

# SOCIAL TOOLS for Bio

## Social Online Tools to Support Collaborative and Inclusive Learning in Biology

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### California Learning Lab Seed Project

The *Social Tools for Bio Seed Project* developed 2 activities for biology classrooms that aimed to provide a collaborative learning space for students to externalize new information, build knowledge, develop sense of belonging, and build study skills. We developed the activities using interviews with 11 faculty to learn about their teaching approach, practices and challenges. We surveyed 517 undergraduates at 3 California Community Colleges, 1 California State University and 1 University of California. For activities, we created a learning pathway that scaffolded social interactions and used graphic organizers for groups to use collaboratively to focus learning while exploring challenging concepts. After each round of deployment, we iterated activities after reviewing knowledge check questions and feedback from students.

#### Research Questions

- **Faculty:** What is the faculty perspective on teaching undergraduate biology? What challenges do faculty encounter in teaching? What strategies do they use?
- **Students:** What is the student experience in learning biology? What supports do students need for collaborative learning?
- **Activities:** How should activities be designed for biology classrooms to help students organize information and maximize learning in a social environment?

#### Faculty Perspectives

We interviewed biology faculty from each institution type. We asked about challenging topics for students (to help inform activity selection), pedagogical approaches (especially role of student collaboration), and what worked well and did not with regards to online learning and collaboration (to inform how they do, or might, implement collaborative learning with online tools). We included what we were learning ourselves as faculty participating in the work of creating and deploying the online activities. Faculty shared and learned about:

- Increased significance of **assessment to inform instruction** (not just assign grades)
- Being more **flexible and/or accessible** with regards to instruction techniques improved student outcomes (e.g. getting rid of time limits, flexible deadlines, **low stakes assessment especially for group tasks**, recording lectures to be re-watched, online office hours)
- Recognizing the **value of collaboration and discussion** and working to **foster that online** (e.g., discussion boards, chat, shared platforms like Google Docs / Slides, defining group roles)

#### In creating the activities, faculty need to:

- Provide explicit guidance to scaffold student interactions
- Be able to adjust the activity
- Provide very clear questions
- Embed assessments in the activity
- Consider how assessments are presented to students -- ungraded or low stakes assessments encourage more student participation & cooperation

#### Student experience

The Student Experience Survey included questions related to how students experienced learning in their biology classrooms. Questions also collected student responses on experiences in low-stakes collaboration scenarios such as breakout rooms and asked, (1) when did it work well and (2) not well; and a high-stakes scenario of a hypothetical group project in biology, and asked, (1) what challenges might you face in completing this project with others, and (2) what help would you need from your instructor to be successful.

#### Low Stakes Scenario Themes:

- Works when everyone talks, works together, participates or engages
- Works when there's a defined problem
- Works when members take on roles like facilitators or break the ice
- It helps when cameras are on and microphones unmuted (engagement social signal)

#### High Stakes Scenario Themes:

- Communication and scheduling an anticipated challenge
- Concerns with workload equity and effort, especially for non-contribution
- Students **need the instructor's help** negotiating workload equity, connecting with others, and creating accountability

#### Lessons:

- Challenges can be mediated by **careful activity design**: include **social connection**, **establish norms** for online interactions, and consider **workload equity**.

### Activity Design

To create activities for classes, we used a Design-based research approach (Scott et al. 2020): we designed activities, tested them in classrooms, collected data to assess student learning and experience, and reflected to iterate the activities. We focused our design on two concepts in biology: (1) DNA and Transformation and (2) Alternation of Generation in Plants. We developed each activity in Google Slides and each followed a learning pathway (Fig. 1) with social, biology and assessment content. Social content included a prompt as an icebreaker and to establish roles. Biology content included graphic organizers to help students categorize information presented in the activity. In the *Alternation of Generation in Plants Group Activity*, students worked together to arrange cellular processes and plant structures to describe a plant life cycle, note ploidy of structures and see patterns (Fig. 2). In the *DNA and Transformation Group Activity*, students explored "Griffith's Experiment" to understand DNA as the molecule of inheritance (Fig. 2).

Scott et al. 2020. Design-based research: a methodology to extend and enrich biology education research. *CBE—Life Sciences Education*, 19(2), p.es11.

