

Table 1. Six Levels of Strategies and Goals for Curriculum Design and Teaching

Level and Time Scale	Teaching Strategies	Goal Structures for Student Learning Outcomes
6-Curriculum Integration Strategies 2-6 months	Connections for Integration between Major System Models from each Unit	Integrated Target Structure: Connections between Units for Integration between Targeted Systems
5-Unit Sized Modeling Strategies 3-15 days	Major Phases within Each Unit: Introducing Problems, Building Model Parts, Synthesis, and Model Application	Top Level Target Models for Each Unit
4-Lesson Strategies 10-80 Minutes	Large-scale Model Construction Modes for Discussion involving multiple models (e.g. Model Competition, Model Combination, concept Differentiation or Integration, Model Evolution)	Planned Learning Pathway leading to a Target Model for Each Lesson
3-Single Model Element Strategies .2-15 Minutes	Promotion of Model Generation, Evaluation or Modification Processes: Small-scale Modes for Class Discussion (e.g. Single GEM cycle (e.g. Model: disconfirmation, modification, domain change, confirmation, finding patterns in observations.)	Model Element Targeted for Small Conceptual Change or Confirmation Individual Steps of Conceptual Change from Model M to Model M' in Implemented Learning Pathway
2-Individual Cognitive Strategies for Teacher “Moves” in Discussion 5-100 seconds	Cognitive Strategies (e.g., request for explanation or prediction, request to run model for evaluation, discrepant question, pose thought experiment, request or introduce an analogy, etc)	Unique Aspects of Student Ideas and Teacher Improvisations Influence Second to Second Acts of Constructive Reasoning on the part of Student as Micro-Contributions to Implemented Learning Pathway
1- Dialogical Tactics 1-20 seconds	Dialogical Tactics used by a teacher in a single discussion turn for fostering student contributions and sharing them (e.g. reflective toss, indicating respect for ideas, etc.)	Active Idea Sharing and Norms for Discussion in Science Class