TEACHING SCIENCE AS INQUIRY pdf

1: Teaching Strategies to Use Inquiry-Based Learning

Teaching science through science inquiry is the cornerstone of good teaching. Teaching science through science inquiry is the cornerstone of good teaching. Unfortunately, an inquiry-approach to teaching science is not the norm in schools as "many teachers are still striving to build a shared.

What Is Inquiry-Based Instruction? Warner and Brian E. Myers 2 Introduction Educators should constantly evaluate and adjust their teaching approaches to meet the educational needs of their students and society. Agricultural educators have the unique ability to incorporate all of these elements into their classrooms and teaching through the context of agriculture. What is Inquiry-Based Teaching? Inquiry-based teaching is a teaching method that combines the curiosity of students and the scientific method to enhance the development of critical thinking skills while learning science. As learners encounter problems they do not understand, they formulate questions, explore problems, observe, and apply new information in seeking a better understanding of the world. The natural process the learners follow when seeking answers and deeper understanding closely follows the generally accepted scientific method. Often, the answers proposed by learners lead to even more questionsâ€”much like the outcomes of research. Students engage in five activities when they engage in inquiry learning and use the scientific method, as noted in the National Science Education Standards published by the National Academy of Sciences. Although these tasks occur in a logical progression, inquiry is a fluid process, and one task may lead back to a previous task. This process is illustrated in Figure 1. Each of these factors can be found in the following example. Question Students in an introductory agricultural education course notice that one of the two plants the class planted on the same day and placed in different parts of the classroom is bigger than the other. Investigate Students know plants need water to grow. They know the plants receive the same amount of water because they are responsible for watering the plants and give the same amount of water to each plant. Since the students know the water is the same for each plant, they decide there must be another explanation for the difference in plant growth. The students research plant growth and find light and temperature are also important factors. The students decide to monitor the temperature in each location to see if a temperature difference exists. For one week, the students take the temperature next to each plant in the morning and the afternoon. Use Evidence to Describe, Explain, and Predict At the end of the week, the students review all of the data collected and determine the temperature is the same in both locations. Their findings eliminate temperature as the cause of Plant A growing faster than Plant B. The learners predict that light is the cause of the difference in plant growth, so they decide to monitor the amount of light the plants are receiving. Investigate The students decide to count the hours of sunlight each plant receives in one day. Every hour, the students check each plant and mark if the plant is in the sun or not. They can conclude light affected the different growth rates of the two plants. Connecting Evidence to Knowledge As a result of their experiment, the students note that water, temperature, and light affect plant growth. They realize a difference in one of these factors can cause a noticeable difference in plant growth. Sharing Findings Since the students did such a good job finding the answer to their question, the teacher asks them to share their work during a parent showcase night. The students explain each aspect of their experiment process and discuss the findings and conclusions. Why Use Inquiry-Based Teaching? Agricultural educators can play a vital role in achieving some of the standards in science, math, reading, and writing, while teaching the agricultural curriculum. When students engage in inquiry, they utilize skills from across multiple disciplines e. Inquiry-based teaching methods provide flexibility to the teachers and students by facilitating student contribution of their strengths, so students of different developmental levels and learning styles learn together. Inquiry-based methods align with the hands-on, experiential education format agricultural education provides. Inquiry-based learning requires students to actively use their hands and minds, and as a result, students are able to assemble ideas to create their own knowledge and understanding. Conclusion Inquiry-based methods support many national and state learning standards and allow agricultural educators to contribute to school-wide educational goals. For additional ideas on further developing inquiry-based learning techniques, see the companion publication titled Implementing Inquiry-Based Teaching Methods. Useful Resources Budnitz, N. What do we mean by inquiry?

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Retrieved January 21, , from http: Methods for teaching science as inquiry 9th ed. Upper Saddle River, NJ: Why inquiry-based teaching and learning in the middle school science classroom? Implementing inquiry-based science standards. Teaching high school science through inquiry: A case study approach. Retrieved April 4, , from http: Original publication date September Visit the EDIS website at http: Warner, graduate student; and Brian E. The Institute of Food and Agricultural Sciences IFAS is an Equal Opportunity Institution authorized to provide research, educational information and other services only to individuals and institutions that function with non-discrimination with respect to race, creed, color, religion, age, disability, sex, sexual orientation, marital status, national origin, political opinions or affiliations.

