

Making a Model of a Closed Ecosystem

Activity Summary

- In this activity, students will:
- ♦ Visit a local pet or aquarium store
 - ♦ Create a closed ecosystem called an Ecojar
 - ♦ Complete an **Essential Skills** Ranking Worksheet
 - ♦ Complete a self-assessment

Prior Knowledge

- **Essential Skills**
- Understanding of the following cycles: water, nitrogen and carbon
- Definitions of the following terms: producers, consumers, decomposers, abiotic and biotic factors



Teaching Planning Notes

- Review assignment including prior knowledge required and assessment and evaluation tools
- Read over the activities with the students and provide instructions for measuring temperature, nitrates, nitrites, total hardness, total alkalinity, and pH
- Purchase any submerged aquatic plant (e.g. hornwort or fanwort)
- Order snails ahead of time
- Purchase Mardel 5 in 1 Test Strips - pH, Hardness, Alkalinity, Nitrite and Nitrate (check the expiry date before you purchase this)
- Purchase an Ammonia Test Kit and Stress Coat
- Prepare a project folder for each group that contains the assignment. (Tip: colour code handouts as an organizational strategy)
- Offer rewards to the most creative name and logo for the group (optional)
- Observe the ecosystem once a week for several months

Note 1: There is potential to plan a field trip to a pet store or specialty aquarium store

Assessment of Student Achievement

| Task | Tool / Type |
|---|---|
| Visiting a local pet or aquarium store | Getting Hooked on Ecojars Gone Fishing Worksheet (Formative) |
| Activity Checklist | Getting Hooked on Ecojars Table 1: Steps for Success Ecojar Checklist (Formative) |
| Attendance and Role Log Sheet | Getting Hooked on Ecojars Table 2: Making an Ecojar Attendance and Role Log Sheet (Formative) |
| Chemical and Biological Data Collection | Getting Hooked on Ecojars Table 3 and 4: Chemical and Biological Analysis of the Ecojar (Formative) |
| Conclusions, Analysis and Applying Your Knowledge | Getting Hooked on Ecojars Table 5: Conclusions and Analysis Table and Applying Your Knowledge Worksheet (Summative) |
| Self-Assessment during Ecojar Activity | Getting Hooked on Ecojars Self-Assessment Tool For the Setup, Data Collection and Dismantling of the Ecojar (Formative) |
| Ranking the Essential Skills used | Getting Hooked on Ecojars This is the Last Catch! Ranking Essential Skills Used Worksheet (Formative) |



FOCUS ON LEARNING

Essential Skills:

Reading Text

Conducting Lab Activity

Document Use

Conducting Lab Activity

Numeracy

Conducting Lab Activity

Writing

Conducting Lab Activity

Self Assessment

Essential Skills Worksheet

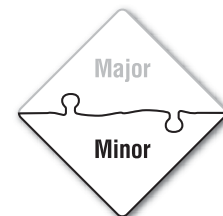
Oral Communication

Conducting Lab Activity

Store Visit

Working with Others

Conducting Lab Activity



Activity and Assessment Materials

- Getting Hooked on Ecojars Assignment Sheet
- Gone Fishing Activity Sheet
- Steps For Success Ecojar Checklist (Table 1)
- Making an Ecojar Attendance and Role Log Sheet (Table 2)
- Building an Ecojar Instruction Sheet
- Chemical and Biological Analysis of the Ecojar (Tables 3 and 4)
- Conclusions and Analysis of the Ecojar (Table 5)
- Applying Your Knowledge Questions and Answer Key
- Self-Assessment Tool For the Setup, Data Collection and Dismantling of the Ecojar
- This is the Last Catch! Ranking the **Essential Skills** Used Worksheet

Curriculum Linkages For Ontario Educators

Essential Skills truly are everywhere and as teachers we are always teaching students the **Essential Skills!** As subject teachers and specialists, we know that many of the curriculum expectations we are accountable to teach and assess, also address the **Essential Skills** and while the linkages are not always readily apparent, the linkages exist nonetheless.

