Curriculum Development: Teaching Genetics Through Hands-On, Field-Based Techniques for Youth

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Introduction

Can we take laboratory techniques commonly used in DNA analysis to the field?
Through our emerging project, "Sovereign Autonomy for Long-term Monitoring Of Non-human genes (SALMONg)," we aim to provide educational materials and technical support to interested communities and build local capacity for cost-effective monitoring of important species.

Image 1. Students from the George River Internship choosing a location to collect eDNA samples.

Methods

- Curriculum development for field-based laboratory methods commonly used in DNA analysis:
  - environmental DNA (eDNA)
  - Polymerase Chain Reaction (PCR)
  - Gel electrophoresis
  - Provide visuals to explain genetics research (Figure 1)

- Hands-on instruction for field-based training:
  - Collect eDNA samples with Smith-Root Citizen Scientist Sampler (Image 2)
  - Pipetting techniques
  - Gel electrophoresis with PCR product (Image 4 & 5)

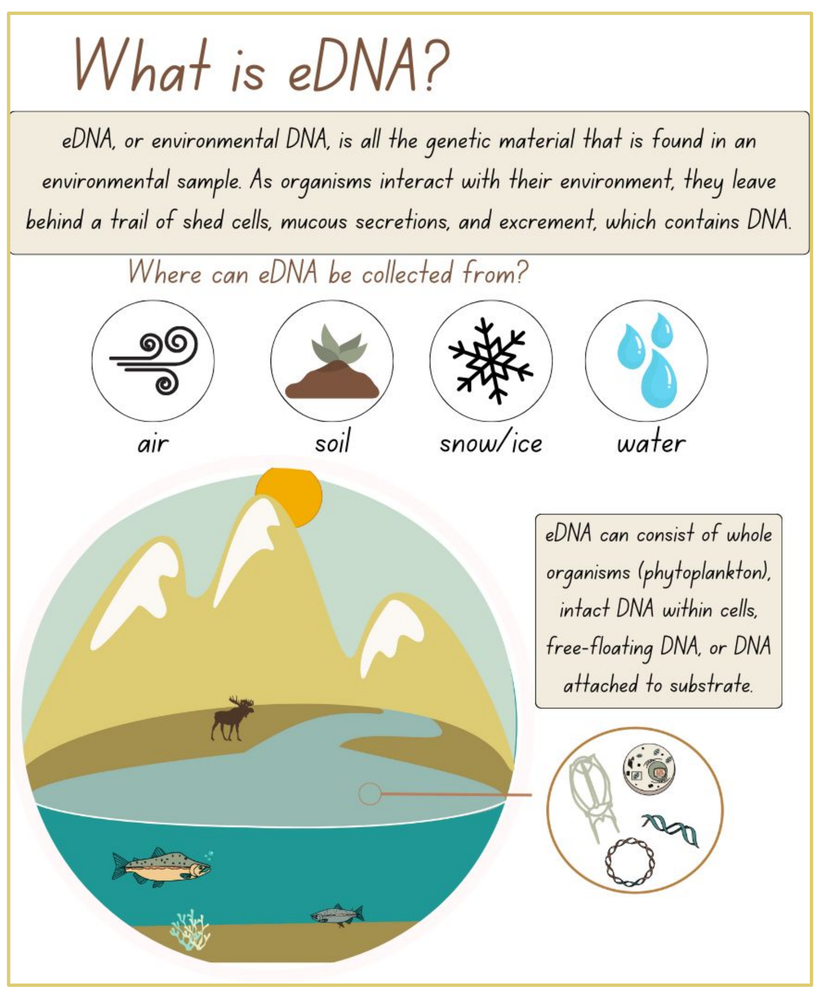

Figure 1. Illustrations by Maris Goodwin for the SALMONg curriculum.

Image 2. Students from the GRI collecting eDNA samples with a Smith-Root Citizen Scientist Sampler on the George River.

Image 3. SALMONg streamside laboratory on the gravel bar of the George River.

Image 4. Kristen Reece instructing gel electrophoresis techniques to GRI students on the gravel bar on the George River.

Image 5. Students at the Science & Culture Camp observing their PCR product on a blueGel unit.

Image 6. Erik Schoen and Brandi Kamermans demonstrating eDNA collection for the Climate Change & My Community workshop.

Results

- eDNA workshop at Climate Change & My Community workshop in Fairbanks, AK:
  - Teachers and community members
  - Classroom setting
    - Intro to pipetting
    - Improved curriculum

- Science & Culture Camp in Bethel, AK:
  - Yukon-Kuskokwim highschool students
  - Classroom setting
    - Grounding activity with map of AK
    - How and why we study salmon
    - Intro to pipetting

- George River Internship (GRI) camp on the George River, AK:
  - Kuspuk School District highschool students
  - Remote gravel bar
    - Collected eDNA samples (Image 1 & 2)
    - Successful PCR and gel electrophoresis on the gravel bar with little to no contamination (Image 3)

Next Steps

- Research and experiment DNA extraction methods with filters for use in the field:
  - Cost effective materials
  - Robust primers
  - Minimal/easy training
  - Limited power sources
  - Safe - minimal harsh chemicals

- Experiment with protocols:
  - Qiagen DNeasy Blood & Tissue Kit
  - Bento Lab Dipstick DNA Extraction Kit
  - Bento Lab Hot Shot DNA Extraction Kit
  - Bio-Rad Chelex applications

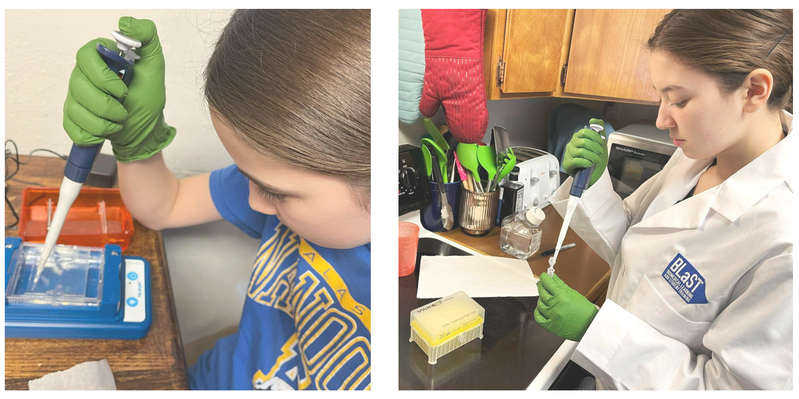

Photo left: Avery, age 13, loading a PCR product into the blueGel machine.
Photo right: Lily, age 17, preparing the MasterMix for the PCR samples.

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