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2: Teaching Science as Inquiry (TSI): Aquatic - Curriculum Research & Development Group

A workshop to introduce teachers to scientific inquiry as described in the "National Science Education Standards" is designed. Participants were involved in brief case studies and activities, treated to an explanation of "Science as Inquiry," and recommendations for professional development were.

Teaching Science through Inquiry. In a statement of shared principles, the U. Department of Education and the National Science Foundation together endorsed mathematics and science curricula that "promote active learning, inquiry, problem solving, cooperative learning, and other instructional methods that motivate students. Some have emphasized the active nature of student involvement, associating inquiry with "hands-on" learning and experiential or activity-based instruction. Others have linked inquiry with a discovery approach or with development of process skills associated with "the scientific method. From a science perspective, inquiry-oriented instruction engages students in the investigative nature of science. As Novak suggested some time ago , "Inquiry is the [set] of behaviors involved in the struggle of human beings for reasonable explanations of phenomena about which they are curious. Others promote the use of heuristic devices to aid skill development Germann, A focus on inquiry always involves, though, collection and interpretation of information in response to wondering and exploring. From a pedagogical perspective, inquiry-oriented teaching is often contrasted with more traditional expository methods and reflects the constructivist model of learning, often referred to as active learning, so strongly held among science educators today. In classrooms where students are encouraged to make meaning, they are generally involved in "developing and restructuring [their] knowledge schemes through experiences with phenomena, through exploratory talk and teacher intervention" Driver, Indeed, research findings indicate that, "students are likely to begin to understand the natural world if they work directly with natural phenomena, using their senses to observe and using instruments to extend the power of their senses" National Science Board, , p. In its essence, then, inquiry-oriented teaching engages students in investigations to satisfy curiosities, with curiosities being satisfied when individuals have constructed mental frameworks that adequately explain their experiences. One implication is that inquiry-oriented teaching begins or at least involves stimulating curiosity or provoking wonder. There is no authentic investigation or meaningful learning if there is no inquiring mind seeking an answer, solution, explanation, or decision. It seems particularly important that inquiry-oriented teaching may be especially valuable for many underserved and underrepresented populations. In one study, language-minority students were found to acquire scientific ways of thinking, talking, and writing through inquiry-oriented teaching Rosebery et al. Active explorations in science have been advocated for teaching deaf students Chira, Finally, experiential instructional approaches using ordinary life experiences are considered to be more compatible with native American viewpoints than are text-based approaches Taylor, Caution must be used, however, in interpreting reported findings. There is evidence of interactions among investigative approaches to science teaching and teaching styles Lock, , and the effects of directed inquiry on student performance may vary by level of cognitive development Germann, There seems also a possible conflict of goals when attempting to balance the needs of underachieving gifted students to develop more positive self-concepts with the desire to develop skills of inquiry and problem solving Wolfe, It must also be emphasized that an emphasis on inquiry-oriented teaching does not necessarily preclude the use of textbooks or other instructional materials. Other materials accommodating an inquiry approach to teaching have been identified by Haury Duschl has described how textbooks can be used to support inquiry-oriented science teaching. As mentioned by Hooker , p. Use of computerized data-bases to facilitate development of inquiry skills has also been studied Maor, Volume I Final report. ED Chira , S. Wherein balloons teach the learning process. Perspectives in Education and Deafness, 8 4 , A sample dialogue based on a theory of inquiry teaching Tech. Bolt, Beranek, and Newman, Inc. ED Dawson, G. An inquiry-based videodisc science curriculum. ED DeBoer, G. A history of ideas in science education. The construction of scientific knowledge in school classrooms. Images of science in science education. Textbooks and the teaching of fluid inquiry. School Science and Mathematics, 86 1 , Directed-inquiry approach to learning science process skills:

