Promoting Science Proficiency in Secondary Cycle One

1. Project Goals

This project's aim was to provide ongoing learning experiences for secondary science teachers at Riverside School Board (RSB) through collaborative work within a teacher team. The project focused on collective inquiry and action research to deepen student understanding and improve achievement. The rubric used by teachers to self-evaluate their teaching practice was created by MaST (Math and Science and Technology Coordinating Committee) based on the Ambitious Science Teaching framework. This tool helped teachers to identify the knowledge and skills used and developed throughout the project.

Through a collaborative effort, teachers would become more aware of their strengths and weaknesses, develop strategies to improve their practice, and model shifts in practice for other teachers. By looking at evidence from the students, the teachers would be using an RTI (Response to Intervention) approach and begin working as a professional learning community. This is a powerful strategy to improve student achievement and could lead to further projects to improve teaching practice and student success in all our schools. Teachers would also gain a deeper understanding of how to create proficiency in science with their students.

2. Project Description

During 2020-2021, multiple offerings of Professional Development (PD) were offered to support teachers who were adjusting to online platforms. Teachers, in this project, participated in sessions intended specifically for Science teachers. Topics included teaching with Inquiry in the online setting, Ambitious Science Teaching, and online tools to support Science teaching.

Teachers met during a PD day to share resources for Competency 1 development and assessment activities. These resources were shared on Microsoft Teams. The documents will be available to all secondary science teachers at RSB.

During our one full day of release the teachers met to set goals for their practice, to explore instructional shifts in teaching practice and to have the opportunity to plan. One of the group's seven members had attended training sessions with Argument Driven Inquiry (ADI) and provided feedback on planning, strategies and challenges. The teachers who attended the day found this helpful and inspiring.

Teachers noted that by nature, inquiry activities are differentiated. It was recognized that teachers are often trying to support students who struggle while struggling to support and challenge students at higher proficiency levels. This project not only supported students at risk but promoted enrichment and engagement at all levels.

Full Day of Release

This day focused on inquiry in the classroom and teaching strategies to support student thinking. Some teachers have tried using an ADI approach this year and are eager to implement it next year.

One strategy that teachers were very interested in is the use of an interactive notebook where students develop a sense of ownership. It included

- Vocabulary lists
- Evidence cards
- Frayer model
- Shared learning experience among the students
- Class discourse about activities in the interactive book

Feedback on an ADI unit planning involved

- Starting with a hook, a puzzling event
- Prompting question(s)
- Content
- Evaluation

Suggestions for planning and implementing ADI in the classroom

- Evaluate pre-existing knowledge so that one starts at the students' level.
- Spend time teaching students how to research and question formulation techniques. It is important to develop their questioning skills so that students become proficient at asking open and closed questions, and prioritizing questions.
- Support students with their organizational skills when note taking, researching, and gathering evidence.
- Encourage students to ask each other questions, circulate and explore/develop strategies to solve problems, and explain their thinking/solutions.
- Note: This year is the first year some students were asked to participate in double blind studies so that students had opportunities to give and receive feedback before submitting final work. At first this takes extra time in planning and in class, but the results are notable.

3. Project Outcomes

Although this was a small group of teachers, the outcomes were very impactful for both teachers and students. Through a collaborative effort, teachers became more aware of their strengths and weaknesses. The teachers became a professional learning community looking at evidence of student learning to drive their teaching.

At the end of the project the teachers were asked to look at the Teacher Rubric and Vision for Science Teaching. This self-assessment rubric created by MaST based on the Ambitious Science Teaching framework and is attached to this report. Initially, teachers identified themselves mainly at the ***Emerging stage*** (first of three stages). Upon reflection and discussion, the teachers began to identify and name

examples of planning and implementation that would place them at the ***Developing and Ambitious*** stages of the rubric. For specific examples, please read below.

Example of shifts in practice as described by participants.

