Journal Clubs: Learning to Read Together

Schedule	homework: Reading 5 minutes: Organizing groups 15 minutes: Small group work 20 minutes: Whole class conversation 10 minutes: Journaling
Materials	students will need access to the internet for homework one copy of the reading per student (they can print and bring) whiteboards (one per group)
Set-up	Students will work individually at desks or tables Optional: document camera or projector and camera

Background:
Far from being a solitary activity, reading, interpreting and using scientific texts is something that scientists often do *together*. Articles are read, reviewed, debated, shared, and discussed, first through a peer review process (prior to publication) and, once published, by scientists and research labs that work to understand and build on the results. In science graduate school and in medical programs, students and faculty organize "journal clubs" — settings in which they review an article related to their field, summarize its findings, and discuss implications.

To familiarize students with closely reading a scientific text, making sense of the authors' ideas and building on those ideas, we employ our own version of a journal club. Using Google Docs (see "Learning to Write" Lesson Plan), students read, comment on, and prepare to discuss a reading relevant to their ongoing inquiry.

Selecting a reading
We have used readings from a range of sources. We have found the most useful readings are those that are brief: two to four pages. Thoroughly unpacking scientific ideas is difficult and time-consuming work, particularly for novices, and focusing on a few pages at a time helps students dig deeply into ideas. And although scientists in a journal club will usually (though not always) read current publications, in our classes we focus on readings that are relevant and timely for our students; rarely are these recent journal publications. This also means that the readings should be related to ongoing work and questions that students have, and speak to interests that are developing in the class, and are not used as introduction to a new unit.

Some examples:
In a course that began by asking students to create stop-motion videos that represented as realistically as possible an object falling, we later read excerpts from Galileo Galilei's "Two New

Sciences." Students had first grappled with many of the ideas that Galileo introduces, and the lack of mathematical formalism makes this both accessible and difficult to read.

In a course on light and color, we had students read a brief excerpt from Newton, in which he describes passing sunlight through a prism twice, noting that it does not divide into more colors on the second pass. He introduces the idea of some colors being "heterogeneal" and others "homogeneal." The investigation and the terminology prove useful for our own investigations around color.

When studying vision, students have read case studies by Oliver Sacks, another case study of "tongue vision" in which an image is projected onto the tongue of a blind man via electrical impulses, and an article on a man who cannot see and yet can navigate around objects and clearly has some kind of visual information reaching his brain. These readings help to spark questions around "where" seeing happens — is it a physical interaction between light and the retina? The retina and the brain? The visual cortex and a more interpretive part of the brain? The story of "tongue" vision helps to clarify questions around whether or not we see "upside down" and what that means.

Uploading to Google Docs
You should create multiple versions of the online document (usually one for every 4 - 6 students you have in class), and link those to your course management system or course website for students to easily access. The document should not be "editable" but should allow comments by anyone with a link. In general, keeping these readings available only to students is sufficient to meet the requirements of copyright; if you have questions, contact your school's librarian.

Final comments:
While we provide one simple example below, this structure can be easily modified for a range of 'reading-together' activities. For example, you can upload a student's writing for comments, or ask a student who has come across a website to turn that into a document to read together.

Homework:
An example of what we provide as a homework prompt is below. (Note that you will likely want several online copies of the document - perhaps one for each lab group.)

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.

This past week we've been trying to develop rules for how to use stop-motion animation to mimic a freely falling ball. This is related to a problem that Galileo first tackled (although not using stop-motion animation).

Tonight you will read an excerpt from Galileo's "Two New Sciences" that addresses this question. It can be accessed here:

http://tinyurl.com/read2gether

We will be reading it in a Google Doc so that you can comment and reply to others' comments.

Some things you might consider and discuss as you read:

1. do you understand what Galileo is proposing? if so, summarize the main ideas or the ideas you find most intriguing in a comment. if not, add a comment that explains what you find confusing.
2. does Galileo's description of acceleration match your own? someone else's? if so, discuss that in a comment. if not, where do you think you disagree?
3. Galileo also makes some comments about how to "do" science — what kinds of expectations he has, and why. Do you agree?

Note: Galileo wrote this as a conversation between three men (Simplicio, Sagredo, and Salviati) — with Salviati representing Galileo's current thinking.