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Treatment effects and aptitude-treatment interactions. Journal of Research in Science Teaching, 26 3 , Developing science process skills through directed inquiry. American Biology Teacher, 53 4 , The effects of hands-on and teacher demonstration laboratory methods on science achievement in relation to reasoning ability and prior knowledge. Journal of Research in Science Teaching, 26 2 , Journal of Research in Science Teaching, 27 7 , In Science curriculum resource handbook. A critical look at practical work in school science. School Science Review, 71 , What research says about biology laboratory instruction. American Biology Teacher, 50 5 , Science and Children, 23 2 , Childhood Education, 67 2 , The interactive media science project: An inquiry-based multimedia science curriculum. Journal of Computers in Mathematics and Science Teaching, 9 1 , The role of experiences in learning science vocabulary. ED Lloyd, C. Science and Children, 25 2 , What do we mean and how can we use them? Development of student inquiry skills: A constructivist approach in a computerized classroom environment. ED Mattheis, F. Effects of a laboratory-centered inquiry program on laboratory skills, science process skills, and understanding of science knowledge in middle grades students. ED Mechling, K. What research says about science programs. Principal, 62 4 , National science education standards: NSB Novak, A. Teaching science as inquiry. Phi Delta Kappa Educational Foundation. ED Rodriguez, I. An inquiry approach to science and language teaching. Journal of Research in Science Teaching, 20 4 , Making sense of science in language minority classrooms. Bolt, Baranek, and Newman, Inc. ED Rutherford, F. Science for all Americans. Teaching Education, 3 2 , Journal of Research in Science Teaching, 27 2 , Analysis of the project synthesis goal cluster orientation and inquiry emphasis of elementary science textbooks. Journal of Research in Science Teaching, 24 7 , The constructivist epistemology of Jean Piaget: Its philosophical roots and relevance to science teaching and learning. ED Tamir, P. Content analysis focusing on inquiry. Journal of Curriculum Studies, 17 1 , ED Tinnesand, M. Throw out the instructions. Science Teacher, 54 6 , Statement of Principles Brochure. Teaching science to gifted underachievers: A conflict of goals. Canadian Journal of Special Education, 6 1 , Further, this site is using a privately owned and located server. This is NOT a government sponsored or government sanctioned site.

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3: Bass, Contant & Carin, Teaching Science as Inquiry | Pearson

Teaching Science as Inquiry demonstrates a manageable way for new and experienced teachers to bring inquiry successfully into the science classroom through a 2-part structure: Methods for Teaching Science as Inquiry and Activities for Teaching Science as Inquiry.

Prospective teachers in colleges and universities may have only high school science courses behind them. Experienced teachers who are certified in other fields may find themselves teaching science. Veteran science teachers or scientists who aspire to teach may have a strong but traditional science background or may be teaching a science different from their background. All may find themselves challenged by the need to learn more or a different kind of science. To teach their students science through inquiry, teachers need to understand the important content ideas in science â€" as outlined, for example, in the Standards. They need to know how the facts, principles, laws, and formulas that they have learned in their own science courses are subsumed by and linked to those important ideas. They also need to know the evidence for the content they teach â€" how we know what we know. But how can teachers learn the major ideas in the scientific disciplines? There are many possibilities, from formal preservice or in-service classes, to independent programs of study, to serious reflection on their interactions with students in their inquiry-based classrooms. The next three vignettes in this chapter describe a range of science courses and professional development experiences that give teachers an opportunity to learn the major ideas of science disciplines through inquiry. The first vignette tells the story of a university-based physicist who teaches teachers within the structure of a university course. The second describes the experiences of a teacher taking part in that same course. And the third tells of a kindergarten teacher who is immersed in science at a program in a science museum. Besides changing the traditional lecture approach in a science course, Page 93 Share Cite Suggested Citation: Inquiry and the National Science Education Standards: A Guide for Teaching and Learning. The National Academies Press. The Physics Education Group in the Department of Physics at the University of Washington offers special courses for both preservice and inservice teachers. The curriculum is based on Physics by Inquiry McDermott et al. References to relevant research can be found in McDermott and Redish, The courses help teachers develop a functional understanding of important physical concepts. However, there is another compelling reason why the choice of curriculum is critical. Teachers often try to implement instructional materials in their classrooms that are very similar to those that they have used in their college courses. Whether intended or not, teaching methods are learned by example. The common tendency to teach physics from the top down, and to teach by telling in lectures, runs counter to the way precollege students and many university students learn best. Therefore, courses for precollege teachers should be laboratory-based. In the curriculum that we have developed and use in our courses for preservice and inservice teachers, all instruction takes place in the laboratory. The students work in small groups with equipment similar to that used in precollege programs. The approach differs from the customary practice of introducing a new topic by stating definitions and assertions. Instead, students are presented with a situation in which the need for a new concept becomes apparent. Starting with their observations, they begin the process of constructing a conceptual model that can account for the phenomenon of interest. Carefully structured questions guide them in formulating operational definitions of important concepts. They begin to think critically about what they observe and learn to ask appropriate questions of their own. As they encounter new situations, the students test their model and find some instances in which their initial model is inadequate and that additional concepts are needed. The students continue testing, extending, and refining the model to the point that they can predict and explain a range of phenomena. This is the heart of the scientific method, a process that must be experienced to be understood. To illustrate the type of instruction summarized above, here is a specific example based on a topic included in many precollege programs. Mathematics is not necessary; qualitative reasoning is sufficient. The students begin the process of model-building by trying to light a small bulb with a battery and a single wire. They develop an operational definition for the concept of a complete circuit. Exploring the effect of adding additional bulbs and wires to the circuit, they find that their observations are consistent with the following

