The Seasons and Biomes Project

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Scientists and teachers collaborate to bring inquiry-based science education to K-12 students

People the world over experience the changing seasons. The shortening and lengthening of the days, the changing air temperatures, and the growth and decay of plants are all part of the seasonal cycle. And they can all be described and measured by school-aged children.

The *Seasons and Biomes Project* (*S&B*) is an inquiry- and project-based initiative designed to increase K-12 students' understanding of the Earth system. Students do this by describing and monitoring their study sites throughout the school year and observing and documenting the seasonal indicators where they live. By collecting and analyzing their own data, they become engaged in their local environment and begin to appreciate the complex web of connections that make up the natural world.

Through the GLOBE database, students have the opportunity to compare their sites with others in similar climate/vegetation zones (biomes) and beyond. This allows them to make connections, and begin to understand the environment, on regional and global scales. As data accumulate over the years, students will also have the opportunity to understand the inter-annual variability of the seasons in their area and to identify any long-term trends.

Scientists and educators have developed a number of *S&B* protocols and learning activities. The protocols provide instructions for doing the field observations and measurements. They also contain background information to help teachers with the scientific content. The learning activities help to explain, and elaborate on, the scientific concepts and ideas that underpin the protocols and the field data analysis and interpretation. These learning activities are designed to help students *explore* these ideas and concepts rather than just memorize information.

There is no right way to set up a student study site – each location is unique and resources vary from school-to-school. Teachers and students decide for themselves what they will study (what questions they want to answer) and how they will do it (which protocols they will use). As they describe and monitor their site, the students practice basic science process skills such as quantitative and qualitative observation, inference, measurement, prediction, classification, data collection, analysis, and interpretation, and designing and carrying out an investigation (*adapted from* GLOBE Teacher's Guide).

The GLOBE Program

(http://www.globe.gov/)

The Global Learning and Observation to Benefit the Environment (GLOBE) program is a worldwide hands-on, primary and secondary school-based science and education program.

For students, GLOBE provides the opportunity to:

- *Collect scientific data on their local environment focused on the atmosphere, water, soil and land cover*
- *Share collected data with others via the internet*
- *Publish the results from student-driven research projects*
- *Create maps and graphs of GLOBE data on the GLOBE website*
- *Collaborate with other GLOBE students and scientists around the world*

For teachers, GLOBE provides:

- *Training at professional development workshops*
- *Teacher's Guide, "how-to" videos and curriculum materials*
- *Continuing support from a Help Desk, scientists and partners*
- *Interactive contact with other teachers, students and scientists worldwide.*

Seasons and Biomes Project Conceptual Framework

EARTH SYSTEM SCIENCE

Understanding Earth as a system requires a quantitative exploration of the connections among all parts (atmosphere, hydrosphere, lithosphere and biosphere) of the system (*from* GLOBE Teacher's Guide).

The ***GLOBE Earth System Poster (Exploring connections in a typical year (1987))*** contains global data on: Solar Energy, Average Temperature, Cloud Cover, Precipitation, Soil Moisture and Vegetation for the months January, March, May, July, September and November.

The ***GLOBE Earth System Poster (Exploring connections in year 2007)*** contains global data on: Insolation, Surface Temperature, Cloud Fraction, Precipitation, Aerosols and Biosphere for the months January, March, May, July, September and November.

THE SEASONS and BIOMES PROJECT

Students investigate the causes of seasons and their impact on the Earth system.

SEASONS can be defined as the four periods of the year (spring, summer, autumn, and winter), beginning astronomically at an equinox or solstice, but geographically at different dates in different climates and/or a period of the year characterized by particular conditions of temperature, precipitation, etc., e.g., *the rainy season.*

BIOMES can be defined as climatically and geographically defined areas of ecologically similar communities of plants, animals and soil organisms; it is often referred to as an ecosystem. Biomes are defined based on factors such as plant structures (such as trees, shrubs, and grasses), leaf types (such as broadleaf and needles), plant spacing (forest, woodland, savanna), and climate.

