

GLOBE Carbon Cycle Activity Flow Chart

Engagement Activities - meant to provide the background students need to understand the context and concepts of later activities

Carbon Cycle Introduction Activities - familiarize students with the components of the carbon cycle at both large and small scales.

Field Activities - performed after appropriate engagement activities in the order listed; implement field activities on their own, either before or after modeling activities; and plant-a-plant may provide a concrete starting point for some concepts (biomass, NPP)

Modeling Activities - performed after appropriate engagement activities; one or many models can be used; implement modeling activities on their own, either before or after field activities; and plant-a-plant may provide a concrete started point for some concepts (biomass, NPP, limiting factors to growth)

Plant-a-Plant Experiments - can be performed entirely on their own without engagementl activities; "Biomass Units" may be useful background or follow up; and provide concrete base for understanding field and modeling activities

Order	Activity	Concepts	Skills	Extensions	Essential Concept	Pre-requisites
Engagement Activities						
	Paper Clip Analogy	Model & system definitions, Modeling Terms, 1-box model diagram, equilibrium, Modeling limitations & assumptions	Graphing, Data recording, Data analysis, Sytem diagramming, Equation development, Manipulating the model	STELLA paper clip model	Labeled model diagram, equilibrium	none
	Water Bucket Demonstration	Modeling Terms, 1-box model diagram, equilibrium, Modeling limitations & assumptions, usefulness of computer models	Observation, Manipulate model variables, Data collection and analysis	STELLA bath tub model	Modeling Terms, Inputs & Outputs Measured in terms of Volume, Equilibrium	none

	Carbon Cycle Adventure Story	Cycles & subcycles, Modeling Terms, Molecules, Units, C pools (C storage) & fluxes, relationship to humans, 45% of living matter is C	system diagramming, tracking C, questioning, problem solving, Calculations	<i>Kinesthetic activity, number sense</i>	Systems: Cycles & Subcycles	System/model basics: terms & definitions, 1-box model diagram
	Carbon Cycle Game					
	Number Sense - How much carbon is that?					
	Human Role in the Carbon Cycle					
	What is DBH?	Circle equation, Standard measurement of trees (DBH), Units	Measurement, Conversions & Calculations, Data analysis	Build your own DBH measurement tools	Circle equation, Standard measurement of trees (DBH)	none
	Biomass Units	Units, Definition of biomass, Measurement of biomass, 45% of living matter is C	Measurement, Calculations, Data analysis, Hypothesis formation	Biomass of biomes - Use of satellite images	Definition of biomass	none
	Human Allometry	Definition of allometry, Relationship between two variables, Line equation, Human allometry, Tree allometry (dbh v. biomass), Species groups	Measurement, Data analysis, Interpret graphs, Hypothesis formation	Equation validation (use other student group)	Definition of allometry, Tree allometry (dbh v. biomass)	DBH, biomass
Core Activities						
	Vegetation Plot Establishment	Scientific field plots, Latitude & longitude	Pacing, Measurement, Compass, GPS		Vegetation plot sampling method	none
	Tree & Shrub Mapping and Tagging	Species ID	Organization		Tree mapping	Vegetation Plot Establishment, Scientific ID using keys

	Vegetation Plot: Tree Measurement	DBH, Tree ID, Species groups, Units, Coniferous vs. deciduous	Measurement, Data recording, Partner collaboration	Other landcover protocols, <i>Future C protocols (soil)?</i>	DBH, Tree ID, Species groups	Vegetation Plot Establishment, Tree mapping or tagging, DBH
	Tree Data Analysis	DBH, Biomass, Tree allometry, Units, Species groups, 45% of living matter is C, C storage, Carbon cycle	Spreadsheet work, Design procedure, Data analysis, Explain/communicate results, Interpret graphs	Compare field plot to classroom biomass, Students research their own question OR teacher generated scenario using field data	Biomass and C storage in a field plot	Vegetation Plot Establishment, Tree mapping or tagging, Vegetation Plot Measurement, DBH, Biomass, Allometry
	Scaling from Plot to Schoolyard					
	Vegetation Plot: Shrub Measurement					
	Shrub Data Analysis					
	Vegetation Plot: Grass Measurement					
	Grass Data Analysis					
	Carbon Mini-plots (GLE- South Africa Activity)					
	Net Primary Productivity	NPP, Carbon Cycle, Biomass, Photosynthesis, Respiration	Calculations, Spreadsheet work		NPP	Biomass, Photosynthesis, Respiration

	iSee Player Tutorial	STELLA Computer Models	Use of computer model, Interpret graphs and tables		Use of iSee Player for STELLA models	Basic modeling terms and concepts
	Biomass Accumulation - Foliar N Model	Foliar N, PSN, Respiration, Turnover Rate, Litter Fall, Carbon Cycle, Vegetation Biomass, Model Terms, 1-Box Model, Equilibrium, Carbon Storage	Manipulate model variables, Interpret graphs and tables, Data collection and analysis		Biomass, Carbon Storage	Basic modeling terms and concepts, Use of iSee Player, Biomass, Photosynthesis
	Earth Exploration Toolbook Chapter: What do forests have to do with climate change?	Carbon Cycle, Biomass, 1-Box Model, Equilibrium, Carbon Storage, Forest Data Collection, Forest role in Climate Change	Manipulate model variables, Interpret graphs and tables, Data collection and analysis		Forests are best understood through a combination of analysis methods: modeling, field data collection	Biomass, Carbon Storage
	Global NPP-Biomass Model	NPP, Limiting Factors to Growth, Carbon Cycle, Precipitation, Temperature, Turnover Rate, Litter Fall, Vegetation Biomass, Biome, Model Terms, Residence Time, Equilibrium, 1-Box Model, Carbon Storage	Manipulate model variables, Interpret graphs and tables, Data collection and analysis			NPP, Carbon Cycle, Biomass, Biome, Basic modeling terms and concepts, (<i>limiting factors to growth?</i>)
	Global C Cycle Model	Multiple Box Models, Carbon Cycle, Feedbacks, Equilibrium, Carbon Storage vs. Carbon Flux	Manipulate model variables, Interpret graphs and tables, Data collection and analysis			Basic modeling terms and concepts, Carbon Cycle
	Seed Germination					none
	Light Experiment	Limiting Factors to Growth, Biomass,	Experimental design, Observation, Use of tools: scales, ovens, rulers			Seed Germination

	Mineral Nutrition Experiment (1)	Limiting Factors to Growth, Biomass,	Experimental design, Observation, Use of tools: scales, ovens, rulers			Seed Germination
	Water Experiment	Limiting Factors to Growth, Biomass,	Experimental design, Observation, Use of tools: scales, ovens, rulers			Seed Germination
	Carbon Dioxide Experiment	Limiting Factors to Growth, Biomass,	Experimental design, Observation, Use of tools: scales, ovens, rulers			Seed Germination
	Photosynthesis Experiment					Seed Germination, CO2 experiment(?)
	Mineral Nutrition Experiment (2)					Seed Germination, Mineral Nutrition (1) (?)