assumptions: As the students conduct further experiments some suggested, some of their own devising , they find that the brightness of individual bulbs depends both on how many are in the circuit and on how they are connected to the battery and to one another. The students are led to construct the concept of electrical resistance and find that they can predict the behavior of many, but not all, simple circuits of identical bulbs. They recognize the need to extend their model beyond the concepts of current and resistance to include the concept of voltage which will later be refined to potential difference. As bulbs of different resistance and additional batteries are added, the students find that they need additional concepts to account for the behavior of more complicated circuits. They are guided in developing more complex concepts, such as electrical power and energy. Proceeding step-by-step through deductive and inductive reasoning, the students construct a conceptual model that they can apply to predict relative brightness in any circuit consisting of batteries and bulbs. We have used this guided-inquiry approach with teachers at all educational levels, from elementary through high school. Having become aware of the intellectual demands through their own experience, the teachers recognize that developmental level will determine the amount of model-building that is appropriate for their students. For the teachers, however, the sense of empowerment that results from in-depth understanding generates confidence that they can deal with unexpected classroom situations. Page 95 Share Cite Suggested Citation: Generalizations and elucidation of general principles come after experience and in iterative fashion. Carefully chosen questions are designed to elicit debates and hard thinking about these ideas based on guided investigations, related readings, and small group and individual work. Specific laboratory investigations have been selected by the staff â€" activities they know will cause the students to confront their existing beliefs about physics. This guided inquiry is essential at the introductory level so that the students can later use their developing knowledge and conceptual understanding to dig more deeply into the key ideas of physical science. The University of Washington program is based on the belief that both lecturing on basic principles and providing unstructured lab time are less effective strategies for bringing about student growth in conceptual understanding and reasoning skills. Today, more than 25 years later, she reflects on how her experience in the program has affected her professional development as a teacher. The good news, however, was that I was welcome to take a newly-created position as the science specialist for grades K Not wanting to relocate and not stopping to consider that my major in French might not have appropriately prepared me for this new position, I Page 96 Share Cite Suggested Citation: The district science supervisor suggested that we start with a couple of Elementary Science Study units, Clay Boats and Primary Balancing. The unit guides and equipment were ordered. I was all set to begin my new teaching role. Never having had a science lesson in elementary school, I was not predisposed, as I had been with the other subjects, to teach it as I had been taught. The students were engaged. They talked a lot about what they were doing and we all asked a lot of questions. But I wanted to do more than just explore and ask questions. I wanted to learn some basic principles and have a clear vision of where we were going. I wanted to lead my students to discover and understand something. But what was it that we should understand? This is when I first came to recognize that if I were to become a truly effective teacher, I would need scientific skills and understandings that I had not been required to develop during my undergraduate years. I applied and was accepted. Nothing I had been exposed to in college had really addressed what I needed to know to guide my students to develop the conceptual understanding and thinking and reasoning skills needed to make sense of the world around them. I walked away from that summer feeling that my brain had been to boot camp. No course of study, no one teacher had ever demanded so much of me. I had never before been asked to explain my reasoning. A simple answer was no longer sufficient. I had been expected to think about how I came to that answer and what that answer meant. It had been excruciating at times, extricating the complicated and detailed thought processes that brought me to a conclusion, but I found it became easier to do as the summer progressed. I also began to realize that just as important as what I came to understand, was how I came to understand it. Through the process of inquiry, I had come to an understanding of content that I had always felt was beyond me. I wanted to be able to ask the questions that would lead my students to the same kind of understanding. The key to the questions was first understanding the content. The content had been the focus of the summer institute and as a result I had developed a conceptual understanding of several basic science concepts including balance, mass,

