Meeting Your Standards Through Engaging, Relevant, and Hands-On Learning Opportunities

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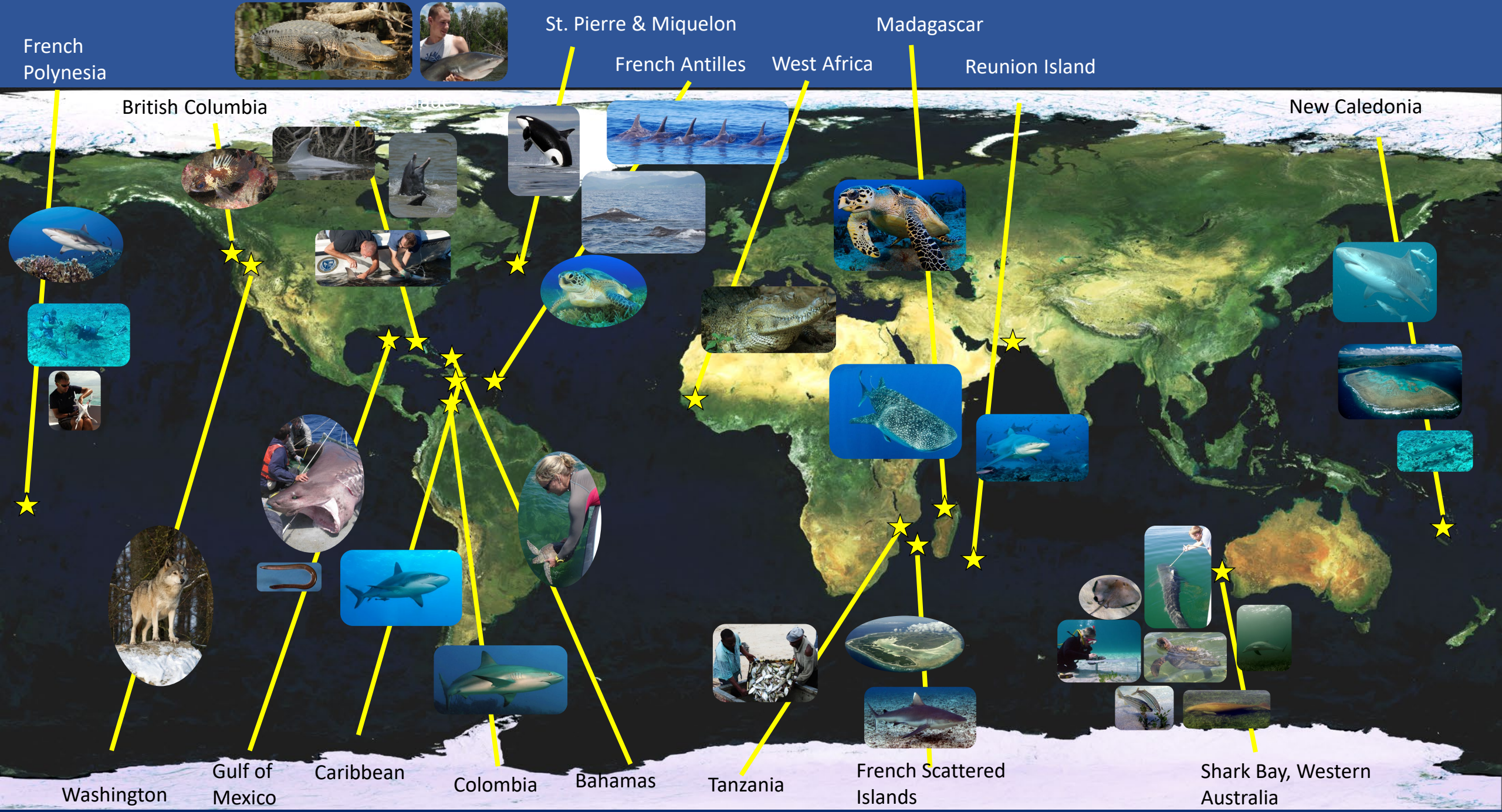
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Colombia
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French Scattered Islands
Shark Bay, Western Australia

Sharing science

SCIENCE IS:

Exploration
Creative
Collaborative
Exciting
Important

SO WHY DO SO MANY STUDENTS THINK IT IS BORING?!

One Issue: what is Science?