Please bring a copy of the reading with your comments to class tomorrow.

If this is your first time using Google Docs (or a similar platform) in class, you'll want to familiarize students with the site. Using the document that you uploaded, show students how to add comments and how to reply to comments. In the example above, we have provided sample comments that are similar to things students might notice and write.

Organizing groups:
Before class, read through the comments, identifying places students found interesting and places they found confusing. In particular, look for places where students disagree on what the text is saying, or disagree on its implications for their own work. Develop brief discussion prompts around those topics.

In this example, we might group students with the following prompts:

Read through the comments related to this passage:

"we find no addition or increment more simple than that which repeats itself always in the same manner."

summarize on your whiteboard: what does this mean? what would be an example of a "less simple" increment? are there comments you disagree with? agree with? are there any questions that you might answer?

also: be prepared to discuss any implications for our stop-motion work.

Read through the comments related to this passage:

"the amount of speed acquired during the first two time-intervals will be double that acquired during the first time-interval alone; so the amount added during three of these time-intervals will be treble; and that in four, quadruple that of the first time interval."

summarize on your whiteboard: what does this mean? can you express this mathematically or graphically?

also: be prepared to discuss any implications for our stop-motion work.

Sagredo offers a critique of the ideas, and Salivati offers two responses:

Sagredo's critique: "indeed, it would not traverse a span in an even greater time; a phenomenon which baffles the imagination, while our senses show us that a heavy falling body suddenly acquires great speed."

Salviati's response #1: "…if the block be lifted only one finger-breadth how much more will it accomplish than if merely laid on top of the stake without percussion? Certainly very little. If it be lifted only the thickness of a leaf, the effect will be altogether imperceptible."

Salviati's response #2: "I do not see how you can doubt that the ascending stone, diminishing in speed, must before coming to rest pass through every possible degree of slowness."

Is there one response you find more compelling? Do you agree that a dropped stone will, at some point early in its fall, be traveling incredibly slowly? And, if so, how does the stop-motion animation reflect that?

Summarize any ideas you have on your whiteboard.

In the comments from one group, there was a lively discussion around this passage:

"A motion is said to be uniformly accelerated, when starting from rest, it acquires, during equal time-intervals, equal increments of speed."

In particular, they wondered why this is only true when an object "starts from rest."

Read through their comments, summarize the debate and present your current ideas.

Near the beginning of the reading, Galileo says he thinks that we should *"make this definition of accelerated motion exhibit the essential features of observed accelerated motions."* There are some interesting comments around this passage, and whether or there are other ways to "make a definition of accelerated motion." Read those.

Prepare a whiteboard that addresses some of those comments: did Galileo "invent" a definition for "accelerated motion" or did he discover it? does our class definition agree with Galileo's?

There are various ways of assigning groups: the first is to inform students of the prompts and let them select the topic they most want to discuss; the benefit is that people will select topics they most want to discuss, but the downside is that some groups may have very few students. The second is to simply give each lab group a prompt; this is usually the fastest. The third is to select groups based on their comments, so that students who have questions or ideas about a particular passage can discuss it more thoroughly; the strength of this approach is that it will mix up groups and you can arrange groups to have dissenting voices.

At the start of class, say something like:

> "I really enjoyed reading your comments and questions on this reading. I've picked ___ (five?) different discussion areas based on those places where you had a lot of questions or ideas… "

Then assign groups or have students self-assign as you see fit, making sure each group has copy of their prompt and a copy of the paper.

Finally, some students may have not done the reading. Rather than having those students join a group and listen in as others catch them up on the reading, we set aside a table in the classroom and ask any students who did not have time to finish the reading to use this time to do so. We try to be equanimous when this happens, and make a comment to suggest that you are simply making the best use of everyone's time:

> "If you have not had time to do the reading, please sit over here and use this time to catch up. No big deal - no harm no foul. It happens."

You may choose to grade participation in the homework, and not give credit to those students who did not complete it on time; this will, of course, depend on your own philosophy on homework, grades and deadlines. (We usually grade these assignments with a simple, low-stakes, credit/no-credit scheme and do not give credit for late work.)

Finally, let students know how long they have to work on this passage. Depending on the prompts and the complexity of the reading, you may need as few as 10 minutes or much longer.