While this activity connects to a variety of courses, it is most closely aligned to the following courses:

- Grade 10 Science Applied, SNC 2P

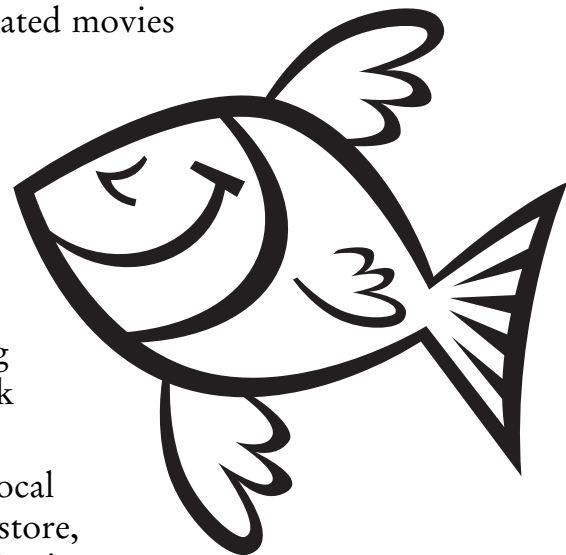
To assist you, the teacher, in making more transparent linkages, we have identified the following curriculum linkages for this activity.

Science - SNC 2P

| Coded Overall Expectations | Coded Specific Expectations |
|---|--|
| BYV.01P – demonstrate an understanding of ecosystems, including the relationship between ecological balance and the sustainability of life; | BY1.01P – describe the processes of photosynthesis and cellular respiration as they relate to the cycling of energy, carbon, and oxygen through abiotic and biotic components of an ecosystem (e.g., explain how glucose, water, and carbon dioxide are produced and/or consumed during these processes); |
| | BY1.02P – illustrate the cycling of matter through biotic and abiotic components of an ecosystem by tracking nitrogen; |
| BYV.02P – analyse natural and human threats to a local ecosystem and propose viable solutions to restore ecological balance; | BY2.03P – through investigations and applications of basic concepts demonstrate the skills required to plan and conduct practical tests on related ecological factors, and collect data using appropriate instruments and techniques safely and accurately (e.g., tests for water quality, air quality, soil composition); |
| | BY2.04P – through investigations and applications of basic concepts select and integrate information from various sources, including electronic, print, and community resources, to answer the questions chosen; |

Getting Hooked on Ecojars

Finding Nemo, and *Shark Tale* are two wonderful animated movies portrayed in aquatic ecosystems. The creators of these stories magically illustrated and captured many ecological principles. In this activity, you will work with a group of students to create and analyze a closed ecosystem for a period of time. This closed ecosystem will be called an Ecojar. The water cycle, nitrogen cycle, and carbon cycle are three important cycles that plant and animal life depends on. Measuring components in ecosystems and studying how they work are important parts of ecology.



Before your group prepares an Ecojar, you will visit a local pet or aquarium store on your own time. While at the store, you will answer the questions on the handout called “Getting Hooked on Ecojars”. While answering the questions, you will discover the variety of products the store sells to their customers. Some of these products will be used in building and analyzing your Ecojar. In this activity you will also discover the real world applications of the **Essential Skills**.

Once the Ecojar is built, each member of your group will rotate through the roles of a Project Manager, a Chemical and a Biological Laboratory Technician. Each of these roles utilizes several of the **Essential Skills** required to successfully participate in the Canadian labour market. The roles of the Project Manager and Laboratory Technicians are described below.

Project Manager (PM)

1. Collect the project folder from the teacher.
2. Record the attendance for the group in Table 2.
3. After task 3, record the role of each member in Table 2.
4. Record the data obtained from the lab technicians.
 - a) Record Chemical Analysis from CLT in Table 3.
 - b) Record Biological Analysis from BLT in Table 4.
5. If a student is absent from the group, share the duties with the other member(s).

