Utforskende arbeidsmåter

Utforskende arbeidsmåter blir i norske læreplaner særlig knyttet til naturvitenskapelige fag, og er en undervisningsmetode hvor elevene arbeider ut fra ett eller flere spørsmål knyttet til et tema. Undervisningen har ofte form som gruppearbeid hvor elevene arbeider aktivt med å samle inn data og informasjon som de bruker til å utvikle spørsmål/hypoteser, etterprøver eller tester for å komme frem til mulige svar som de kan velge mellom. Utforskende arbeidsmåter struktureres ofte ut fra tre bærende elementer: - å stille spørsmål/formulere hypoteser, å finne svar gjennom å tolke data som evidens, og å formulere og presentere naturvitenskapelige argumenter basert på evidens. Eksempel på forskningsartikler hvor samarbeidslæring er benyttet som undervisningsmetode:

- Using ethological techniques and place-based pedagogy to develop science literacy in Hawai'i's high school students
- The Chemistry of Cat Litter: Activities for High School Students To Evaluate a Commercial Product's Properties and Claims Using the Tools of Chemistry
- Experiential learning model in two-dimensional kinematics
- Stepwise Inquiry into Hard Water in a High School Chemistry Laboratory
- Predation on Plasticine Model Caterpillars: Engaging High School Students Using Field-Based Experiential Learning & the Scientific Process
- Chemistry Cube Game – Exploring Basic Principles of Chemistry by Turning Cubes

Using ethological techniques and place-based pedagogy to develop science literacy in Hawai'i’s high school students

Author: Christine M. Ambrosino and Malia Ana J. Riveraa

Year: 2020

Abstract

This high school-level, place-based, inquiry-driven laboratory module familiarises students with techniques used to analyse animal behaviour while facilitating the development of the observational skills highlighted by the Next Generation Science Standards (NGSS). Throughout the module, students observe, quantify, and discuss local invertebrate behaviours in the classroom. While field-testing the module with Hawai’i high school students, we administered anonymous, online surveys before and after participation to examine whether the use of animals and language from the local environment and cultural landscape unique to Hawai’i helped to connect students with the ecology surrounding them and emphasise the relevancy of scientific observations beyond the classroom. Survey responses indicated increased content understanding, increased confidence in scientific skills, and more positive attitudes towards marine science among participants. Utilising ethological techniques within a place-based framework provides an adaptable platform for students in any location to develop the science literacy skills at the core of NGSS.

Keywords: Animal behaviour; place-based education; hypothesis testing; experimental design; authentic scientific inquiry; experiential learning; student-centred; NGSS

Referanse: Ambrosino, C. M., & Rivera, M. A. J. (2022). Using ethological techniques and place-based pedagogy to develop science literacy in Hawai‘i’s high school students. *Journal of Biological Education*, *56*(1), 3-13. https://doi.org/10.1080/00219266.2020.1739118

Tag: naturfag, utforskende arbeidsmåter

The Chemistry of Cat Litter: Activities for High School Students To Evaluate a Commercial Product’s Properties and Claims Using the Tools of Chemistry

Author: Teresa Celestino and Fabio Marchetti

Year: 2015

Abstract

Educating future scientists and citizens is more effective if students are guided to correctly apply what they learned in school to their daily lives. This experience-based work is focused on the study of a well-known commercial product: cat litter. This material offers different starting points for a critical examination. Questions related to physical properties at the origin of the litter’s efficacy, to information on chemical composition provided in the packaging, and to environmental features and possible noxiousness of cat litter were asked to be investigated by secondary school 14−15 year old students, through laboratory experiments based on problem solving approach, analysis of tag claims of different cat litter brands and cooperative learning activities. This multidisciplinary approach gives the chance to learn effectively chemistry core concepts and to avoid the typical students’ lack of attention.

Keywords: High School/Introductory Chemistry, Laboratory Instruction, Inquiry-Based/Discovery Learning, Problem Solving/Decision Making, Consumer Chemistry

Referanse: Celestino, T., & Marchetti, F. (2015). The chemistry of cat litter: Activities for high school students to evaluate a commercial product’s properties and claims using the tools of chemistry. *Journal of Chemical Education*, *92*(8), 1359-1363. https://doi.org/10.1021/ed500505j

Tag; kjemi, utforskende arbeidsmåter

Experiential learning model in two-dimensional kinematics

Author: Ann Daniel

Year: 2019

Abstract

Researchers have shown students develop misconceptions in projectile motion for various reasons. A common misunderstanding among first-year high school physics students is the notion that the horizontal and vertical components are interchangeable in projectile motion. The students' incorrect reasoning is connected to their personal experiences when they claim a heavier object will reach the ground before a lighter object when dropped from the same vertical height. When the students are asked about two objects projected horizontally with different speeds from the same height, they will quickly assume that the faster horizontal moving object will hit the ground first, reasoning that the horizontal speed directly affects the vertical speed. The students fail to notice that the initial vertical velocity equals zero. This article describes the implementation of an experiential learning activity that addresses students' confusion and helps improve their conceptual understanding of kinematics in two dimensions. Generated from experiences, experiential knowledge is not always correct due to inaccurate interpretations. Therefore, teachers need to select experiential activities that will have the greatest learning potential. Sometimes the greatest impact an experience can have is using small collaborative groups with whole class discussions. Similar to life experiences, experiential learning relies on collaboration, which gets the students directly involved reinforcing and/or clarifying previous knowledge into a new context.