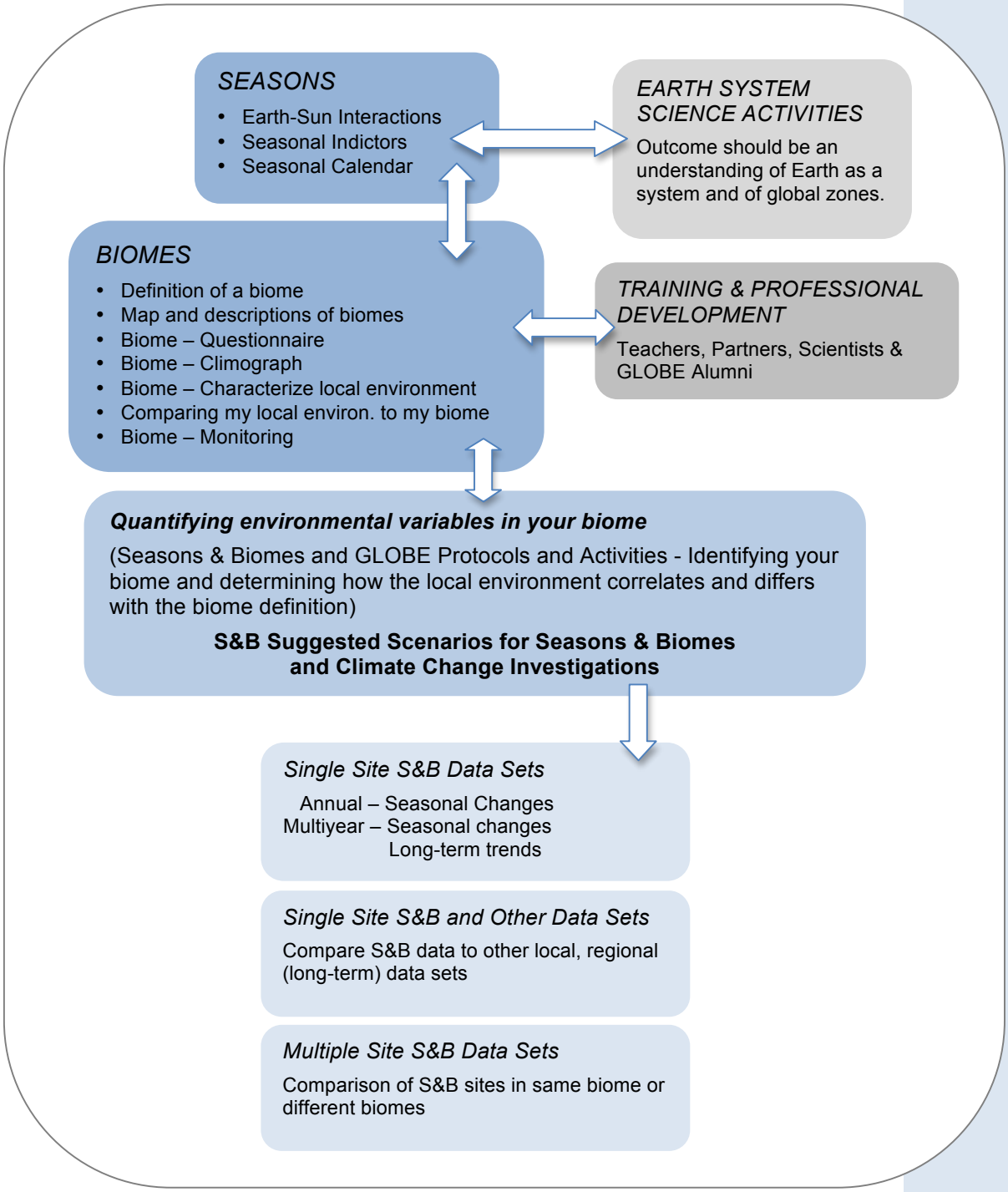
Students learn ***BASIC CONCEPTS*** relating to seasons and biomes and explore their local manifestations through ***INQUIRY LEARNING***:

- *What kind of seasons do we have in our local environment?*
- *What is the* **climate** *in our area?*
- *What variables should we look at to determine this?*
- *What biome do we live in? How can we determine our biome?*
- *Does our local environment differ from our biome? How?*
- *Are there seasonal changes in our biome? How can we determine this?*
- *Are there long-term changes in our local environment?*
- *What causes change in our biome? How can we determine this?*
- *What can we do to stop OR adapt to the changes in our biome?*

The combination of GLOBE and S&B protocols used at a student research site is up to the students and teachers. Because the information is collected in a standardized way, it can be compared from visit-to visit, from year-to-year and from site-to-site.

The *Seasons and Biomes Project* is designed to complement the existing GLOBE protocols and learning activities. The GLOBE *Earth System Science* poster and activities provides an introduction to annual variability of a number of key variables on a global scale. A number of GLOBE protocols can be used, along with the new *Seasons and Biomes* protocols, to describe and monitor students' study sites. The *Seasons and Biomes* group has offered professional development workshops through the GLOBE program.

GLOBE Program – Seasons and Biomes Project Interactions



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Protocols and Learning Activities developed for the *Seasons and Biomes Project* by Kim Morris

WEATHER AND CLIMATE

- Introduction To Weather And Climate
- What Is Weather?
- What Was The Weather Like On.....?
- From Weather To Climate – The Climograph
- How To Make A Climograph From Your Local Weather Data
- Comparing Current Monthly Averages To Climate
- Does Climate Change Over Time?
- Climate Zones And Biomes

SEASONS

- Exploring Solar Energy Variations On Earth: Time and Seasons
- Exploring Solar Energy Variations On Earth: Changes In The Length Of Day, Solar Angle And Solar Insolation Through The Year
- Describing Seasons Using Different Definitions (What Is A Season?)
- Seasonal Indicators In My Local Environment
- The Seasonal Calendar (*adapted from other material*)

BIOMES

- Introduction To Terrestrial Biome Classification Systems
- The Seasons And Biomes Project Terrestrial Biome Classification
- Identifying Our Biome: An Initial Assessment (*with others*)
- Characterizing Our Local Study Site (*with L. S. Gordon*)
- Exploring The Variability Of Terrestrial Biomes
- How Does My Local Environment Compare To My Biome? (*with L. S. Gordon*)
- Monitoring Our Local Area Through the Year (*with L. S. Gordon*)
- Changing Biomes With Changing Climate

ICE SEASONALITY

- Ice Seasonality Protocol
- Site Definition Field Guide and Site Definition Sheet
- Ice Observation Field Guide
  - Annual Summary Guide – Single Freeze-up/Break-up Cycle
  - Annual Summary Guide – Multiple Freeze-up/Break-up Cycles
  - Ice Seasonality and Science Education Standards
- River Ice Glossary
- Lake Ice Glossary
- Site Set-up Learning Activity
- Exploring Ice Seasonality Data
- The Physical States of H_2O: Vapor, Water and Ice
- Understanding Mass, Volume and Density
- Using Snow To Understand Density
- Making Measurements In A Snowpit
- Calculating Conductive Heat Flow Through A Snow Cover

INVASIVE PLANT SPECIES

- Invasive Plant Species Protocol
- Site Definition Field Guide and Site Definition Sheet
- Vegetation Sampling Field Guide and Plant Species Inventory Data Sheet

DATA ANALYSIS

- Exploring Our Data With Descriptive Statistics and Simple Graphing Techniques (*with others*)
- Exploring Our Data With Graphs

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