and volume. Along with these concepts I had discovered an appreciation for the need to control variables in an experiment. I was now better equipped to take a more critical look at the science units I had used the previous year. I recognized that Clay Boats had probably not been the best choice for a teacher with only a budding understanding of sinking and floating, but Primary Balance seemed to be an appropriate choice since I had explored very similar materials and had some ideas of how I could lead students to discover, through experiments in which they would come to understand the need to control variables, which factors seem to influence balance and which do not. Page 97 Share Cite Suggested Citation: It is an understanding of the content that allows me to teach with confidence units such as electric circuits, magnetism, heat and temperature, and sinking and floating. And although this content knowledge was essential, simply understanding the content did not assure that I could bring my students to an understanding appropriate for them. How does one begin to develop some expertise in these strategies we call inquiry? For me, I can only suppose that it began by reflecting upon my personal experiences. However, in subtle ways, over a period of many years, I began to teach in the way in which I had been taught in the summer institutes. I know that early on I began to pay attention to the questions that I asked, for the questions stood out in my mind as the tools that, when deftly wielded, resulted in the desired state of understanding in me. I knew, too, that questions would help me to discover the intellectual status of my students. In other words, where they were. I envisioned the terrain between the students and their conceptual understanding. I liken the terrain to an aerial photograph that clearly details all the various roads that lead to the designated destination. I am well acquainted with this terrain, because I have traversed it on more than one occasion myself, and have conversed with others who have, perhaps, taken a different path to the same destination. It is in this way that I can offer guidance to my students, so that they may not wander too far from a fruitful path.

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4: Bass, Contant & Carin, Teaching Science as Inquiry (with MyLab Education) | Pearson

Teaching Science as Inquiry introduces prospective and experienced teachers to the science content, teaching strategies, and inquiry activities necessary to teach science in contemporary ways. In addition, the inclusion of the National Science Education standards will provide all readers a useful framework for making instructional decisions.

Think of an Essential Question When introducing inquiry, you can guide students toward an essential question. Once students understand how it works, they can do this step on their own. For this example we are talking about the life cycle of an animal. A good, open-ended question will lead to more questions, and that is the goal with inquiry-based learning. You want students to use higher-order thinking, which will require them to produce more information. Plan for Learning Skills For this example our plan is to teach students about the life cycle of an animal. But that is not the only thing that we want them to learn. So your next step is to plan out what learning skills you want to know by the end of this. You may want to use inquiry to introduce students to write detailed paragraphs about life cycles, or be able to read non-fiction text. You may want them to make a presentation or collaborate with their peers on a project. Whatever you choose, now is the time to plan for these activities. More often than not, the students will lead you to the skills they need to learn through their questions. This is when you have to be prepared for anything. Gather All of Your Resources To prepare for your inquiry-based learning lesson, you will need a variety of resources. You can choose fiction and non-fiction texts, computer programs, age-appropriate apps, videos, Internet sites, and whatever else will help students find the answers that they are looking for. Set Expectations Like any lesson or project that you have students working on, you will want to set some expectations. Collaboration and cooperative learning are a huge part of inquiry-based learning, so students need some guidelines on how to engage and work with others. The traditional rules, like kindly share all materials with others, and be respectful, will work just fine. So what does inquiry learning really look like? Students start by expressing their own curiosity, then they explore, ask questions, and investigate for answers. While building their knowledge, they continue to ask questions and search for answers, until they are able to share their knowledge with others. Inquiry-based learning is a process, and students will shift through the stages of it as they learn. Once you try it in your classroom, you will see for yourself how free-flowing and creative your classroom can really be. Do you practice the inquiry-based learning model in your classroom? If so, do you have tips that you would like to share? Please leave your thoughts in the comment section below, we would love to hear your ideas.

TEACHING SCIENCE AS INQUIRY pdf

5: Teaching Science as Inquiry by Joel E. Bass

TeachingScience asInquiry S cience literacyâ€"the ability to use one's knowledge and under- In teaching science as inquiry, teachers can vary the level of.

