Junior Teacher PD	Inquiry Based Learning

PD Session Framework

Introduction

The teacher PD sessions are a set of three videos being released by Science North, including this one which is geared towards junior level teachers from Grade 4 to Grade 6. 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 Box)**
- **Part 3: At Home Inquiry Challenge (Space Mission)**

Part 1: What is Inquiry Based Learning?

What is Inquiry Based Learning?

Inquiry based learning is one of the principal 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. Being able to connect this stage to prior learning will help to engage students, though as students reach the junior level they may also be more inclined to explore a topic that interests them outside of what you've taught,
- **Brainstorm:** During this phase, students are encouraged to start thinking about the challenge and possible solutions. If the challenge is framed as a science experiment, students should form a hypothesis that predicts what they think they will observe. This stage also invites students to learn more about the topic. Being able to learn more about a topic stems from research, which can take the form of books, videos, websites or even exploring the world around them.
- **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] As teachers navigate the digital world, what can be especially valuable for junior level learners would be providing students with starting points for their research, such as links to reputable websites and videos, or recommendations for online books or stories to read.

Part 2: Sample Inquiry Activity

Activity Overview:

Mystery Box: In the mystery box activity, pulling down on the string makes the box go up, while pulling up causes it to go the other way. Students are tasked with trying to replicate this experiment without looking at what is going on inside the box.

Observe

There are many questions that can be asked to try to understand what is happening inside the box:

- What do you notice when you pull the strings?
- Try pulling it at different speeds, sideways or upside down.
- What do you hear?
- Is the box heavy or light?
- What (and how many) materials were used

Brainstorm

Try to predict what is happening in the box. Draw a sketch that depicts how the string causes the box to move up or down. Draw as many details as needed and use arrows to show how elements of the box move.

Create

Recreate the box as best as you can using the materials provided. Providing students with a larger material list than needed will help them think of different ways of building the box.

Improve

Did the box move the same way as the original? If not go back to the brainstorm process and try a different approach. Similarly, if the box isn't moving as fast or as smoothly as you'd like, think of ways to improve the design.

Share

Discuss the results of your challenge. What worked well, what didn't? What was your solution for the box? Do you think there were other ways that this could have been accomplished?

Materials

- Box
- String
- Carabiners/pulleys, etc.

Key Concepts

Looking at this activity strictly from a science perspective, two key elements apply. First is the process of scientific inquiry. Students were required to make a hypothesis, test that hypothesis and form a conclusion based on what they learned. Second, this activity fits well into the Pulleys and Gears strand of the Grade 4 curriculum. While a carabiner, or even a loop in the string doesn't resemble an actual pulley, it serves the same purpose by changing the direction of the rope and reducing the amount of friction. Both these functions serve to make work easier, effectively mimicking a pulley in this set-up.

Part 3: At Home Inquiry Challenge

At Home Inquiry Challenge

Space Mission: Your mission, if you choose to accept it, is to plan and model an exploration mission to a planet of your choice. It can be any planet within our solar system, a planet outside of it, or even a planet that you made up. The goal of this challenge is to learn about planets as well as space exploration.

Observe

There is a lot to think about at this stage of the mission. Students should be thinking about what they know about space and consequently what they might need to build, create or plan to explore it. Some things to consider can include:

- How will the spacecraft launch? What type of spacecraft will you require?
- Is this going to be a manned mission or one done autonomously?
- What is the planet like, what will be done once the spacecraft arrives? Will it be mined, explored, colonized and if any of those, what needs to be considered to do this?
- Will the spacecraft deploy a satellite or a rover? What will those look like?

Brainstorm

There are lots of questions to consider, and at this point students should be researching their options as well as starting to plan their mission. Maps, sketches and calculations are all valid things to do during this stage. If students plan on building models to replicate components of their mission, they can create drawings to help put their ideas on paper.

Create

This stage has lots of possibilities, and creating models is a fun way to add a hands-on element to the project. Some things that students can consider building include:

- A rocket (as well as a means of launching it)
- A model of the planet
- Space tools or equipment (helmets, spacesuits, etc.)
- A landing rover
- An orbiting satellite (Canadian CubeSat Project)

Improve

Use this as an opportunity to reflect on what you created and to find ways to make improvements. How can you launch your rocket higher, how can your landing rover land more slowly, could your model of the planet be more detailed? Use your friends, family and classmates to get feedback and suggestions then apply it.

Share

We want to see what you created! Share your pictures or videos of your space mission with us and we will feature some of our favourites on our social media platforms. You can share these with us on 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 intermediate 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.