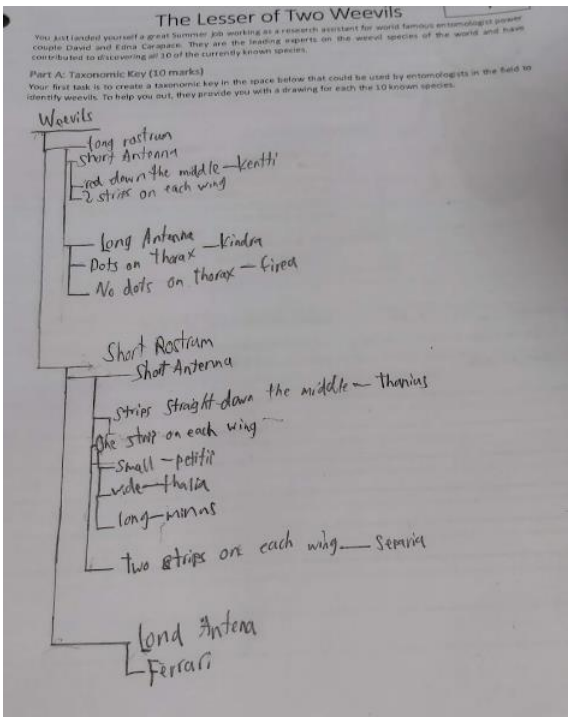
Planning for Engagement in Scientific Ideas

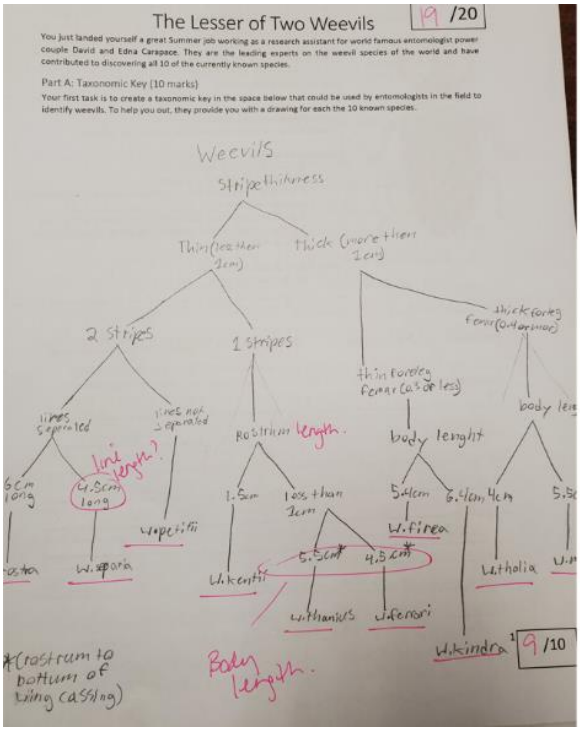
Teacher participants at Heritage Regional High School (HRHS) spent time at the end of 2020 to plan units for their Secondary 1 classes that would target big ideas through daily inquiry. Rather than use workbooks, they created interactive lessons that required students to investigate concepts through guided inquiry, some direct teaching, and investigation. Students were asked to develop arguments/explanations at the end of these units. They modelled their units in a similar process to the ADI framework used at Saint Lambert International School (SLI) and highlighted above

Selecting and Representing Student Ideas Publicly

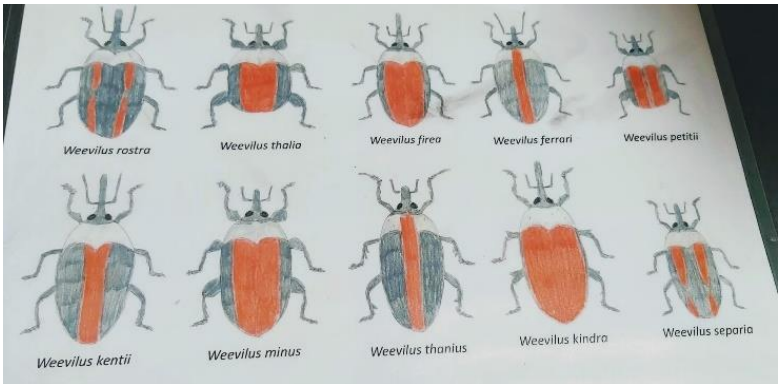
Teachers shared examples of how they are facilitating students to talk through activities such as think-pair-share. They recognized that their students have more opportunity to talk to other students. They noted that this is at the developing stage as they find more students are sharing their thinking but that the sharing is often student-to-teacher talk and they would like to promote more student-to-student talk.

When interviewed, the teachers had recently completed a unit on taxonomy and adaptation. They shared their task and samples of student work.