Workshop 6 Workshop 7 Workshop 8 Contributing Authors: What is Inquiry teaching? Inquiry encourages children to question, conduct research for genuine reasons, and make discoveries on their own. The practice transforms the teacher into a learner with students, and students become teachers with us. Inquiry teaching honors previous experience and knowledge. It makes use of multiple ways of knowing and taking on new perspectives when exploring issues, content, and questions. How will inquiry teaching help my students learn? Students quickly see the cycle of learning and that learning has cycles. Students learn to think and problem solve. They learn that there is no one place or one resource for answers, but that many tools are useful for exploring problems. Students actively involved in making observations, collecting and analyzing information, synthesizing information, and drawing conclusions are developing useful problem-solving skills. These skills can be applied to future "need to know" situations that students will encounter both at school and at work. Why is the time dedicated to this teaching methodology a good investment? You are spending time supporting thinkers and helping their minds develop so that they can approach new learning creatively and energetically. Students are learning how to learn. You are supporting their quest for knowledge and their curiosity about their world. In traditional schools, students learn not to ask too many questions, instead to listen and repeat the expected answers. Most of our schools focus on teaching a set of basic skills that do not serve the needs of modern society. Our modern society is faster paced, globally networked, technologically oriented, and requires workers who can problem solve and think critically. Inquiry teaching and learning teaches students how to seek appropriate resolutions to questions and issues. What is my role in an inquiry classroom? The success of your inquiry classroom comes from a shift in your role from the "sage on the stage" to the "guide on the side. You are the leader, the coach, the question asker, the seeker of resources, and the theory builder. Although there are still many times when you present information to students, you are not solely responsible to impart all of the information. Students participate as question askers and seekers of answers. You create a rich variety of assessments for students to "show what they know. How do I begin to build "a classroom community? Maintain clear expectations within high standards socially and academically. Begin the year by outlining clear "ground rules" with your students, making it clear that there is no tolerance for disrespectful or hurtful actions to others. For inquiry to be successful, students need to feel safe to take risks, share ideas, and believe ideas can lead to more ideas and questions, even if they are not correct. Virginia Lockwood, the first grade teacher seen in the video program, created a mantra she continually shares with her students: For example, you can stop your teaching if a child giggles at another, and remind students how the classroom should operate. How can teachers keep all students involved in an inquiry classroom? Cooperative work groups foster a sense of community and include all students. The groups are given a task. Each student is assigned a role. For example, one student might be the recorder. The other student might be the presenter to the class. As you develop the interpersonal skills of the students and the complexity of the project, you may want to expand the group size to three or four. A few examples of student roles may include: How can I begin to build techniques of inquiry into my existing lessons? A key technique to encourage inquiry in your existing lessons is to focus on the nature of conversation in your classroom. In a traditional teacher-centered classroom, notice how all eyes are always on the teacher, who presents information. For inquiry to be successful, the classroom needs to shift from a teacher-centered to a student-centered environment, whereby students contribute to the questioning and generating hypotheses. If you have a specific lesson plan with dictated outcomes, take time to let students linger in their conversations, encouraging them to wonder and think. Ask them questions, such as "Why do you think that? What resources are available to support my science content knowledge? There are a variety of search engines on the Internet to support your teaching and the development of background knowledge. This site may be used as a search engine to explore a specific topic. In addition, suggested science categories are provided under the Science and Nature link. Also, seek out resources from local nature centers, botanical

gardens, zoos, and other outside science organizations. These agencies provide educational outreach and support to schools. In addition, there is a wide assortment of non-fiction books available on science topics. How can science kits that are not specifically designed for inquiry be extended to encourage inquiry? Many science kits are full of excellent materials. Try to engage students in conversation about these materials before you engage in activities with designated outcomes. For example, in a traditional classroom, students might look at a diagram and then listen to a lecture about a topic. How is inquiry science teaching different than "hands-on" science teaching? In inquiry teaching and learning, students are thinking and questioning. They are coming up with the questions to investigate. Students devise these investigations that in fact are hands-on, but not prescribed by the teacher. Students need to work out discrepancies in previously held ideas and new observations they are making about their world and environment. An old adage states: Why is it important for students to learn how to access information and find their own resources? We are living in an information age where available information is expanding at a remarkable rate. If students only learn how to memorize, when they leave school they have the knowledge base that is the equivalent of an outdated encyclopedia. Students need to learn how to ask and answer new questions that arise. To answer the questions, they will need to learn how to filter the vast resources to find the information that they need. They will need to evaluate the resources for accuracy. Finally, they need to learn how to process sources of information to make thoughtful decisions in the future. What kinds of questions can I ask to facilitate an inquiry discussion? Questions are at the heart of inquiry learning and teaching. While questions are often part of the traditional classroom, the sources and purposes are quite different. In the traditional classroom, the teacher often uses questions to provoke feedback about a reading or an activity. In the inquiry classroom, the teacher asks questions that are more open ended and reflective in nature, such as "What are you thinking, and why do you think that? For further resources, see:

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6: Teaching Science as Inquiry by Arthur A. Carin

Teaching Science as Inquiry Research tells us that an inquiry approach to science teaching motivates and engages every type of student, helping them understand science's relevance to their lives, as well as the nature of science itself.

