Silent Science: Peer Feedback on Developing Ideas

Schedule	5 minutes: Getting started 10 minutes: Individual work 25 minutes: Feedback 10 minutes: Debrief
Materials	One piece of paper per student (they should provide this unless you want to create a handout) Pencils Pens in different ink colors (so that it's easy to see what is feedback and what is not)
Set-up	Students will work individually at desks or tables Optional: document camera or projector and camera

Background:
Offering and receiving feedback from peers on your scientific ideas is a central part of scientific inquiry. Practicing scientists engage in this practice continuously: as they work in the lab, discuss ideas and challenges in lab meetings, in conversations and over email with more distant colleagues, and in the peer review process for grants, papers, and conference submissions.

This can be difficult to orchestrate: some students are talkative and willing to work through ideas on the fly in a classroom, others prefer having some time to think through ideas on their own before joining a conversation. For this reason, written feedback — where each student provides comments to another's writing — can be one way in which every student has the chance to provide and receive feedback.

Student feedback on papers, however, can address a range of things: the reviewer might comment on how the paper is structured, noticing transitions between paragraphs and ideas; they might focus on grammar, calling out a comma splice or split infinitive; they may think a third-person account is required and edit accordingly; they may focus on an idea they disagree with or find poorly explained and correct this for the author. At times, the conventions they address are idiosyncratic or the content they address may reveal their own misconceptions. We find that meaningful feedback is often best achieved when students are given very targeted, early drafts and asked to respond to one another's ideas in the spirit of inquiry.

"Silent science" is one way to do this. Students answer a targeted prompt and then receive focused feedback from several peers; everyone shares their ideas, everyone provides feedback, and everyone receives feedback. Moreover, the feedback is specific: it addresses clarity of ideas and whether or not their peers agree with those ideas. Ideally this feedback should mirror the kind of feedback students have been receiving from the instructor on their

earlier writing assignments; you should model the kind of feedback that you hope students will provide to each other.

Getting started:
You will want to create a prompt for students to write about or diagram. It should be something that is familiar to students — an idea they have thought about before and that all groups can weigh in on, even if the class has not reached a consensus. It should take them a half-page or less to respond to the prompt. You might choose something that was part of a homework assignment; this ensures everyone has a response that has received some consideration and allows them to pull out one particular part of their assignment for peer feedback. For example, when studying optics, and after a homework on lenses, we might ask students to explain what it means for an image to be "in focus." Or we might ask, when studying color, for students to explain what makes a color a primary color. We have also found this to be a good opportunity for students to receive feedback on diagrams; during a unit on pinhole cameras, we might ask them to draw a diagram of what happens when the pinhole is made bigger. When running a workshop for physics faculty, we asked them to diagram light leaving a flashlight.

Say something like:

> *Today I'd like everyone to have a chance to get detailed, targeted feedback on their ideas about _____. To do this, you're going to take about 10 minutes to _____ (diagram your ideas / write an explanation / etc.), and then I'll swap papers with others in the class and they can offer feedback.*
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> *When offering feedback, you should decide (1) do you <u>understand</u> what the author is saying? if so, you might paraphrase it ("you're saying… "); if not, point out what is unclear or paraphrase what you think they might be saying. (2) do you <u>agree</u> with what the author is saying? If so, comment on that. If not, why not? Explain why you disagree with their idea. (3) Note what the author is doing <u>well</u> or what <u>more</u> they might do to help convey their ideas.*
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> *The prompt I want you to write about is: _____.*

Write the prompt on the board so that participants can refer to it for the rest of the session.

Individual work:
As they work, you can write the feedback guidelines on the board. As each student finishes, collect his or her paper and hand it to another student (from a different group) for feedback. Do limit writing to ten minutes; most will have finished in this time (or you have chosen a prompt that is too novel or too long).

Feedback:
As students finish providing feedback, collect their papers and redistribute until every paper has feedback from at least three peers from other groups.

We recommend that students use a different color ink to provide feedback; this helps the author know which comments come from which reviewer. You might consider giving each lab group pens of the same color and passing papers around until each has feedback in three different colors. This allows feedback from a range of groups, with their differing ideas and observations.

Debrief:
After the papers have 3 or more comments, return them to their authors. Give them some time to read through the comments their peers have made.

There are a range of ways to wrap up Silent Science. Often we have students simply review their feedback and discuss with their lab group. They should reflect on their feedback and discuss what changes they plan to make when constructing diagrams or writing an explanation in the future. Often the feedback will spur new questions - when students disagree, this is a rich opportunity to further the inquiry, either through new experiments or more discussion.

If you want a more extensive discussion on their ideas and their feedback, we suggest that you glance at the papers while handing them back. Look for one or two that are particularly rich: if selecting just one, look for a paper that has rich ideas and strong comments. Your goal should be a discussion with students about the following: what was the student trying to show, and how does the feedback help them further their ideas or improve the clarity of the ideas they are sharing. As you hand the paper back to the student, let them know you would like to share their paper with the class. Using a document camera (or taking a quick photo with a phone), project the paper to the class. Have the reviewers of the paper share what they noticed; ask the first student to respond — feel free to add in any comments you would like to make.

Instead of walking students through a piece of feedback, you might instead want to highlight differing ideas. Students often expect that there is only one right way to explain a scientific phenomenon, and as they read through their peers' papers they may wonder "should I have done that instead?" It may be useful to look at two papers that both do good, but different, kinds of things. If so, look for two papers that have different ways of explaining a phenomenon, or where students have chosen to focus on different ideas (for example, in our class one student might emphasize why the image is brighter when a pinhole is enlarged, while another might emphasize why the image is blurrier; their work will be quite different). By discussing their work and feedback (again by projecting images and having students walk through what they were noticing), you can launch a conversation about the variation in ideas and your expectations for them.

Resources:
This material draws from our work published in Atkins Elliott, Leslie, Jaxon, Kim & Salter, Irene. *Composing Science: A Faciliator's Guide to Writing in the Science Classroom*. Teachers College Press & the National Writing Project, 2016.