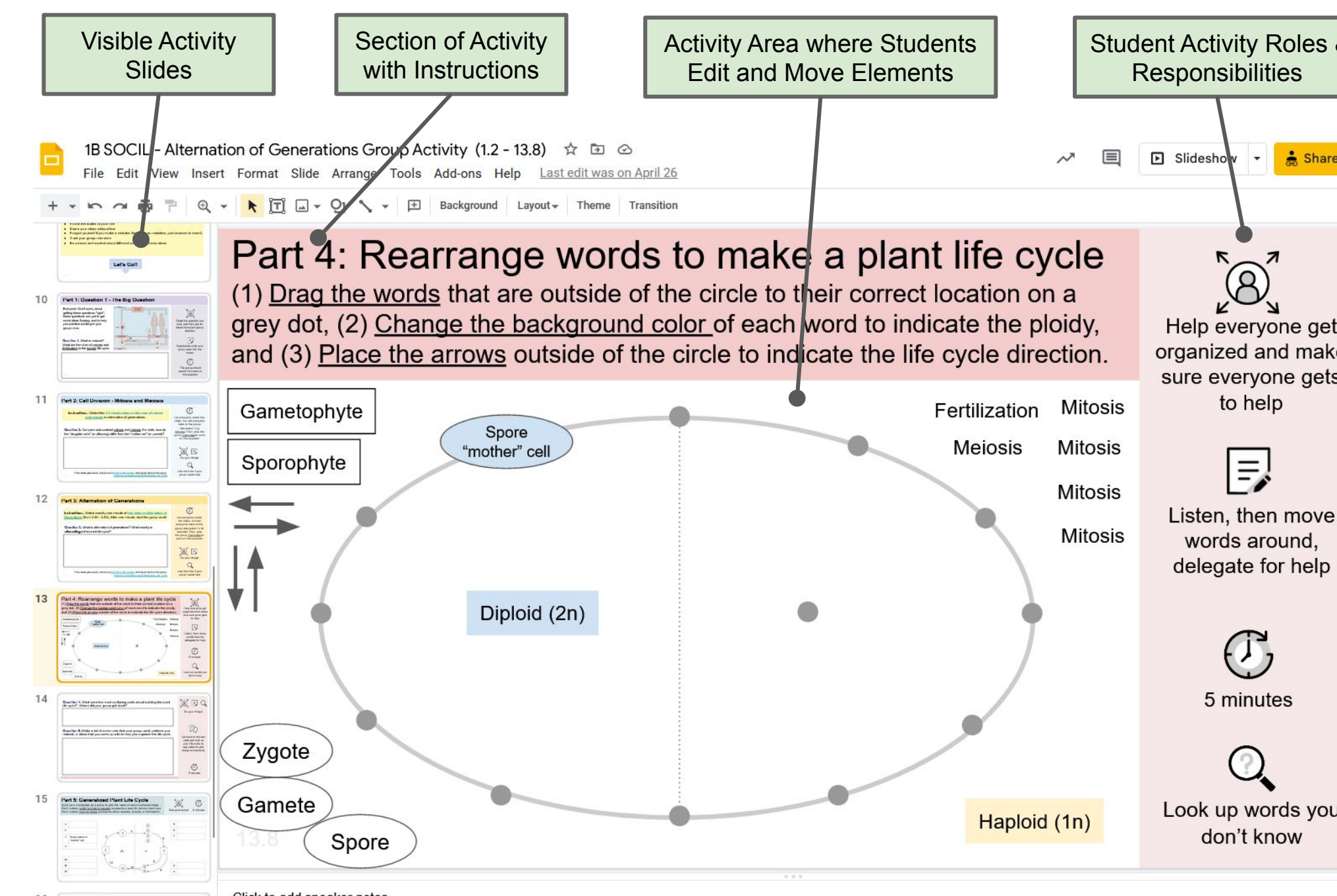


Figure 1. Flow of online activity. Students experience content and prompts that facilitate social connection, biology content, and assessment through pre- and post-activity knowledge checks.

