Intermediate Teacher PD	Inquiry Based Learning

PD Session Framework

Introduction

The teacher PD sessions are a set of three videos being released by Science North, with this being the final session geared towards intermediate teachers for Grade 7 and Grade 8 students. The goal of these sessions is to provide teachers with an overview of Inquiry Based learning while also sharing ideas and resources to do two inquiry-based activities with students.

There are three parts to the session:

- **Part 1: What is Inquiry Based Learning?**
- **Part 2: Sample Inquiry Activity (Mystery Tube)**
- **Part 3: At Home Inquiry Challenge (Water Power)**

Part 1: What is Inquiry Based Learning?

What is Inquiry Based Learning?

Inquiry based learning is one of the key learning styles used here at Science North. When you visit our Science Centre, you'll find yourself learning by doing, through a variety of hands-on activities, demonstrations and interactions that encourage students to ask questions, be curious and discover what is around them. That's inquiry-based learning; self-directed learning where the responsibility is on the learner to discover new knowledge rather than relying on getting it from someone else. [1] Inquiry based learning emphasizes active participation by engaging students in challenges that pique their interest and encourage them to learn more. [1]

Why Use Inquiry Based Learning?

What we love about inquiry-based learning at Science North is that it encourages students to follow the same process used by scientists to construct knowledge. Science revolves around not knowing the answer to something and being able to problem solve to come up with clever and helpful solutions. It engages students in an authentic scientific discovery process which builds their ability to communicate and think like a scientist. [1]

Potentially more important to inquiry-based learning right now is that this method of learning lends itself incredibly well to learning from home during the quarantine. Technology allows students to follow the inquiry process with self-guided projects that enable them to learn at their own pace and in areas that interest themselves. Inquiry based learning builds long term skills in students such as being able to identify problems, ask questions, carry out experiments, understand data and presenting results. No doubt these skills are beneficial to the scientific process, but they are also real-world skills that create well rounded learners. [1]

What are the steps in Inquiry Based Learning?

It is widely accepted that when participating in inquiry-based learning, the scientific process gets broken into five different inquiry phases, which make up the inquiry cycle. It's considered a cycle because the scientific process isn't linear but rather requires students to come back to different phases. [1] The learning is constantly changing and growing, encouraging students to learn from trials, make changes and expand their knowledge in the process. The names of the five phases change but at Science North we like to think of them as follows: **Observe, Brainstorm, Create, Improve and Share.**

- **Observe:** During the observation stage, the learning topic is introduced to the students. The goal is to stimulate curiosity about the topic by asking a question, providing a challenge or asking students to think about something they love and want to learn more about. One of the benefits of doing this at the intermediate level is that students will have more of a selection of previous learning to pull from and the initial topic or challenge can be more open ended.
- **Brainstorm:** During this phase, students are encouraged to start thinking about the challenge and possible solutions. Students at the intermediate level should be encouraged to perform their own research which will allow them to dig deeper in the subject. Encourage a wide range of media for them to consider, such as websites, magazines, books, movies, podcasts and more.
- **Create:** Depending on the challenge, this phase can take different forms. This can be as simple as creating a drawing of the solution, building a prototype or even completing a science experiment. The goal of this stage is to take curiosity and turn it into action.
- **Improve:** During this stage, students are encouraged to make changes and improve on their creation stage. By seeking feedback from others, they can get ideas on how to make their project even better. An important part of science is making mistakes and getting feedback, which can be used to develop a deeper solution to the challenge.
- **Share:** This one of our favourite stages, we like seeing what you've created! Being able to share solutions to challenges promotes literacy and communication skills while also providing an opportunity to reflect on the project. We want you to share your projects with us on social media: **@ScienceNorth** and **#ScienceAtHome**

What is the Teacher's Role in Inquiry Based Learning?

As a teacher, your role is to develop a culture of inquiry, support discussions and promote the nature of science. You can also assist your students by providing information and resources about the learning topic and helping to facilitate collaboration. [2]

Part 2: Sample Inquiry Activity

Activity Overview:

Mystery Tube: The mystery tube activity requires students to recreate a tube that has string moving in unique and unexpected ways. Since they can't see the inside workings of the mystery tube, students have to deduce what is happening based on observation. Watch the video to see the mystery tube in action and to learn to make your own.

Observe

As the ropes in the mystery tube are moved, students should be observing to see what can be learned. Students should be asking how the strings are connected, if there are additional material and if so what they can be, how long the strings are and what is inside to make them move as they do.

Brainstorm

During the brainstorm stage, encourage students to draw what they think is happening inside the tube. Use arrows as part of the diagram to add details explaining the movement.

Create

During this stage, students will recreate the mystery tube using the available material.

Improve

Test the re-created mystery tube and compare it to the original. If there are noticeable differences, use this as an opportunity to improve the design so that it moves more like the original model.

Share

Discuss what you did to make the mystery tube. Where were you successful, what did you learn, what steps along the way were the most challenging.

Materials

- Paper towel roll
- Muffin liners (parchment paper)
- Elastics
- String
- Beads
- Scissors

Key Concepts

This activity really nicely demonstrates the process of scientific inquiry. Students were required to make a hypothesis, test that hypothesis and form a conclusion based on what they learned. Not being able to look inside the mystery tube is a big part of this activity, since often scientists can't open something up to check their answers either. That said, you are certainly welcome to show your students how it works.

Part 3: At Home Inquiry Challenge

At Home Inquiry Challenge

Water Power: The premise of this at home inquiry challenge is simple, can you lift a fist-sized rock off the ground only using the power of water? Students will be required to apply the properties of fluids to accomplish this task.

Observe

The observation part of this activity is fairly open-ended but students should be encouraged to observe and apply some of the properties of fluids. Where does water get its power and what properties will allow it to accomplish this task? Accessing prior learning will be beneficial at this stage of the project.

Brainstorm

Lifting rocks with water is not a novel or a new concept. Performing research will allow students to gain ideas as they learn how the likes of hydraulics or water wheels work. Encourage them to record what they learn and start drawing or sketching their plan for lifting the rock.

Create

Build something to life the rock off the ground, while only using the power of water. We don't want to give too much away but there are many options that students can pursue. To successfully accomplish this task, the rock should be lifted approximately 30cm off the ground.

Improve

Students should be constantly tinkering and improving their design. This challenge will likely result in some failed attempts but being able to learn from those attempts is a key part of the enquiry process. Encourage students to seek advice and feedback from friends and family.

Share

Sharing the results of this project not only encourages the use of communication skills but it allows for reflection on the project and how it went. We would also appreciate if you could share your results with us. We'll try to feature as many submissions as possible using our social media: **@ScienceNorth** and **#ScienceAtHome**

Conclusion

Inquiry-based learning is great because it can be used to learn and explore so many different topics. We only gave you two suggestions, but there are countless other projects that you can try with your students. Join us next week as we explore two new inquiry activities for the junior level or come up with your own. If you do, be sure to share those with us, we always appreciate seeing what you and your students are up to. Thank you!

Bibliography

[1] M. Pedaste, M. Maeots, L. A. Siiman, T. de Jong, S. A. van Riesen, E. T. Kamp, C. C. Manoli, Z. C. Zacharia and E. Tsourlidaki, "Phases of inquiry-based learning: Definitions and the inquiry cycle," *Educational Research Review,* pp. 47-61, 2015.

[2] M. Dobber, R. Zwart, M. Tanis and B. van Oers, "Literature review: The role of the teacher in inquiry-based education," *Educational Research Review,* vol. 22, pp. 194-214, 2017.