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Over the last few years I have observed that most science teachers across the state are trying to increase their workload every year. More teachers are trying to teach more to an increasing number of students. With the “high-stakes” testing and increased public scrutiny, many teachers are beginning to “cut corners” and sacrifice inquiry-based science to make sure that their students know all of the science vocabulary in the book and science content that can be copied into science notebooks.

Due to increased pressure many teachers appear to be doing the right things and they are surely approaching the limits of human ability in how hard they are working. As the teaching landscape has been changing, the things that I have not seen are just as important as some of the ones that I have seen.

Before going any further, it is important to note that I have seen a lot of excellent science teaching where teachers are doing it the right way. It is not the excellent science teaching that I plan to address in this message. I hope that those excellent science teachers will each grab two other teachers and show them what they are doing. I think that they will agree with just of this message.

1. I have seen many classrooms where the teacher does all of the explaining.
2. I have been in many classrooms where the students were not engaged in doing science.
3. I have seen many students memorizing science vocabulary and facts.
4. I have not seen students writing about their understanding of science, but have seen them copying notes from the “board”.
5. I have not seen a lot of analysis of student understanding.
6. I have not seen a high percentage of students using science process skills.
7. I have seen most students being evaluated by using multiple choice questions.
8. I have not seen much re-teaching of science.
9. I have not seen science teachers in grades K-8 with enough time to plan for teaching science.
10. I have seen a lot of “down time” in science classes where the students were not performing at high levels.

The National Science Teachers Association (NSTA) and many of its leaders have been suggesting that science teachers use the “5E” Lesson Plan to teach effective classroom science. This plan is consistent with many of the learning cycle approaches that have been so successful for many years.

I would like to suggest a couple of additions to this method that I call the “5E-Plus” Lesson Plan. Please allow me to use this plan, along with a few things that I have seen those excellent teachers doing, to suggest how we can change what we have been seeing and not-seeing in the science classroom.

The 5E-Plus Lesson:

Engage ---> (Enjoy)	Explore ---> (Enjoy)	Explain ---> (Enjoy)	Elaborate ---> Extend Expand Examples	Evaluate --->	Engage...
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Engage

When students are “engaged” with a science concept or principle and then they are encouraged to “explore” their understanding of it, then they are more able to explain it accurately. Even when they can not explain accurately, it takes less teacher effort to address misconceptions. By skipping the first two steps and going directly to the “explaining” step, we basically ask the student to memorize our explanations without supportive evidence. Students are less likely to remember explanations when their minds have done very little to figure out

how things work.

Explore

By “exploring” how science works, students will be able to use all of the process skills to seek answers and solutions. They will routinely follow the scientific method and will be able to easily interpret data, charts, graphs and models construct an accurate understanding of science. Students can not learn how to use these skills by taking notes, memorizing definitions and listening to someone else’s explanations.

Explain & Elaborate

When the teacher does all of the explaining, students get very little practice explaining science concepts and principles. When they are asked to explain or are evaluated to see if they accurately understand explanations, then it is more difficult for them to express themselves. When asked, they are forced to remember someone else’s explanation rather than their own.

Any time spent requiring students to copy definitions is time that is pretty much wasted. Time would be better spent asking students to “explain” using the important vocabulary. Time should be used for the student to “expand, extend, and elaborate” on the concept that is being studied. A valuable use of time would be time spent on applying the concept and explaining examples or uses of the concept.

When students repeat that which we have said or that which we have asked them to copy from the “board”, it does not mean that they understand it. If we believe otherwise, we are fooling ourselves into thinking that our students are “getting it”. Instead, we must ask our students to write their explanations as often as possible. This gives them opportunities to construct their understanding of science and allows us to know what they are thinking. By writing their explanations, students provide us with the chance to analyze their thoughts and to find out if they are “getting it” or if they need additional experiences to correct their thinking.

Evaluate

It is alright to use multiple choice questions to evaluate what a student has learned. But it should not be the only way that students are evaluated. Extended response questions should be used as well as authentic assessments. These assessments can help measure the use of process skills as well as content. If multiple choice items are used they should be good ones. Too many items have clues, ridiculous foils or more than one correct answer. Students who constantly use poor items are overwhelmed when they encounter “good” items that lack the clues that they are accustomed to seeing.

Use of varied assessments also allows the teacher to better identify concepts that must be re-taught to some students. Extended response and authentic items even provide teachers with clues about students’ misconceptions.

Enjoy

Notice that the word “enjoy” appears all over the 5E-Plus Lesson. Our students enjoy doing science much more than copying definitions and memorizing explanations. If they enjoy doing science, they are likely do more science and they might be more likely to pursue careers in science or become scientifically literate citizens.

These suggestions may overly simplify a complicated issue, but it is evident that science teachers can not afford to waste even one minute of class time. The need for planning time to arrange for teaching science effectively is more important than ever. We have to use our planning time efficiently and seek ways to get more time to plan. Teachers must work together to make this happen.

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