

Guidelines for Using Computer Simulations Interactively in the Classroom

- Instructor buy-in – practice and plan out your interactivity, multitasking requires preparation.
- Student buy-in – begin with an enthusiastic statement of the purpose and benefits of interacting with the simulation. You are asking students to exert substantial mental energy to reason with the representations used. Convince them there is a valuable payoff!
- Budget sufficient class time – It will take students a while to become comfortable with the representations used. Give them enough time or don't bother with it. Minimum time recommendations:
 - Simple simulations > 5 minutes
 - Complex simulations > 15 minutes
- Quick overview of simulator functionality – help students with the representations.
 - Break up multi-functioned simulations into small chunks when possible.

Interactivity

- Simple questions over declarative information serve a purpose by keeping students participating during the early stages of becoming familiar with the simulator.
 - You may wish to control the timing of the class' answer – otherwise the smart kid in the front row will yell out the answer before others have had a chance to think. Example: “on 3 – what time does this phase rise? – 1,2,3”.
- Indicating Events – Animate a simulation and have students yell out “now” when a particular event occurs. Examples: when showing the moon orbiting Earth for a particular observer, “yell now when the moon is rising” or when simulating a K2 and B2 eclipsing binary system, “yell now when the light curve is at its lowest level”.
- Describing Relationships – Limit the possible answers. Examples: When I increase X, what happens to Y? Better to ask “if I increase X, will Y increase, decrease, or stay the same?”. How long until the moon (presently a waxing crescent) is a waning crescent? Better to ask “approximately how many weeks until the moon is a waxing crescent?”
- More Complex Questions
 - Have students record their predictions on a notepad. You can then have them defend their answer exactly like you would in peer instruction. Example: “Hold up your sketch so that your ~5 closest neighbors can see it. Find someone with a different answer than you and convince them that you are correct. You have one minute.”
 - Group Discussion – Example: “Break up into groups of 3 or 4, elect a group reporter who will share your group's thoughts with the class, and brainstorm on – how will the light curve shown change if I increase eccentricity? You have two minutes.”

- Encourage students to recognize a simulator's shortcomings (when appropriate). It will often be necessary to use leading questions to accomplish this.