Small group work:
Students should have copies of the reading with them. As they work, circulate among the groups. Make sure that the group agrees on what the text *says* before they debate whether or not they agree with it or if it relates to their own research. Once they do agree on the meaning of the text, encourage them to discuss how this relates to their own ideas and those from their classmates. Any ideas or questions for other groups should be written up on the whiteboard for later conversation.

If groups move at very different paces, you can ask a group that finishes early to address a second prompt. If a group is taking significantly longer than others, you may choose to narrow the scope of their prompt.

Whole class conversation:
The goal of the reading and this conversation is for students to: (1) fully understand the reading; (2) determine whether or not they agree or disagree with the ideas presented reading; and (3) articulate ways in which the reading informs or furthers their own inquiry.

The structure to your whole-class conversation will depend on the reading: if it is complex and students struggled to understand the science, you may want to go through the reading in depth, first discussing the idea from the text before engaging in any kind of response to those ideas. If so, you might start by saying something like:

> "The scientific ideas in this paper are pretty complex, and I'd like us to first work through understanding those ideas before we discuss whether or not we agree with those ideas or find those ideas useful."

Or:

> "The scientific ideas in this paper are pretty straightforward, but I want to take just a few minutes to make sure we're all on the same page with those ideas before we discuss whether or not we agree with those ideas or find those ideas useful."

In the example we provide here, we might continue by saying something like:

> "I've heard different groups interpreting Galileo's comment about "equal increments of speed" differently. Can we start with this sentence — "A motion is said to be uniformly accelerated, when starting from rest, it acquires, during equal time-intervals, equal increments of speed." — and make sure we all agree on what that means? — Group 3, I think this was your prompt…"

If your prompts follow the reading closely, you might discuss the prompts in order of their place in the reading.

Generally speaking (though not always) we first focus conversation on understanding the text. When a student suggests, say, that he disagrees with the text, or thinks that this applies to an open problem in the class, say something like:

> "So what I hear you saying is _____(summarize briefly how the comment is related to analysis, and not interpretation: "that you disagree…" or "that this will help us in figuring out…"). — A lot of people seemed to raise that point in the comments. But before we start that conversation, I want to finish discussing what the text means. So if you can hang on to that point, we'll get back to it in a few minutes."

After unpacking the main point(s) of your reading, turn attention to other issues raised in the comments or by the prompts. You might have each group present in turn, or — if the conversation naturally leads from one prompt to another — follow the conversation where it leads.

Journaling:
When the conversation has finished, give students an opportunity to reflect in their lab notebooks. Depending on what you have read and its connection to your own work, students might summarize the main ideas, or discuss whether or not they agree with those ideas, or how those ideas have implications for their ongoing work. Here, we might say:

> "For the next 10 minutes, use this time to collect your thoughts on how this reading applies to your stop-motion animations for a falling object. How do you think Galileo would create the animation? Do you agree with that? Are there changes you now want to make to your animation?"

Alternatively, you could ask them to do this as homework.

As a final note:
If we find that our students are not meaningfully commenting on the text we provide, our first hypothesis is that the text was not the right one to be reading: students do not yet have questions or ideas that the text speaks to, the text is too complex for them to find a way "in," or the text is so straightforward that they have nothing meaningful to add. If it is introduced too soon, you might table it and return later (saying something like, "so I noticed that you were struggling to have something to say about this paper — I want to set it aside for now and come back to it in a few weeks…"). When too complex — when students annotate with questions but few ideas and answers — you might choose a very short section to unpack in class as a group, and then ask them to repeat that work (closely reading shorter sections) as homework. And when too straightforward, you might decide that class time would be best spent just briefly summarizing the text and moving on.

Occasionally, however, students need support in understanding how to comment — the ways in which we read and query texts. If you feel that this is the case (and not that the text itself is the issue), you might start with groups working at tables to read and comment online on a shared computer. In this case, print a copy for every student in addition to the Google Doc; be explicit in describing why you have chosen the text - how it relates to ongoing questions and this adds

another voice to the conversation. Have a laptop for every lab group and project the Google document for all to see. Ask students to highlight any sentences they have trouble understanding; and ask students that, if they see a highlighted sentence, try to interpret that in the comments. We find that, as students see the document being populated with questions, interpretations, and discussions, little support is needed beyond that.

Resources:

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