

SUPPLEMENTAL MATERIALS

Supplemental Materials provides several documents that support the main manuscript. First, we provide text of the preservice-teacher's version of the survey of beliefs about optimizing learning from two representations. Second, we describe the coding manual used to code free response data. Third, we provide a figure showing how simultaneous presentation of mitosis and meiosis was presented, and in this case, how signaling support was added (Figure S1. Simultaneous presentation with signaling support: Meiosis II).

1. Pre-service Teacher Study Text

Science Education Survey

Thank you for participating in this survey. We are currently developing new teaching materials to help students learn about cell reproduction through the processes of **mitosis** and **meiosis**. Your feedback will help us design these teaching materials. Please answer all of the questions to the best of your ability.

PART A: Background Information

1. **What is the highest level of Biology instruction you have had? (circle 1 answer)**
 - a. Middle school (grades 7-8 or ages 11-13) or less
 - b. High school (grades 9-12 or ages 14-18)
 - c. Undergraduate education
 - d. Graduate education
2. **In what country did you receive your pre-college science instruction: _____**
3. **Have you learned about the processes of cellular reproduction in the past?**
 - a. No
 - b. Yes
4. **Could you describe mitosis to a friend?**
 - a. No
 - b. Yes

5. Could you describe meiosis to a friend?

- a. No
- b. Yes

PART B: Study Description

You are going to be seeing some diagrams that describe the two ways cells reproduce: mitosis and meiosis. Before you see the diagrams, please tell us how you think the diagrams should be presented.

6. I think I would learn BEST if:

- a. Mitosis and Meiosis were shown together in ONE diagram
- b. Mitosis and Meiosis were shown one at a time in SEPARATE diagrams.

Explain why you chose this answer:

7. I think a middle school student (grades 7-8/ages 11-13) would learn BEST if:

- a. Mitosis and Meiosis were shown together in ONE diagram
- b. Mitosis and Meiosis were shown one at a time in SEPARATE diagrams.

Explain why you chose this answer:

2. Adult Survey Coding Manual

In this survey, adults were asked:

“If you were just learning about two closely related science topics, such as osmosis and diffusion, and you received a diagram for each concept, would you rather have a separate diagram for each, or both presented together? Why?”

A follow-up item asked how a middle-school student should receive the same information (separated or combined diagram), and why.

CODES

You will be coding the “why” portion of each of the above items. If the response includes the information the code is looking for, give it a 1. If not, leave it blank. In some cases, the respondent may have said, “Same reason as I gave in the first question.” In this case, go back to the coding for the first item and copy it to the second.

Compare/Contrast – Respondent says that the presentation would help them compare and/or contrast similar diagrams.

Examples: That way I could compare them; I learn better if I can see the differences; They have many similarities, and this way I can see what is the same and what is unique.; I will be able to distinguish between the two better.

Easier – Respondent says the chosen presentation style is easier.

Examples: It’s easier to learn like that; It’s too hard if you have to remember one thing and go back and remember something else; It’s easier for kids to focus on one thing at a time.

Confusion – Response specifically suggests that preferred style will either help to avoid confusion, or that the alternate style is too confusing.

Examples: Having too much information on one page is confusing; I get confused when I have to remember something.

Understand better – Response indicates that the style of presentation would help the learner understand the concept better.

Examples: It will be better for me to code it into my working memory if I see them this way; It will help me organize my understanding; Younger children are able to grasp concepts better if they learn them together/separately.

3. Supplemental Figure: Sample of simultaneous diagrams

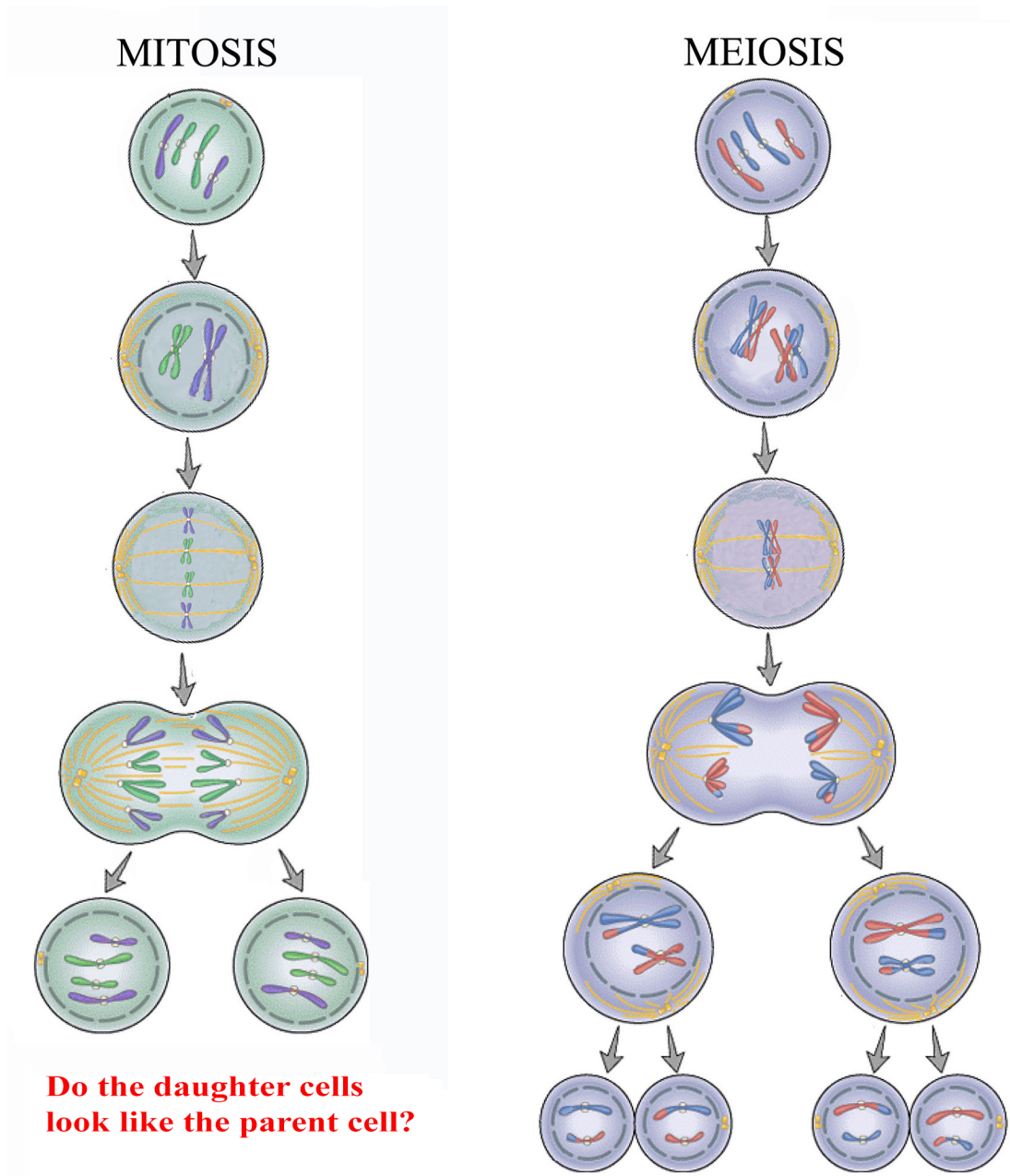


Figure S1. A diagram showing both mitosis and meiosis simultaneously, with Signaling Support.