

Teacher Scenario A: Mrs. Johnson

Background

Mrs. Johnson teaches high school environmental science at the same school as Mr. Diego. The district has developed a K-12 scope and sequence, a pacing guide, and has recommended specific textbooks for teachers to use to plan for instruction. The school is focused on using best practices in teaching that support improved learning and achievement for all students. Since the school is also asking teachers to use data to inform instruction, the science department has agreed to give common assessments – end of unit chapter tests that all students in the same course take no matter what teacher they have – so that teachers can learn from the data.

Mrs. Johnson attended a summer professional development institute along with other teachers from her school. The teachers are working together through their school-based professional learning community to implement the ideas and strategies learned during the institute. Mrs. Johnson and Mr. Diego attended different institutes and are part of different small groups.

Course details

The PD institute that Mrs. Johnson attended was centered on incorporating scientific case studies in high school science classrooms. Before Mrs. Johnson started using these resources, she wanted to ensure her students were comfortable with the quantitative reasoning (QR) skills they would need to fully understand and appreciate the findings within the case studies. She gave her students a formative assessment at the beginning of the course to examine the variation in QR skills of her students. To her surprise, she saw that most students struggled in many aspects of the assessment, especially questions about reading and interpreting graphs. Because of the emphasis on QR on state and national standardized tests, she spent an entire week at the beginning of the semester devoted to QR lessons that would form a foundation for future activities and deep thinking for the rest of her course. Each day she chose one topic that would build on the student's work from the previous lesson. She started by giving students examples of scientific questions and having students identify relevant independent and dependent variables. The following day she had students practice graphing. She provided instruction to remind students when to use certain graph types and what is to be included on each graph. The next day, she provided definitions of the terms “claims” and “evidence” and had her students practice identifying well-written examples. She followed this lesson by providing short vignettes from environmental case studies and showed the students a graph summarizing the results of an experiment. She had the students practice writing claims that answered the question posed by the scientists and supporting these claims with evidence. The next day, she introduced the term “reasoning”. She had the students revisit the case studies and either revise or add reasoning that showed how the evidence supported the claim.

For the remainder of the semester, she referred back to these skills the students learned at the beginning of the semester by devoting one day a week to investigating scientific case studies focused on environmental science. Again, the students had to practice reading the scientific vignettes, interpreting graphs and data, and then make claims supported by evidence. Sometimes these case studies aligned perfectly with other content she was teaching that week, and sometimes she chose one that was about a new topic. About halfway through the semester, she introduced the outline for an inquiry project that would be ongoing for the rest of the semester.

The students would be investigating how water quality affects stream food webs. First, she had her students examine a large online dataset from a long-term experiment that collected data on several water quality parameters and biodiversity in streams in their state. She gave them an assignment to develop a scientific question and use the variables in the dataset to produce a graph. Using what they learned from their observations of this dataset, she had them form groups and brainstorm a question they could investigate by collecting data from the stream near their school campus. Mrs. Johnson replaced the weekly case study examination with class trips to the stream so that the students could collect long-term data. At the end of the semester, she had the students make graphs and interpret their data. She had each group make a poster that presented the study and the results. Unfortunately, many of the groups had messy data that did not show a simple trend and the students struggled with interpreting what was happening in the stream. This was the first year she had tried this inquiry project, so Mrs. Johnson felt unprepared to handle discussions about variation in the data arising from experimental error versus natural variation, and other topics about messy data in front of her students. Moving forward, she decided that if she did a large-scale inquiry project in the future, she would have to first have students examine case studies that had messy data and results that were not straightforward so that she and her students would have more practice discussing these topics.

Teacher Scenario B: Mr. Diego

Background

Mr. Diego teaches high school biology at the same school as Mrs. Johnson. The district has developed a K-12 scope and sequence, a pacing guide, and has recommended specific textbooks for teachers to use to plan for instruction. The school is focused on using best practices in teaching that support improved learning and achievement for all students. Since the school is also asking teachers to use data to inform instruction, the science department has agreed to give common assessments – end of unit chapter tests that all students in the same course take no matter what teacher they have – so that teachers can learn from the data.

Mr. Diego attended a summer professional development institute along with other teachers from his school. The teachers are working together through their school-based professional learning community to implement the ideas and strategies learned during the institute. Mr. Diego and Mrs. Johnson attended different institutes and are part of different small groups.

Course details

Mr. Diego went to a PD Institute that explored various experiments that could be integrated into his state's science curriculum for high school biology. After his summer PD institute, Mr. Diego mapped these experiments on to his school's pacing guide and chose which ones he would use with his students that year. Mr. Diego broke down the topics he was going to teach into 10 units and found two guided experiments that would fit. Each experiment would take 1-2 days to complete and would reinforce key concepts he wanted the students to learn. For each unit, Mr. Diego first introduced the relevant biological content by sharing videos, defining key terms, reading science news articles, and doing short hands-on activities or games. After his students were given the content for each unit, he would proceed to do labs that reinforced content that he had previously taught from the unit. As an example, for the unit on photosynthesis, Mr. Diego had his students collect data on the differences of plant performance when some were kept in the dark and others in the direct light. For each experiment, he had the students record data, make graphs, and interpret the results. At the end of each experiment, the students were expected to submit a lab report on the standardized template that Mr. Diego gave them. The students were to include the scientific question, methods, data, graphs, and conclusions to demonstrate what they learned. Mr. Diego knew that reading and interpreting graphs was highly emphasized on state and national standardized tests, so he wanted to make sure his students were prepared by having lots of experience with graphing and summarizing the results from the experiments. By the end of the semester the students would have practiced these skills 10 times with Mr. Diego's standardized lab report write-ups. Mr. Diego used these lab reports and quizzes with questions about the lab experience as a way to assess how effective each lab had been. The standardized lab report template was a way for him to determine whether his students' QR skills were improving over the course of the semester.

In addition, to further prepare his students, Mr. Diego started each class with 5 minutes devoted to a short math problem that was written in the context of a biological scenario. Mr. Diego's goal was to find additional problems that would give students practice integrating math and science. For example, he might start the day with a problem where students calculate means for a small set of data on cell mutations or practice converting dilution data from decimals to scientific

notation. Towards the end of the semester, Mr. Diego assigned a four-page research paper on a symbiotic relationship between two or more species. In this paper, the students were to define the different types of symbiosis, provide examples, and then focus on one concrete example to research and elaborate with detailed information. The students were to provide at least one graphical representation within their report to support part of their research. To be explicit about his expectations, Mr. Diego provided a checklist and a rubric for how he would be grading the research paper. Mr. Diego built in several points for him to check their progress before the final submission. For example, the students were to select the symbiotic relationship they would be researching after one week, after the second week they were to submit three peer-reviewed references for articles. The week prior to the final deadline, the students were told to bring a draft to the class so they could do a peer review.