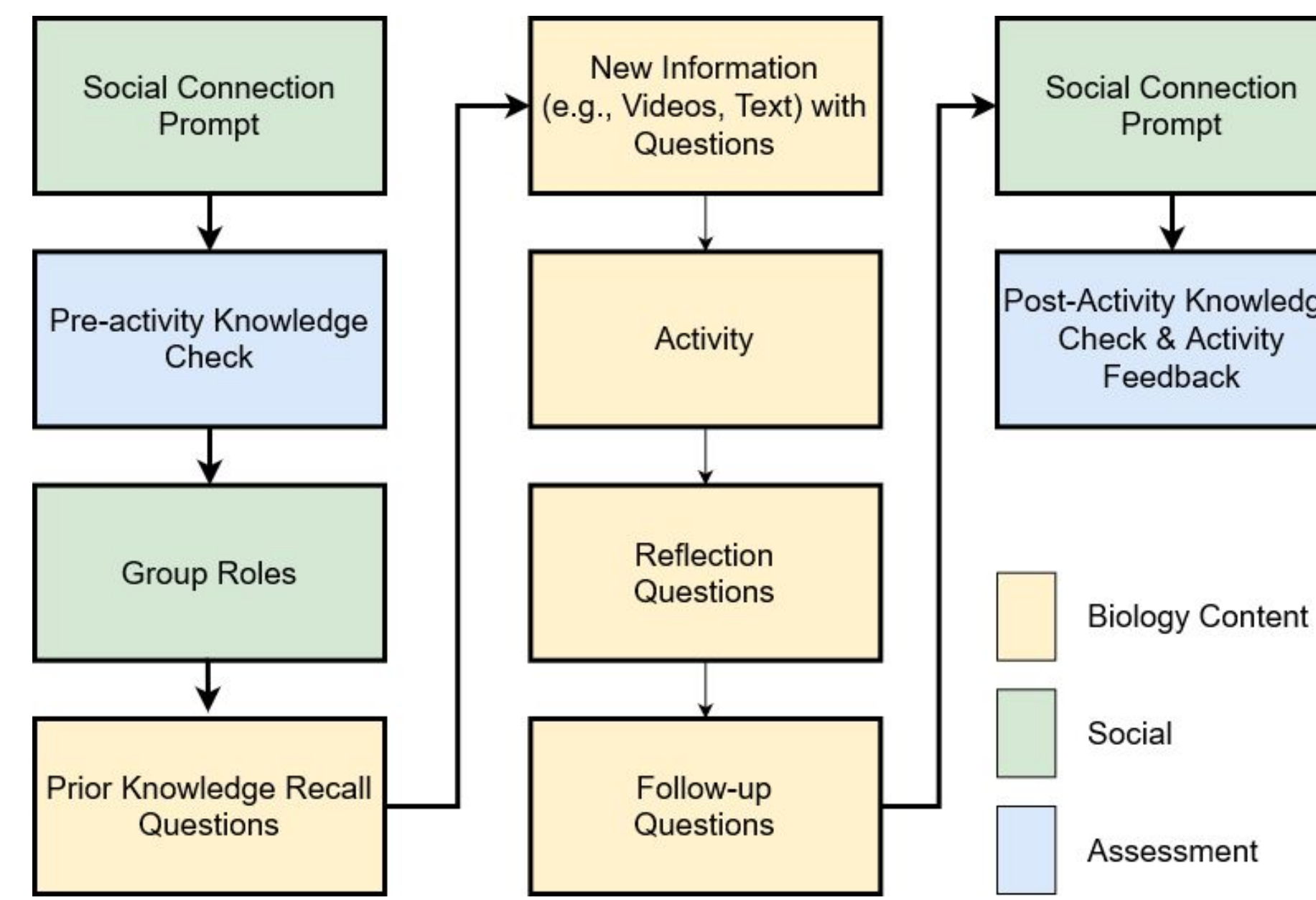


Figure 2. Example of Social Tools activity. Students participate in the activity using Google Slides. Students are able to review and revise, move and edit elements, and are guided in social interactions and roles throughout the activities. All activities use Google Slides as a platform that can be deployed in a live classroom or in Zoom breakout rooms. Left: *Alternation of Generations Group Activity*; Below: *DNA & Transformation Group Activity*.

3. Do you think each treatment listed will produce disease in the mice? Explain your predictions.

Treatment	Prediction	Explain your prediction
Living S cells		
Living R cells		
Heat-killed S cells		
Mixture of heat-killed S cells and living R cells		

Help everyone get organized and make sure everyone gets to help

Read the slide out loud, ask for ideas from each group member, and make sure that everyone gets a chance to contribute

Ask for help typing if you need it

5 minutes

Look up words you don't know

Review Griffith's Experiment slides

#### Testing and Iteration

We deployed activities in 14 classrooms at California Community Colleges (DVC, LMC, LPC), CSU – Stanislaus, and UC Berkeley. Each partner institution had at least 1 deployment of 1 activity with LPC and LMC testing activities multiple times.