Warner and Brian E. Myers 2 Introduction Much like a woodworker continually acquires new tools to perform different tasks in his shop, educators, too, should search for tools to add to their repertoire of educational practices. One tool is not sufficient to do every task a woodworker must complete, and one teaching method should not be considered sufficient for teaching all topics and meeting all standards. Inquiry-based teaching methods provide agricultural educators with another teaching technique for developing life-long learners. They prove especially useful in delivering concepts that rely heavily on science. Teachers play a vital role in adapting the inquiry process to the knowledge and ability level of their students. Based on the objectives of the lesson and the abilities of the students, teachers must decide how much guidance they will provide. Regardless of the amount of assistance that teachers provide, the fundamental goal of inquiry is student engagement during the learning process. When incorporating inquiry-based methods into the classroom, educators should ensure that each of the six stages of the inquiry cycle, as shown below, is complete. Six Stages of the Inquiry Cycle Inquisitionâ€”stating a "what if" or "I wonder" question to be investigated Acquisitionâ€”brainstorming possible procedures Suppositionâ€”identifying an "I think" statement to test Implementationâ€”designing and carrying out a plan Summationâ€”collecting evidence and drawing conclusions Exhibitionâ€”sharing and communication results Llewellyn, , p. A sample classroom lesson plan follows in Figure 2. In order to answer the questions, students work individually or in small groups to explore, observe, and discover answers. The teachers can then expand upon the discoveries the students make to provide explanation of the discovery and instruction. Preparation Teachers must develop important questions for which they want students to search for the answers to start the lesson. They must also design activities which will allow students to discover or obtain the necessary experiences for the basis of the lesson. Finally, the teacher must gather and prepare the materials for the lesson. Strategies When using guided discovery, student discovery should begin as soon as possible. Teachers should give a brief introduction and quickly distribute the materials. Teachers may provide direction by asking questions or giving hints. This model shares features with guided discovery, and many lessons can be adapted to either instructional model. Teachers can use the 5-E model to meet objectives and deliver specific concepts and explanations. This model also follows a step-by-step progression, where each step builds on the previous step. Engagement The first step serves as an interest approach or motivator. It builds curiosity and provides direction for the remainder of the lesson. During this stage the question for investigation is developed, prior knowledge is activated, and procedures, rules, and safety precautions are outlined. Students should be able to immediately transition into the exploration phase. Exploration This stage imitates guided discovery. Students manipulate the materials, make discoveries, and share their findings with classmates and the teacher. The teacher provides scaffolding by observing, questioning, and guiding. Exploration provides concrete experience from which student learning and knowledge can build. Explanation In this stage teachers invite their students to share their discoveries and explanations. Teachers should encourage students to make connections to their experiences during the exploration phase. Together, students and teachers utilize the concept and the experiences to describe and explain the phenomenon and answer the initial question. Elaboration Elaboration allows students to create connections between new concepts, principles, theories, and real-world experiences by applying them to a new situation. The application of this new knowledge provides an opportunity for students to move beyond memorization to deeper understanding of what they have learned. Small group and classroom discussions continue to play a vital role in the learning process by allowing students to share and defend their understandings and explanations. Informal assessment and feedback may be provided throughout the inquiry learning process to reassure, encourage, or direct students. Formal assessments, such as tests or projects, provide the teacher with feedback and allow them to determine how much the students have learned from the activity. Students should also be encouraged to utilize self-assessment throughout the learning process. Conclusion Inquiry-based teaching methods provide

agricultural educators with another tool to add to their toolbox of educational practices. Educators can use this method to capitalize on the naturally inquisitive behaviors of students. When learning through inquiry approaches, students should engage in each element of the inquiry cycle and extend their knowledge to different situations. While completing inquiry-based lessons, students develop important skills that will help them become successful, lifelong learners. Useful Resources Budnitz, N. What do we mean by inquiry. Retrieved January 21, , from http: Methods for teaching science as inquiry 9th ed. Upper Saddle River, NJ: Why inquiry-based teaching and learning in the middle school science classroom? Implementing inquiry-based science standards. Teaching high school science through inquiry: A case study approach. Original publication date September Visit the EDIS website at http: Warner, graduate student; and Brian E. The Institute of Food and Agricultural Sciences IFAS is an Equal Opportunity Institution authorized to provide research, educational information and other services only to individuals and institutions that function with non-discrimination with respect to race, creed, color, religion, age, disability, sex, sexual orientation, marital status, national origin, political opinions or affiliations.