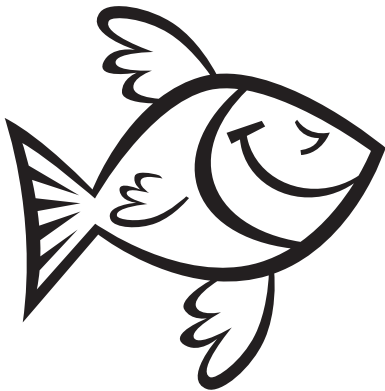
Getting Hooked on Ecojars

Chemical Laboratory Technician (CLT)

1. Collect all of the equipment required for measuring the temperature, nitrate, nitrite, hardness, alkalinity, and pH.
2. Measure the temperature and give the value to the PM.
3. Measure the pH and give the value to the PM.
4. Measure the ammonia level and give the value to the PM.
5. Return the equipment to the appropriate location.
6. Clean up their section of the lab station.

Biological Laboratory Technician (BLT) (BLT → not bacon, lettuce and tomato!)

During the initial setup of the aquarium, BLT will:



1. Obtain the aquarium (after the water has sat for 48 hours)
2. Add the following to the aquarium:
 - a) a squirt of stress enzyme (stress coat)
 - b) 4 strands of aquatic plants - push them into the gravel
 - c) 6 small snails
 - d) 3 guppies
3. Return the aquarium (with the lid on) after CLT has finished with the chemical tests.

After the initial setup, the BLT will:

1. Obtain the aquarium for data analysis.
2. Count the number of fish and give the value to the PM.
3. Count the number of snails and give the value to the PM.
4. Describe the plant life in the aquarium to the PM.
5. Describe the physical appearance of the water (e.g., cloudy, clear, colour) to the PM.

Note: a healthy ecosystem will have a pale green colour in the water because of the algae. The algae were developed from the spores that were present on the plants and animals. If the water does not develop a green colour, move the aquarium closer to the light source.

6. Return the aquarium (with lid on) to the appropriate location when you and the CLT are finished.

Getting Hooked on Ecojars Gone Fishing

Name of Student: _____ Date: _____

Visit a local pet store (or aquarium store) that sells aquatic specimens, aquariums and chemical test kits. While you are circulating through the store notice the **Essential Skills** the employees are using. Complete the worksheet below.

Name of store: _____

Location of store: _____

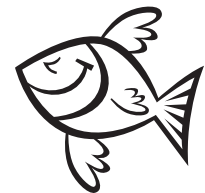
Write the name of four aquatic plants and their prices.

1. _____ \$ _____
2. _____ \$ _____
3. _____ \$ _____
4. _____ \$ _____

Find the cost of feeder guppies. \$ _____

How many guppies do you get for that price? _____

Calculate how much 3 guppies would cost. \$ _____



Does the store sell snails? \$ _____

If yes, how many snails do you get for the price. _____

Calculate how much 6 snails would cost. \$ _____



Getting Hooked on Ecojars

Locate three different chemical test kits that a customer would buy to analyze the water in their aquarium. Write the name of the manufacturer, what chemical(s) the kit tests for, and the price of the kit.

| Name of Manufacturer | Chemical(s) Analyzed in the Kit | Kit Price (\$) |
|----------------------|---------------------------------|----------------|
| 1. _____ | _____ | _____ |
| 2. _____ | _____ | _____ |
| 3. _____ | _____ | _____ |

Describe one occupation you have observed in this store that has benefited from having some knowledge of aquatic systems. Describe the top two **Essential Skills** this employee would require to be successful in this position.

List as many industries you can think of that would perform chemical analysis of water (retail, manufacturing, and personal.)



Getting Hooked on Ecojars

Table 1: Steps For Success

Ecojar Checklist

Below is a checklist you will complete throughout the course of this activity. This will help you keep track of your progress and ensure success.

