Hands-on and inquiry-based learning

Best Practice Engagement: Recommendation 4

The review on Best Practice Principles for Community Science Engagement Programs identified seven recommendations for effective and impactful community science programs.

In support of the delivery of an effective community science engagement program, the fourth recommendation focuses on incorporating ***inquiry-based learning*** and ***hands-on experiential approaches*** that address both the understanding of science and scientific investigation skills.

By interacting directly with materials and processes, learners transform experience into knowledge, reinforcing both understanding and practical skills.

Image: Students participating in the James Cook University Aboriginal and Torres Strait Islander Marine Science (ATSIMS) Program
Credit: Laura Boderke

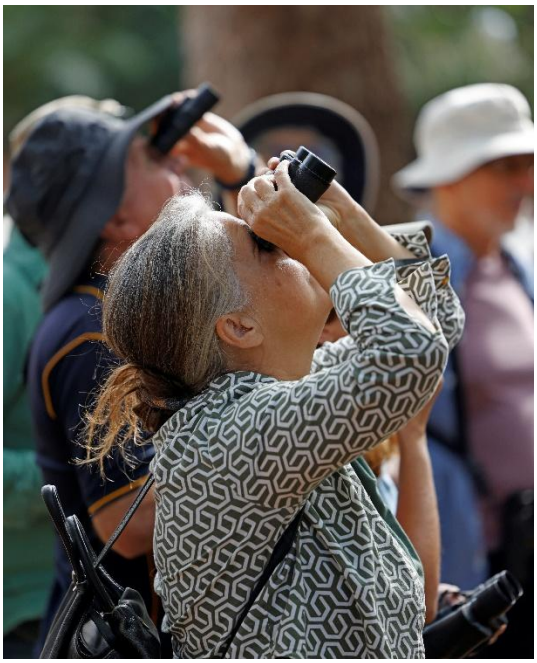

Image: Bribie Island Nature Festival citizen scientists participating in a bioblitz
Credit: Stephen Finkel

Hands-on experiential learning in science, facilitated through scientific investigations and experimentation, is a key component of impactful STEM engagement. It promotes critical thinking skills and an understanding of the process of scientific inquiry.

Case study: Discover the Microbes Within!

Discover the Microbes Within! The Wolbachia Project is an immersive, ***hands-on and inquiry-based learning program*** that transforms students into researchers. It integrates biodiversity, bioinformatics and molecular biology to investigate the widespread *Wolbachia* bacterium. This bacterium is found in many insects, spiders and scorpions, and has been used as a biological tool to eliminate local dengue virus in Far North Queensland.

Central to the project's long-term and global success is its reliance on hands-on, experiential learning, through a five-step experiential learning workflow:

Hands-on field collection: Students engage in active field research to gather and identify local arthropods from their own communities.

Experiential DNA extraction: Working hands-on in their school labs or alongside partner universities, students master micropipetting and fluid handling to isolate genomic DNA from their collected specimens.

Genetic amplification: Through hands-on operation of thermocyclers, samples are processed using polymerase chain reaction to detect the molecular presence of the bacterium.

Gel electrophoresis and sequencing: Students gain practical laboratory experience as they physically load agarose gels to visualise their results, ultimately utilising DNA sequencing to unlock the sample's genetic code.

Interactive bioinformatics analysis: This critical phase of experiential learning guides students through advanced computational tools, where they analyse their own raw sequence data to determine the precise species of the host insect, verify the *Wolbachia* infection status, and even pinpoint the specific bacterial strain.

Students have a unique opportunity to learn critical molecular biology and bioinformatic skills – practical skills that are usually reserved for more advanced academic settings. They also publish verified findings to a global database, contributing to real science and enabling worldwide collaboration through shared data and cross-border learning.

For further detail about *Best Practice Principles for Community Science Engagement Programs*, read the full report, which includes case studies and other resources, at www.chiefscientist.qld.gov.au.