- **Science literacy** is usually measured as ability to recite facts about previous scientific inquiries
  - Long term retention of facts from academic settings often isn't that great
- Poor focus on what scientific research
  - Has led to the perception that combing the internet is of the same value as real scientific research
- **Result 1:** The public generally is underequipped to understand and interpret data or appreciate the importance of quality research
- **Result 2:** We have sucked the life and excitement out of science

The Science Literacy Challenge

- Science literacy should incorporate the **two key aspects of science**
  - 1. Our state of understanding of the world based on previous work
  - 2. The process/enterprise of science (continuing to study and respond)
    - Includes knowing how to recognize experts and your own areas of incompetence
- We need to continue to improve our models for science education
  - What is the mix of process/facts needed in classrooms?
  - Instill a willingness to be wrong!!
  - We need to be hands-on!!

Science Skills

Students need to **be scientists** not just study scientists

Observe

Question

Predict/Model

Investigate

Draw conclusions

Make connections

Be persistent

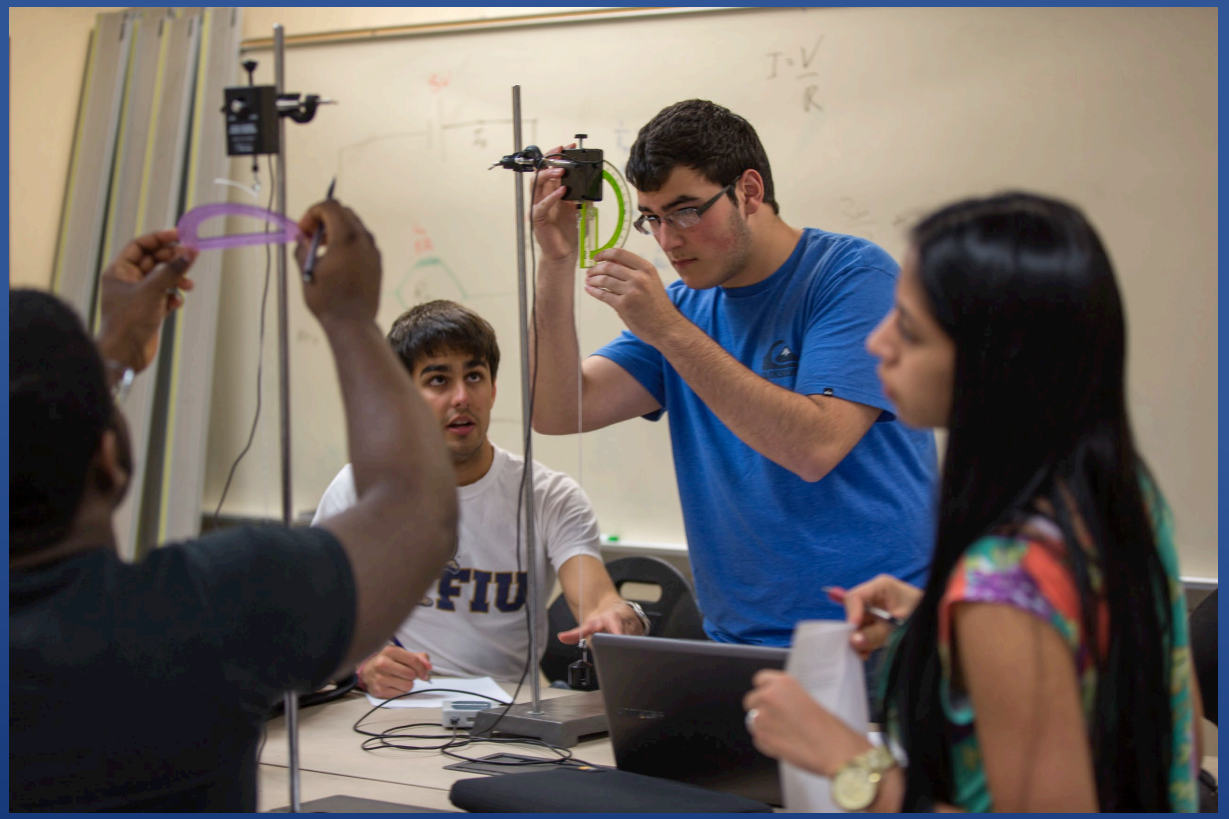
A Solution: Bring Real-World Science into the Classroom

A Solution: Hands-on learning

- Lots of ways to be ”hands-on”
  - Traditional labs, and design/build challenges
    - But beware of labs that just confirm reality
      - Challenge is important – it gets the brain working not just go through the motions
  - Short games or arts-based investigations
    - Help meet students where they are
  - Models of many types
  - Get outside (or potentially online)
    - Observation skills are surprisingly overlooked
  - Video-based projects
- Critical for preparing for the university classroom or careers

