

Assignment Instructions

For this peer-graded assignment, we're asking you to practice developing concrete, useful, measurable learning objectives. Doing so is the first step in the backward design process, so it's important that you improve your ability to craft good objectives.

First, select a topic that would be appropriate for an introductory STEM course you might teach one day. You can choose any topic you like, but feel free to pick one of the following suggestions: photosynthesis (biology), reactions and rates (chemistry), buoyancy (physics), plate tectonics (geology), the derivative (mathematics), and conditionals (computer science). By focusing on an introductory course, you'll make it easier for your peers, who might not be in your discipline, to give you feedback.

Second, write an appropriate course-level learning goal for the course that this topic would appear in. Your goal should start with the phrase, "Students should be able to..."

Third, write three-topic level learning objectives for this topic. Your objectives must begin with the phrase, "Students should be able to..." One of your objectives should fall at the "understand" level of Bloom's taxonomy, one at the "apply" level, and one at the "analyze" level. This three-level structure is a bit artificial, but it's useful for this practice activity.

Finally, answer the following questions about your three topic-level learning objectives:

- For your "understand" objective, what one or two misconceptions might your students have that would make it challenging for them to meet this objective?
- For your "apply" objective, what aspects of the objective might be hard for a novice but second-nature to an expert? How might you make these aspects more explicit when working with students?
- For your "analyze" objective, how would this objective require students to understand relationships among multiple concepts or principles?
- For each objective, how might you measure a student's achievement of that objective?

Week 3 Peer-Graded Assignment

Topic: Meiosis (biology)

Course-Level Learning Goal: Students should be able to explain how the process of Meiosis produces gametes in eukaryotes.

Topic-Level Learning Objective: Students should be able to *understand* the phases of Meiosis, and how they are distinct from the phases of Mitosis.

Topic-Level Learning Objective: Students should be able to *apply* the concepts of segregation and independent assortment to specific traits inherited from parent to

offspring.

Topic-Level Learning Objective: Students should be able to *analyze* the two divisions of Meiosis and the products of each division in terms of number and genetic identity of cells.

- 1. For your “understand” objective, what one or two misconceptions might your students have that would make it challenging for them to meet this objective? (Consider the discussion of prior knowledge in Week 1)**
 - a. Students might fail to pay attention to the slight, but significant, differences between terms such as chromosomes, sister chromatids, and homologous chromosomes or homologues in their understanding of the phases of Meiosis and how they are distinct from the phases of Mitosis.
 - b. Students might fail to truly understand the differences between haploid (n) and diploid (2n) cells.

- 2. For your “apply” objective, what aspects of the objective might be hard for a novice but easy for a second-nature to an expert? How might you make these aspects more explicit when working with students (consider the discussion of expert blind spots in Week 2)?**
 - a. Students might not initially be able to define the terms “segregation” and “independent assortment” – they may not even be able to define the term “trait.” Thus, it might be beneficial to make students recall this specific learning objective when the definitions for “trait,” “segregation,” and “independent assortment” are explained in class. This will encourage students to pay attention to these definitions, as they are included in a learning objective and thus could appear as part of a later assessment.

- 3. For your “analyze” objective, how would this objective require students to understand relationships among multiple concepts or principles (consider the discussion of knowledge organizations in Week 1)?**
 - a. As part of fulfilling this learning objective, students would have to think about all phases of Meiosis and keep track of the number of cells that are produced after each phase. Students would also have to recognize that Meiosis is process of sexual reproduction in eukaryotes. Thus, students would likely make a connection that Meiosis, in comparison to Mitosis, results in a different number of genetically non-identical offspring.

- 4. For each objective, how might you measure a student’s achievement of that objective (next week will feature an in-depth discussion of assessment, but it’s useful to have some ideas at this stage)?**
 - a. Ask students to diagram the process of 1 cell with 4 chromosomes going through the process of Meiosis AND Mitosis.
 - b. Ask students to explain why segregation and independent assortment are unique to the process of Meiosis.
 - c. Ask students to list the number of cell products and their genetic identity

after the first division of Meiosis (Meiosis I) and at the second division of Meiosis (after Meiosis II).