Keywords: Physics, experiental learning

Referanse: Daniel, A. (2019). Experiential learning model in two-dimensional kinematics. *The Physics Teacher*, *57*(9), 648-649. https://doi.org/10.1119/1.5135803

Tag: fysikk, utforskende arbeidsmåter

Stepwise Inquiry into Hard Water in a High School Chemistry Laboratory

Author: Mami Kakisako, Kazuyuki Nishikawa, Masayoshi Nakano, Kana S. Harada, Tomoyuki Tatsuoka, and Nobuyoshi Koga

Year: 2016

Abstract

This study focuses on the design of a learning program to introduce complexometric titration as a method for determining water hardness in a high school chemistry laboratory. Students are introduced to the different properties and reactions of hard water in a stepwise manner so that they gain the necessary chemical knowledge and conceptual understanding of the basic principles of complexometric titration. This approach involves investigating the performance of soap and household laundry detergent in hard water and using a colorimetric method to semiquantitatively determine the concentration of calcium ions in hard water by a test kit. The stepwise inquiry and learning are promoted using coordinated experimental work, logical thinking, and discussion with the aid of demonstrations and explanations. As each inquiry and learning step is completed, students develop models that describe the observed chemical properties and reactions of hard water. Using the simple models that they develop, students finally propose the basic principles of complexometric titration for determining water hardness. Based on their experimental principles, practical titration experiments are performed and the experimental data are analyzed to determine water hardness. Throughout the learning program, students actively apply preliminary knowledge and acquire new chemical knowledge and conceptual understanding from the laboratory exercises. Therefore, the students experience the process of scientific inquiry accompanied by the development of their understanding of chemical concepts. This paper reports that the developed learning program may be introduced as a suitable laboratory learning exercise in high school chemistry courses.

Keywords: High School/Introductory Chemistry, Analytical Chemistry, Environmental Chemistry, Collaborative/Cooperative Learning, Inquiry-Based/Discovery Learning, Aqueous Solution Chemistry, Water/Water Chemistry

Referanse: Kakisako, M., Nishikawa, K., Nakano, M., Harada, K. S., Tatsuoka, T., & Koga, N. (2016). Stepwise inquiry into hard water in a high school chemistry laboratory. *Journal of Chemical Education*, *93*(11), 1923-1928.

https://doi.org/10.1021/acs.jchemed.6b00217

Tag: kjemi, utforskende arbeidsmåter, samarbeidslæring

Predation on Plasticine Model Caterpillars: Engaging High School Students Using Field-Based Experiential Learning & the Scientific Process

Author: Wendy Leuenberger, Estefania Larsen, Jacob Leuenberger, Dylan Parry

Year: 2019

Abstract

Engaging students in hands-on inquiry helps them develop skills associated with the scientific process. Development of simple experiments using model caterpillars can provide an experiential demonstration of the scientific process and ecological principles for high school students. Caterpillar models are formed from plasticine, a nontoxic, nondrying modeling clay, and are an excellent tool for quantifying relative predation rates by birds, small mammals, and invertebrates. Lifelike surrogate larvae are glued to vegetation for short periods (one week) and retain identifiable marks (beak, teeth, mandible imprints) following predator attack. This technique is simple, inexpensive, and provides rapid and clear results, rendering it a highly effective method of inquiry for high school students. Students can use these methods to ask a variety of research questions, such as comparison of predation in nearby habitats (park vs. backyard), vegetation (tree vs. shrub), season (spring vs. fall), or coloration (aposematic vs. camouflage). For many students, this may be one of few opportunities at the high school level to investigate science “in the field” and integrate scientific practices, such as the scientific method and inquiry, in an authentic research experience. Participants develop their scientific reasoning skills through creation of research questions and interpretation of results. They learn experimental technique, build field skills, and work collaboratively. This experiment aligns with the Next Generation Science Standards.

Key words: Ecology; experiential; field skills; predation; scientific inquiry; scientific method.

Referanse: Leuenberger, W., Larsen, E., Leuenberger, J., & Parry, D. (2019). Predation on plasticine model caterpillars: Engaging high school students using field-based experiential learning & the scientific process. *The American Biology Teacher*, *81*(5), 334-339.

https://doi.org/10.1525/abt.2019.81.5.334

Tag: naturfag, biologi, utforskende arbeidsmåter,

Chemistry Cube Game – Exploring Basic Principles of Chemistry by Turning Cubes

Author: Markus T. Müller

Year: 2018

Abstract

The Chemistry Cube Game invites students at secondary school level 1 and 2 to explore basic concepts of chemistry in a playful way, either as individuals or in teams. It consists of 15 different cubes, 9 cubes for different acids, their corresponding bases and precursors, and 6 cubes for different reducing and oxidising agents. The cubes can be rotated in those directions indicated. Each ‘allowed’ vertical or horizontal rotation of 90° stands for a chemical reaction or a physical transition. Two different games and playing modes are presented here: First, redox chemistry is introduced for the formation of salts from elementary metals and non-metals. Second, the speciation of acids and bases at different pH-values is shown. The cubes can be also used for games about environmental chemistry such as the carbon and sulphur cycle, covering the topic of acid rain, or the nitrogen cycle including ammoniac synthesis, nitrification and de-nitrification.

Key words: Acids/bases · Basic chemical principles · Chemistry Cube Game · Collaborative/cooperative learning · Equilibrium · Inquiry-based/discovery learning · Humor/puzzles/games · Oxidation/reduction · Salt formation · Secondary school level 1 and 2 · Speciation

Referanse: Müller, M. T. (2018). Chemistry Cube Game–Exploring Basic Principles of Chemistry by Turning Cubes. *Chimia*, *72*(1-2), 62-62.https://doi.org/10.2533/chimia.2018.62

Tag: kjemi, utforskende arbeidsmåter, samarbeidslæring