This is the visual students were given to develop their own Taxonomic Key.

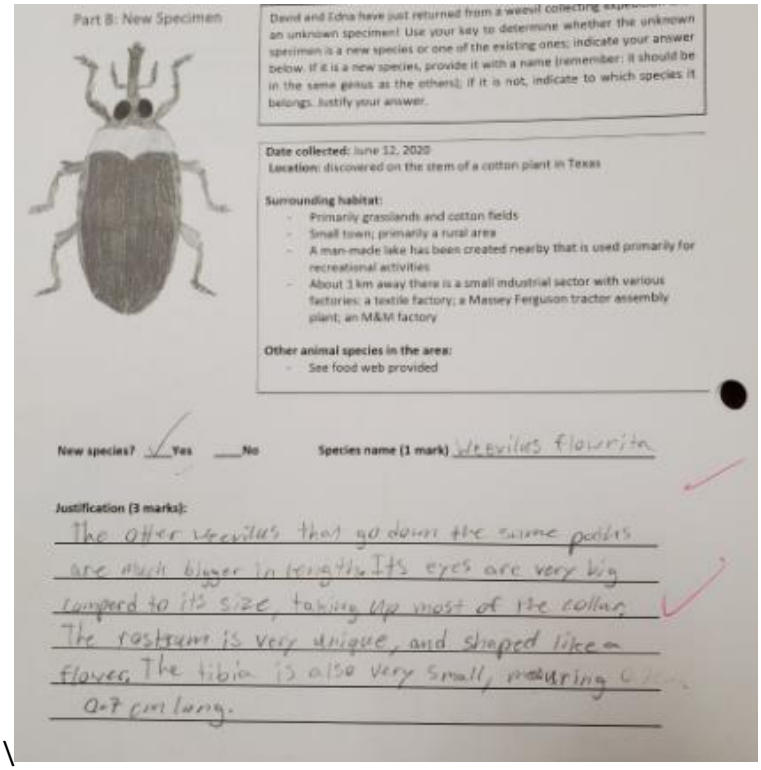


Construction of Evidence Based Explanations

Teachers are asking students to use their acquired knowledge to develop explanations. The students must explain their answers and support their thinking with evidence.

The teachers at HRHS have developed at least three units, with this in mind. One of the examples is this unit on taxonomy and adaptation.

Here is an example of student work. Students were asked to use their acquired knowledge to explain the characteristics of a new specimen that had been found. In previous years, this topic would include some fill in the blank type questions from a workbook. Teachers noted that students were making connections to important scientific concepts that they were not making in previous years.



Part B: New Specimen

David and Edna have just returned from a weevil collecting expedition. an unknown specimen! Use your key to determine whether the unknown specimen is a new species or one of the existing ones; indicate your answer below. If it is a new species, provide it with a name (remember: it should be in the same genus as the others); if it is not, indicate to which species it belongs. Justify your answer.

Date collected: June 12, 2020
Location: discovered on the stem of a cotton plant in Texas

Surrounding habitat:
- Primarily grasslands and cotton fields
- Small town; primarily a rural area
- A man-made lake has been created nearby that is used primarily for recreational activities
- About 1 km away there is a small industrial sector with various factories: a textile factory; a Massey Ferguson tractor assembly plant; an M&M factory

Other animal species in the area:
- See food web provided

New species? ✓ **Yes** ___ **No** **Species name (1 mark)** Weevilus flowrita

Justification (3 marks):
The other weevilus that go down the same paths are much bigger in length. Its eyes are very big compared to its size, taking up most of the collar. The rostrum is very unique, and shaped like a flower. The tibia is also very small, measuring 0.7 cm long.

