Sara A. Wyse, Kristy J. Wilson, Elena Bray Speth, Jennifer L. Momsen, Tammy M. Long

INSTRUCTOR CHECKLIST – MODELING

The following summarizes literature-based recommendations for implementing modeling in the college classroom. Summaries of the articles leading to these recommendations can be found in the LSE Feature: https://lse.ascb.org/evidence-based-teaching-guides/modeling-in-the-classroom/

SELECTING A MODEL(S) AND ASSESSMENTS TO SUPPORT LEARNING GOALS

- ❑ Consider your course content and context. Reflect on your course to identify what biological contexts, processes, and/or systems are essential to your course (e.g., carbon cycling, photosynthesis, or phenotypic outcomes of genetic mutation) and could benefit from model-based instruction. Modeling can help students work through complex concepts and/or ideas about which student often hold preconceptions (e.g., decomposition).
- ❑ Determine your specific learning goals. Identify and articulate measurable learning outcomes related to both content and skills. What do you want students to know and be able to do? Can modeling be an effective way of achieving those goals?
    - Biology content learning goals may include modeling to: represent a system, illustrate and associate concepts, explain and/or predict relationships among concepts, structures, or species, or to illustrate the dynamic nature of a system.
    - Modeling is a core scientific practice. Examples of learning goals related to science process skills may include: predicting the impact of a perturbation on a biological system, identifying short and long-term consequences, testing hypotheses, using data to draw conclusions about components of the system or the system as a whole.
- ❑ Select the type of model that supports your goals for student learning. In biology, multiple types of models serve distinct purposes. Choose a model type that aligns well with your learning goal (e.g., identify interrelationships). Some commonly used model types include the following:
    - Phylogenetic trees - Supports understanding of evolutionary relationships between organisms.
    - Diagrams/animations - Support understanding of where processes take place, how those elements appear, and how processes occur. They are commonly used in/with textbooks.
    - Tactile models – Supports the building of spatial awareness and reasoning about structure-function relationships.
    - Simulations - Supports model permutation to observe changes and make/test predictions of phenomena like molecular structure of a protein, changes in cellular concentrations of proteins or metabolites, population dynamics. Students can also observe anatomical differences, or participate in health care simulations.
    - Structure Behavior Function models – Supports the focus on connections among system components to explain biological phenomena.

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- ❑ Review specific recommendations about using these model types in the teaching guide (https://lse.ascb.org/evidence-based-teaching-guides/modeling-in-the-classroom/example-models/).
- ❑ Determine appropriate model-based assessment. Consider assessments that ask students to use, interpret, test, create or draw a model, and/or apply their content knowledge and skills to a novel modeling task. Determine what evidence would show student understanding and proficiency with content or modeling.

MODEL-BASED INSTRUCTION

- ❑ Explicitly discuss the models regularly used in the classroom. Students' perceptions of models are diverse, from viewing models as realistic representations to recognizing models as abstract representations that are tentative and testable. Instructors can help students expand their understanding of models and recognize that all models have limitations.
- ❑ Incorporate regular, intentional practice to develop modeling skills. Students need carefully scaffolded opportunities to read, build, and interpret models. Time on task is a critical component for all types of model-based learning. Deliberate modeling practice allows students to acquire and use skills, and build on these through increasingly complex tasks.
- ❑ Ask students to not only work with pre-made models, but to construct their own models of systems. The creation process is important to develop model-based reasoning skills. Models may be created individually or in groups.
    - Individual models help students make their own personal mental models visible, but may also be overwhelming. Support students here through practice, feedback, and time to work through multiple, complex modeling tasks.
    - Group modeling tasks enable students to work together, jointly creating knowledge, and may provide the needed support when tackling complex modeling tasks. Modeling as a group helps develop communication skills, as students communicate about why certain elements are present in systems and why/how they are connected to other components.
- ❑ Provide opportunities for revision and feedback. Models may reveal preconceptions or areas where students are experiencing cognitive dissonance, and instructors can use student models to provide timely feedback. Following feedback, provide opportunities for students to revise their models as they learn new knowledge and development their understanding. Often, models become more parsimonious in this process of iteration as students prune out irrelevant content and clarify their understanding of mechanisms and relationships.
    - Consider asking students to provide specific types of feedback to peers (e.g., is the model function clear? Circle an area where the mechanism is unclear). Involve students in the process of evaluating models, as this may support the development of model-reasoning skills and content understanding simultaneously.
- ❑ Instruct students to use the models (given or created) to reason about the system (e.g., what happens if...? Predict the consequence of removing this component.)