TEACHING SCIENCE AS INQUIRY pdf

7: Teaching Science as Inquiry - Arthur A. Carin, Joel E. Bass, Terry L. Contant - Google Books

The Teaching Science as Inquiry (TSI): Aquatic professional development (PD) project was conducted by researchers and curriculum developers at the Curriculum Research & Development Group (CRDG), College of Education, University of Hawai'I at MÄ•noa from

Teaching Science as Inquiry: OPIHI professional development provides middle and high school science teachers with background content knowledge, science teaching pedagogy, curriculum, classroom materials, and authentic field-based citizen science research experience in their local watershed. OPIHI has four major educational, scientific, and societal goals: To improve the content, pedagogical, and scientific process knowledge of teachers and students by engaging them in authentic, place-based citizen science research. To enable teachers and students to rigorously monitor intertidal regions in the Hawaiian Islands and contribute to a decadal review of the original OPIHI project. To establish a statewide network of OPIHI teachers who interact and support each other through an online curriculum and associated teacher community. Project-based learning Place-based, project-based learning is an effective way to involve teachers, and their students, in authentic scientific inquiry as exemplified in the Next Generation Science Standards Practices of Science. This type of learning allows students to connect directly with their local environment, develop a respect for nature, prepare to be wise stewards and make better-informed decisions about environmental practices and sustainable resource use. Place-based, project-based learning can thus fill a critical need by making learning relevant and bridging the growing gap between humans and the environment. The intertidal The intertidal is a marine ecosystem that is covered with water during high tide and exposed to air during low tide. The assemblage of organisms that live in the intertidal is uniquely adapted for the challenging set of living conditions that come from being alternatively submerged and exposed. The intertidal zone of tropical islands has been poorly studied, particularly in comparison to the intertidal zone of temperate regions. Despite the lack of scientific study as an ecosystem, the Hawaiian intertidal is particularly vulnerable to human threats because it lies at the interface between terrestrial and subtidal habitats, thus bearing the impact of both terrestrial and marine alterations. At the base of the watershed, the intertidal is affected by everything that happens upstream, from euthrophication to pollution and development. The ecological position of the intertidal makes it vulnerable to threats such as species invasions and climate change. The intertidal is a model habitat in which to measure ecological change. However, long-term monitoring is difficult to implement as efforts often require numerous trained individuals and ongoing monetary support. Citizen science The accessibility that makes the intertidal zone susceptible to human impacts also makes it ideal for citizen science. Citizen science can play a valuable role in collecting ecological research data that is usually costly, time-consuming, and labor-intensive, allowing the scientific community to address questions that would otherwise be logistically or financially unfeasible. Involving citizens in the collection of data for research also has a number of direct and indirect societal benefits, including increasing awareness and understanding of environmental issues; increasing connectedness to and responsibility for the environment; and increasing ability to communicate knowledge and experience to others. Citizen science projects also provide opportunities for public education and engagement in science, creating a more scientifically literate society. The program, named after a culturally important limpet Cellana spp. OPIHI provides opportunities for safe marine field-based experiences; in accordance with DOE rules, students do not get wet above the knees. Students who take part in OPIHI are empowered by the realization that they are capable of doing science. From â€", students at 8 schools monitored 13 intertidal sites access to data available at http: OPIHI student data resulted in the first description of community-level patterns at multiple intertidal sites across the Hawaiian Islands Cox et al.

8: Teaching Science through Inquiry. ERIC/CSMEE Digest.

Teaching Science as Inquiry models this effective a Research tells us that an inquiry approach to science teaching motivates and engages every type of student, helping students understand science's relevance to their lives as well as

the nature of science itself.

9: What is Inquiry-Based Science? | Smithsonian Science Education Center

Today, many teachers use a variety of different teaching strategies, methods, and models in their classrooms, like the inquiry-based learning model. This method takes the traditional model and flips it around.

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