Classroom approaches to hands-on learning

- Some lessons from the university classroom
  - Flipped classrooms work; but students need to understand the process and expectations of active learning
  - Portion control is important
  - Tone matters!
  - Group work and peer learning is powerful
- Some more thoughts
  - Remember to focus on process not just facts
  - Not knowing is ok…in fact it is **good**



Tips for effective group work 1

- Peer learning success – key design features
  - Give each student a defined role and have the success of the group depend on each student contributing
    - Insures individual accountability
    - Encourages positive social interactions
    - Helps even in online environments where teacher's ability to interact with each student/group is limited…students have to take responsibility
  - Define and reinforce social skills that are important for group members during the task

Tips for Effective group work 2

- Have specific strategies to increase motivation to collaborate
  - Single deliverable for a group (goal interdependence)
  - Everyone gets a reward if everyone achieves a certain goal (or score) at the end of a lesson (reward interdependence)
  - Each member gets different materials needed to complete the task (resource interdependence)
  - Take turns playing different roles (role interdependence)
  - Unique tasks that are needed to complete overall tasks, like an assembly line (task interdependence)
  - Individual grades with a bonus for team success

Tips for effective group work 3

- Provide opportunities for self disclosure during and especially after work
  - Taking turns during work
  - Reflection and discussion of group performance after the lesson (e.g. what could have been improved, what worked well)

Let's give it a try….but first a story…

Let's give it a try!

Name _____ Date _____

HANDS-ON LAB

Identify Factors That Influence a Population Change

Scientists use models and simulations to predict, observe, and evaluate changes to plant and animal populations in the wild. In this lab you will model how a wolf pack might be affected by different changes to the ecosystem in which it lives.

MATERIALS
- cup
- number cube
- objects for counting, small (options include: beads, beans, and toothpicks)

Procedure

STEP 1 Place ten objects on the table.

STEP 2 Roll the number cube. The number on the number cube indicates what happens to your pack. Record the *Ecosystem change* and *Change in population* in your data table. Adjust the number of objects that represent your wolf pack.

If you roll a . . .	You change the pack by . . .	Because of this ecosystem change . . .
1	Subtracting 4	drought results in a food shortage for prey
2	Subtracting 3	deforestation destroys some wolf habitat
3	No change	plenty of rain; plant and prey populations stable
4	Adding 4	over-hunting of bears reduces competitors for wolf prey
5	Adding 2	new rabbit population (prey) enters the ecosystem
6	Subtracting 2	disease introduced by stray dogs causes some wolves to die

STEP 3 At the end of each year the mature pups leave. For every eight wolves in your pack, subtract two wolves from the pack. Record this data in the *Change in population* column. Adjust the number of objects you have accordingly. Record the pack total in the last column.

STEP 4 Unless a food shortage occurred the previous year, five new pups are born at the start of each year. Add this data to the *Starting number of wolves* column of the data table. Adjust the number of objects accordingly.

STEP 5 Repeat steps 2–4 until you complete eight years of play or until your pack dies out, whichever comes first. A pack dies out when there are either no more wolves or only one wolf remaining.

Year	Starting number of wolves	Ecosystem change	Change in population	Total wolves in pack
1	10	disease	− 2; − 2	6
2				
3				
4				
5				
6				
7				
8				

Expanding learning opportunities

- Find a partner
  - **Trade** sheets and **check the results**
    - This is an opportunity to discuss how to interact with a partner in a positive way in a class discussion
      - Important skills: collaboration, willingness to check work, openness to constructive feedback
  - **Compare** and **Contrast** your results?
    - How many wolves were in the pack at the end of year 8?
    - Did the same factors affect your packs over the course of the eight years?

Extending the lesson and engaging a broader group

- **Gather** data from the entire class
  - **Create** a chart of the number of wolves remaining in each pack
  - If each pack was part of an overall population, **describe** why scientists would want to study more than one pack in a particular population

More ways to extend or differentiate

- Have students create their own game based on a different organism and ecosystem (a great opportunity to have students explore local ecosystems or ones they are particularly interested in)
  - This can really reinforce key standards that you are trying to focus on
- Have students **reflect on** and **discuss** what science skills they learned during this activity
  - You might have them think about how these skills are important in their lives
- Have students **explore** careers that relate to the lab