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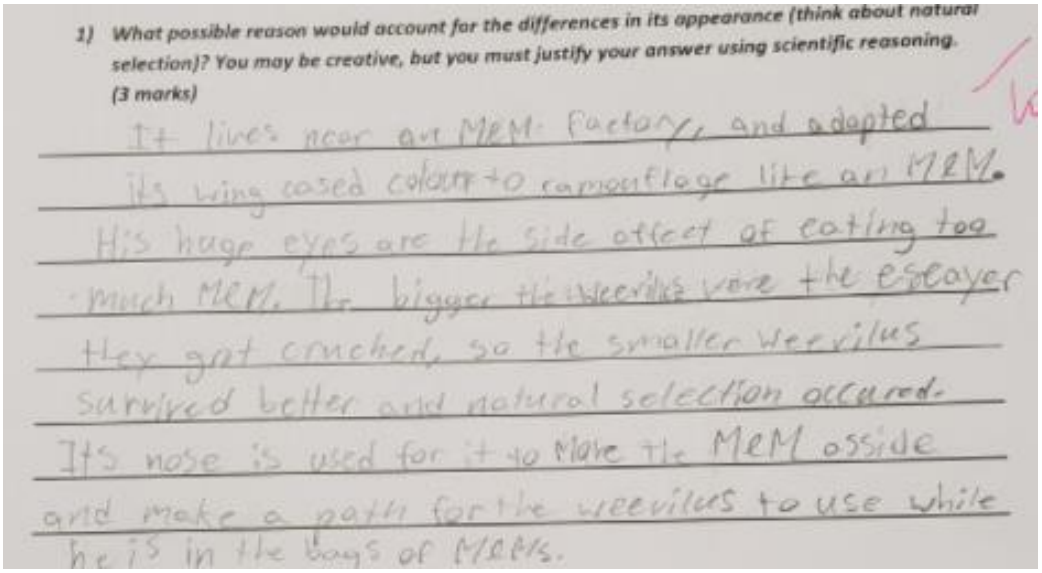
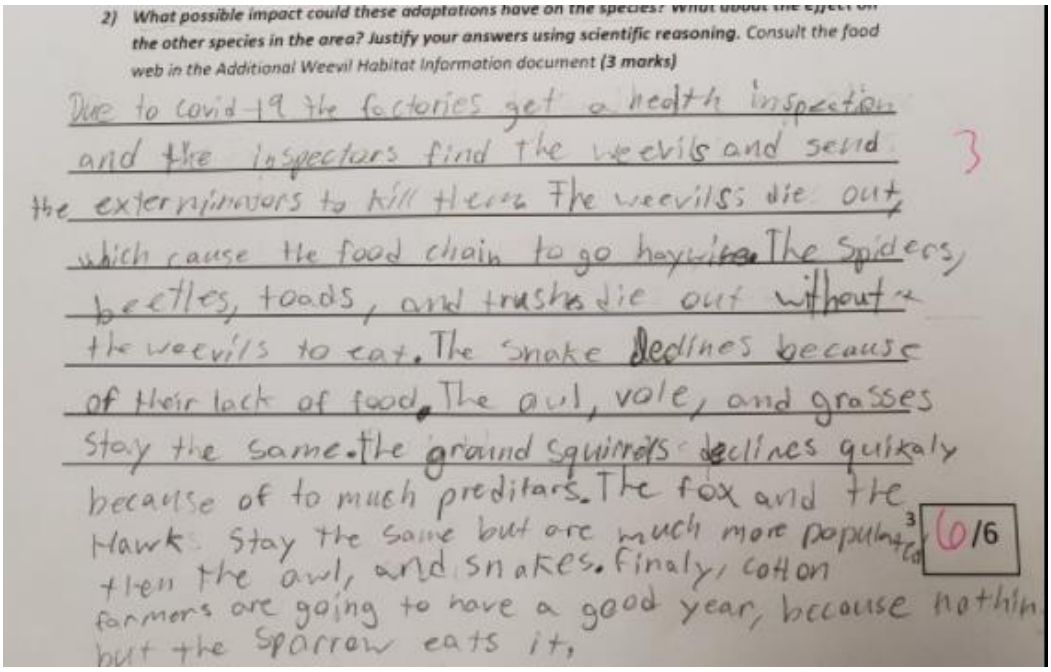


1) What possible reason would account for the differences in its appearance (think about natural selection)? You may be creative, but you must justify your answer using scientific reasoning. (3 marks)

It lives near an MeM factory, and adapted its wing cased colour to camouflage like an MeM. His huge eyes are the side effect of eating too much MeM. The bigger the weevils were the easeayer they got crushed, so the smaller weevilus survived better and natural selection occured. It's nose is used for it to Make the MeM asside and make a path for the weevilus to use while he is in the bags of MeMs.