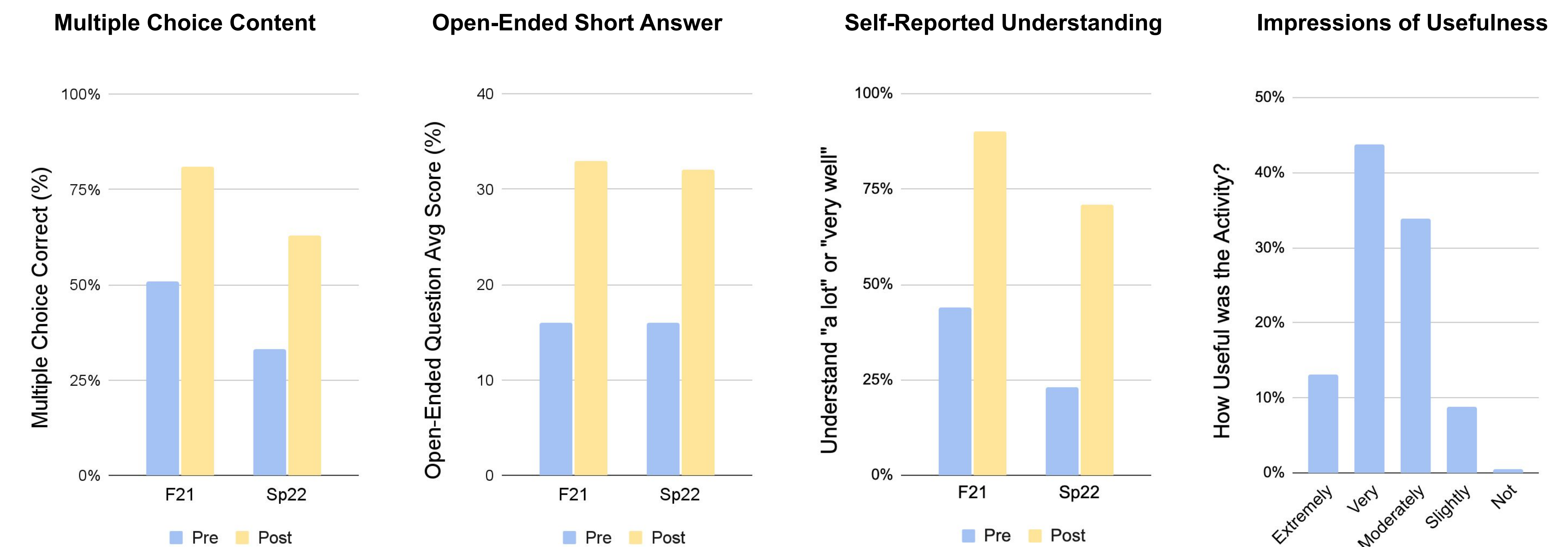
Activity	Sp 2021	F 2021	Sp 2022
DNA & Transformation	1 (23)	1 (42)	1 (68)
Alternation of Generations in Plants	3 (44)	3 (77)	5 (103)

To assess student learning after the activity, we used Qualtrics for pre- and post- activity knowledge checks, self-assessment of learning, and feedback on the activity. We used Gradescope to score activities turned in by the students for misunderstandings to improve activities.

For the *DNA & Transformation Group Activity* we iterated to adjust the format of questions to break long questions into smaller and more highly scaffolded questions. For the *Alternation of Generations Group Activity*, we iterated to share more information on the importance of collaboration in learning, and to help students establish consensus on collaboration approaches.

#### Measured Learning Outcomes and Student Impressions

We measured student learning and the student experience through pre- and post-activity surveys. We saw significant gains in content knowledge (as measured with multiple-choice questions and an open-ended short answer question) and self-reported understanding. Data below is for the *Alternation of Generations Group Activity* and pre- and post-activity surveys that were fully completed by 79 students in F 2021 and 97 students in Sp 2022.



## Social Tools for Bio: Communities of Practice

### Scaling Success Project

For 2022-2024, the *Social Tools for Bio* project is scaling into a Community of Practice for biological sciences instructors at public institutions in California. Our first year-long cohort starts Spring 2023.

**Learn how to make activities, collect data to inform your teaching, and iterate activities to infuse your classroom with collaboration!**

*Social Tools for Bio: Community of Practice* will meet every other week in spring and fall semesters (8 sessions/semester). Sessions will focus on developing activities, through learning and using:

- Design tools for teaching including the 5E Framework and backwards design
- Design-based research, Biology education research, and assessment of student learning
- Activity flow, student collaboration models, accessibility and equity for online learning
- Design reflection and iteration

You will work collaboratively with other program participants to develop activities for your classrooms and contribute to shared resources. We will have an in-person kickoff meeting for each cohort at UC Berkeley and a digital poster session at the end of each semester. The program is two-semester long and each participant receives a stipend of \$2000 upon completion of the program.

#### Find out more about the program and apply!

We'll be opening up our application soon for recruitment to our Spring 2023 cohort! Please share your interest on our form and we'll send you more information on how to apply: <https://forms.gle/WnvsbDz2gdnRD7E7>.



#### Here's what faculty are saying...

Students, for the first time, seemed less confused and did a lot better on the exam questions on the topic after doing this activity last semester.

-- Jill Bouchard, Professor of Biology, Los Medanos College, *Alternation of Generations in Plants*

#### Interested in using the activities with your students?

Activities are available upon request and will be available online soon. If you're interested in using the activities, please fill out the activity interest form at: <https://forms.gle/GqmgeiQWoU2UAjpU9>.

