



## Student-Authored Publications As a Means To Teaching Science Practices

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In recent years science instruction has privileged science facts and concepts. This is in part because assessing knowledge of facts and concepts is simpler than assessing science practices. This has fostered a culture of coverage; rather than allowing students to engage in inquiry, science instruction has been about reading from textbooks, labeling parts of a cell, memorizing cycles, and following cookbook style labs. While some may argue that learning to pipette accurately is an important skill, I argue that the more important science learning begins with design. Professional scientists design investigations and experiments; they pose questions and devise means to answer these questions.

While some teachers may worry that their students lack the capacity or background knowledge to carry out work as scientists<sup>1</sup>, the articles in *The Journal of Experimental Secondary Science* (JESS) demonstrate just how capable students can be. Recent research has likewise demonstrated that inquiry can support student learning and achievement<sup>2</sup>, particularly for long term retention and skill development<sup>3</sup>. Students can understand and retain scientific facts, concepts, and principles learned through inquiry<sup>4</sup>. Further, while traditional instruction tends to widen achievement gaps, inquiry has been shown to help narrow gaps<sup>2</sup>. All students need opportunities to engage in science inquiry.

With the recent release of the Next Generation Science Standards<sup>5</sup>, a strong focus is now placed on learning science practices. This includes posing questions, planning investigations, analyzing data, and communicating findings<sup>6</sup>. JESS is an important resource for teachers and students engaging with curricula and practices aligned to the NGSS.

Research has shown how valuable examples are for supporting student learning<sup>7</sup>, particularly for complex or ambitious instruction. Teachers can use articles published in JESS as examples to support their students to learn how to communicate their findings. Because the articles in JESS are written by other students, they are more accessible than articles published in other scientific journals. The articles in JESS demonstrate that secondary students can plan, conduct and publish results of their science experiments; this therefore serves as an important resource for students who may not see themselves as scientists, and who may view science as inaccessible.

Teachers can model scientific journal clubs with their students using articles from JESS; this practice—common in scientific labs—is a means to support scientific literacy<sup>8</sup>. Teachers wishing to implement a journal club need to provide structure to avoid book report style activities. Teachers should instead encourage their students to explore articles while considering critical questions such as: Are the questions scientific? Why or why not? Are the methods clear enough to reproduce the experiment? Does the study answer the questions it set out to answer? Are the conclusions supported by the results? If we wanted to do a follow-up study, what could we do to build on this work?

As may be clear from these questions, articles in JESS can also be a resource for teachers and students to design new investigations. Teachers can guide their students to reproduce an experiment. For instance, some JESS articles report studies involving collection of field data from a specific location; students could replicate the methods used in a new locale. Teachers can also guide their students to extend JESS studies. By critically discussing JESS articles, students can propose related work. This is an important support for teachers and students who may be less experienced carrying out the practices called for in the new science standards. JESS articles can also serve as a resource for the materials and equipment needed to carry out various types of investigations and experiments; teachers can look to JESS articles to propose equipment purchases, donations, to write grants, or to seek partnerships with university scientists.

As any scientist can tell you, publication is a key component of their work, and also a pleasurable one. The effort to “find and tell the story in the data” is rewarding and itself a learning process. While many teachers ask students to write lab reports, or conduct a review of research, rarely do students have the experience of writing a publishable paper.

The opportunity to publish a science article in JESS is significant, allowing students and teachers to take on authentic science identities. Unlike writing another lab report for the teacher to grade, writing for an external, scientific audience transforms the experience of writing. It elevates it because writing for the JESS audience provides a sense of purpose, and also a sense of responsibility. However, it is important to remember that when an article is submitted to any scientific journal—including JESS—it almost always requires revision. Authors learn to take criticisms offered by their peers and editors to improve the quality of their work and to advance understanding in the field. Teachers can help their students navigate this process and encourage them to persevere.

Not only does a publication in JESS look impressive on a student’s college application, the skills gained in the process of planning, conducting, and communicating science will support students to be successful in college coursework.

In summary, as states move to adopt and enact science practice standards, JESS stands as an important resource for teachers and students.

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