2) What possible impact could these adaptations have on the species? What about the effect on the other species in the area? Justify your answers using scientific reasoning. Consult the food web in the Additional Weevil Habitat Information document (3 marks)

Due to covid 19 the factories get a health inspection and the inspectors find the weevils and send the exterminators to kill them. The weevilss die out, which cause the food chain to go haywire. The Spiders, beetles, toads, and trushes die out without the weevils to eat. The snake declines because of their lack of food. The owl, vole, and grasses stay the same. the grainnd squirrels declines quikaly because of to much preditars. The fox and the Hawk stay the same but are much more populated than the owl, and snakes. finaly, cotton farmers are going to have a good year, because nothin but the sparrow eats it.

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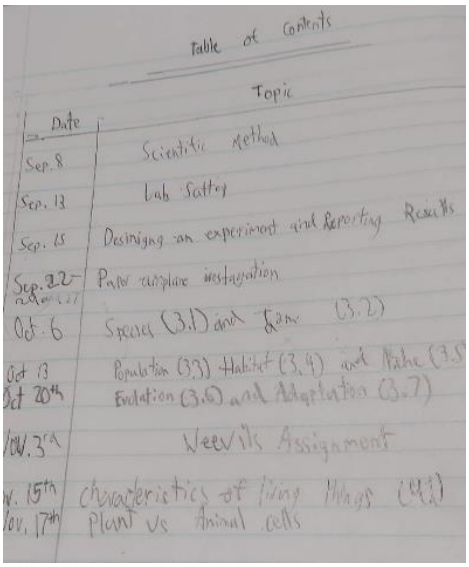
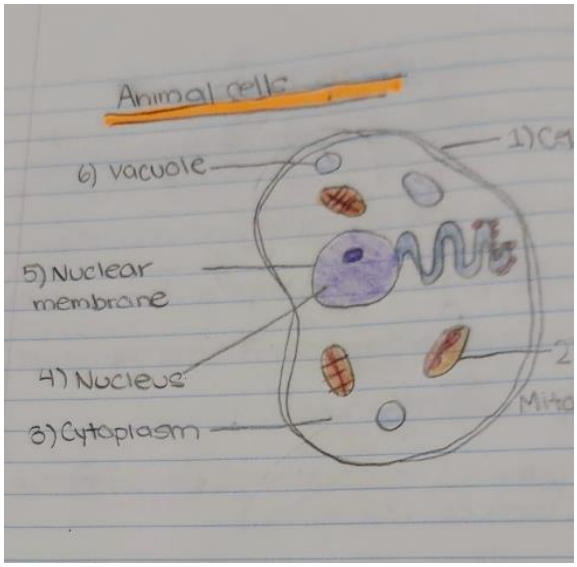
Supporting Ongoing Changes in Student Thinking with Tools and Routines

Teachers are shifting to collect notes, and evidence through the use of student created notebooks, questions booklets, and portfolios. This is an area that the HRHS teachers identified as a work in progress. They plan to visit an SLI classroom to get feedback from a teacher who has been using interactive notebooks for several years.

Here are examples from pages of the students' notebooks at HRHS.





4. Reinvestment

Some of the teachers involved in this PDIG are now participating with the Secondary Science Alternative Assessment Project (SSAAP) that began in 2021 and is being coordinated by MaST.

The teacher at SLI is continuing to implement Argument Driven Instructions and meet and work collaboratively with the teachers from the PDIG, and others.

The teachers at HRHS plan to continue their work and would like to extend it to Secondary 2. As they become more confident, they would like to include other teachers. The teachers plan to continue meeting and collaborating even though the PDIG is complete.

A teacher from Centennial Regional High School has joined the group and is also working with the group on the SSAAP project.

5. What went well

The teachers who are implementing the ADI and Ambitious Science Frameworks are noting that the students are more engaged and making connections to some of the big ideas in Science.

The feedback regarding teacher engagement was also positive. "I am having more fun teaching this year because of the changes we have made".

Challenges

The biggest challenge is time. Teachers struggle to find time to meet. They are involved in school life and extracurricular activities. They do not want to leave the classroom; the time with their students being the highest priority. Much of the planning and collaborative meeting time is done on the teachers own time.

Resources used by teachers during this project

https://www.argumentdriveninquiry.com/

https://ambitiousscienceteaching.org/

https://phet.colorado.edu/