, repeated readings, re-calibration)	X		X	X	X	X
9. Identify data components						
10. Identify similarities and differences	X					
11. Explain reasons for differences						
12. Use appropriate mathematical procedures		X	X	X		X
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						

GLOBE Inquiry Concepts – Chapter by Protocol

Inquiry Concepts within the HYDROLOGY Investigation Area	Collecting Your Water Sample	Water Transparency	Water Temperature	Dissolved Oxygen	Acids, bases, pH, pH measurement, buffers	Electrical Conductivity	Salinity	Optional Salinity	Alkalinity	Nitrate
1. Students set up a new, appropriate problem/application								X		X
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	X	X	X	X	X	X	X	X	X	X
6. Equipment is used properly	X	X	X	X	X	X	X	X	X	X
7. Measurement Quality - Errors are detected	X	X	X	X	X	X	X	X	X	X
8. Measurement Quality - Quality assurance procedures are employed (multiple, repeated readings, re-calibration)	X	X	X	X	X	X	X	X	X	X
9. Identify data components				X			X			
10. Identify similarities and differences		X		X						

GLOBE Inquiry Concepts – Chapter by Protocol

Inquiry Concepts within the HYDROLOGY Investigation Area	Collecting Your Water Sample	Water Transparency	Water Temperature	Dissolved Oxygen	Acids, bases, pH, pH measurement, buffers	Electrical Conductivity	Salinity	Optional Salinity	Alkalinity	Nitrate
11. Explain reasons for differences										
12. Use appropriate mathematical procedures			X	X	X	X	X	X	X	X
13. Infer patterns, trends		X								
14. Explain data and relationships		X								
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										

GLOBE Inquiry Concepts – Chapter by Protocol

Inquiry Concepts within the SOILS Investigation Area	Field Measurements	Lab Analysis	Soil Moisture & Temperature	Gravimetric Soil Moisture	Optional Gypsum Block Soil Moisture	Infiltration	Soil Temperature
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	X	X	X	X	X	X	X
6. Equipment is used properly	X	X	X	X			X
7. Measurement Quality - Errors are detected	X	X		X	X	X	
8. Measurement Quality - Quality assurance procedures are employed (multiple, repeated readings, re-calibration)	X	X		X	X	X	
9. Identify data components	X					X	
10. Identify similarities and differences	X			X			
11. Explain reasons for differences							
12. Use appropriate mathematical procedures	X	X		X		X	
13. Infer patterns, trends	X			X			
14. Explain data and relationships							
15. Create multiple formats for representing data	X				X		
16. Compose informal and informal discourse to inform, explain, persuade							
17. Create and make presentations of key conclusions and findings							

GLOBE Inquiry Concepts – Chapter by Protocol

Inquiry Concepts within the LAND COVER Investigation Area	Qualitative Land Cover sample site	Quantitative Land Cover sample site	Biometry	MUC System	Manual Interpretation Land Cover Mapping	Unsupervised Clustering Land Cover Mapping	Accuracy Assessment
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	X	X	X	X	X	X	
6. Equipment is used properly	X	X	X	X	X	X	
7. Measurement Quality - Errors are detected	X	X	X	X	X		X
8. Measurement Quality - Quality assurance procedures are employed (multiple, repeated readings, re-calibration)	X	X	X	X	X		X
9. Identify data components			X	X			
10. Identify similarities and differences	X	X	X	X	X	X	X
11. Explain reasons for differences							
12. Use appropriate mathematical procedures	X	X	X	X			X
13. Infer patterns, trends	X	X	X	X	X	X	X
14. Explain data and relationships							X
15. Create multiple formats for representing data					X	X	X
16. Compose informal and informal discourse to inform, explain, persuade							
17. Create and make presentations of key conclusions and findings							

GLOBE Inquiry Concepts – Chapter by Protocol

Inquiry Concepts within the SEASONS Investigation Area	no protocols in the Seasons Investigation Area
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	
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	

GLOBE Inquiry Concepts – Chapter by Protocol

Inquiry Concepts within the GPS Investigation Area	Basic GPS measurement	Offset GPS measurement
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	X	X
6. Equipment is used properly	X	X
7. Measurement Quality - Errors are detected	X	X
8. Measurement Quality - Quality assurance procedures are employed (multiple, repeated readings, re-calibration)	X	X
9. Identify data components		
10. Identify similarities and differences		
11. Explain reasons for differences		
12. Use appropriate mathematical procedures		X
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		