| STEP | DUE DATE | COMPLETED <input checked="" type="checkbox"/> |
|--|----------|---|
| Getting Hooked on Ecojars | | <input type="checkbox"/> |
| Task 1: Setting the Bait! | | <input type="checkbox"/> |
| Task 2: Luring You In! | | <input type="checkbox"/> |
| Task 3: It is "Reel" Easy to Setup the Ecojar | | <input type="checkbox"/> |
| Task 4: Chemical and Biological Analysis of the Ecojar | | <input type="checkbox"/> |
| Task 5: Dismantling the Ecojar | | <input type="checkbox"/> |
| Task 6: Not Another Fish Story - Your Conclusions, Analysis, and Applying Your Knowledge Section | | <input type="checkbox"/> |
| Self-Assessment Tool For The Setup, Data Collection and Dismantling of the Ecojar | | <input type="checkbox"/> |
| This is the Last Catch! Ranking the Essential Skills Used | | <input type="checkbox"/> |

Getting Hooked on Ecojars

Table 2: Making an Ecojar Attendance and Role Log Sheet

Starting Date: _____

Creative name for your group: _____
(related to the topic at hand, of course!)

Completion Date: _____

Under the date, record the actual date of the investigation and write the acronym for the role of the student. (PM = Project Manager; CLT = Chemical Laboratory Technician 1; BLT = Biological Laboratory Technician, A = Absent, L = Late)

| NAMES OF STUDENTS | DATE | DATE | DATE | DATE | DATE | DATE | DATE | DATE | DATE | DATE | DATE | DATE |
|-------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |

Getting Hooked on Ecojars

Building an Ecojar

Materials:

- large bottle of jar with a top (at least 3-4 L)
- clean gravel and/or sand
- light source (natural or 60 W bulb)
- strainer
- thermometer
- Mardel 5 in 1 Test Strips - pH, Hardness, Alkalinity, Nitrite and Nitrate, Ammonia Test Kit
- pond snails (6)
- strands of an aquatic plant (4)
- plant-eating fish (e.g., Guppies (3))
- ruler
- a bottle of stress coat

Task 1: Setting the Bait!

1. Groups will be assigned and the group folder will be distributed.
2. Sit together with your group.
3. Read over the entire activity and make sure everyone in the group has a clear understanding of the roles of the Project Manager, Chemical and Biological Laboratory Technicians.
4. Decide on a creative name and logo for your group. Write the name and draw the logo for your group on the Attendance and Role Log sheet. See Table 2 . (Hint: add colour to your logo).
5. Record everyone's name in Table 2 and take the attendance.
6. Return your group folder to the teacher.

Task 2: Luring You In!

1. Using a strainer, clean and wash the gravel.
2. Place the gravel to a depth of 2-3 cm in the jar.
3. Fill the jar almost to the top with tap water. Let the jar stand with the top removed for 48 hours. This lets the chlorine leave the water.
4. Prepare two labels with your creative group's name and logo. Tape one label to the bottle representing your aquarium (hint: do not make the logo too big because light must get into the aquarium). Tape the second label onto the front of your group's folder.
5. Clean the lab station.
6. Assign roles for next class.
7. Place the aquarium in the designated location and return your folder to the teacher.

Task 3: It is "reel" easy to set up the Ecojar.

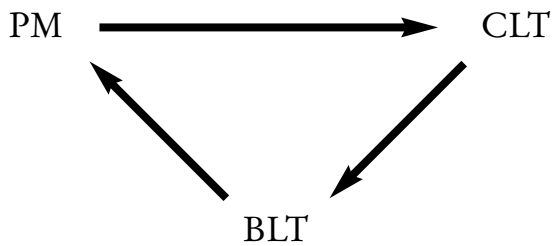
After 48 hours, your Ecojar is ready to be setup.

1. Review the roles of PM, CLT, and BLT.
2. Read and follow the instructions for each role.
3. Refer to Steps For Success Ecojar Checklist and complete the appropriate portion.

Getting Hooked on Ecojars

Task 4: Chemical and Biological Analysis of the Ecojar

1. Each time the Ecojar is analyzed, the roles must be rotated.
The PM becomes CLT; CLT becomes BLT and BLT becomes PM.



2. Continue switching roles until your data collection is completed.
3. Refer to Steps For Success Ecojar Checklist and complete the appropriate portion.

Task 5: Dismantling the Ecojar

1. At the end of this activity, every member of the group is responsible for dismantling and cleaning the Ecojar.
2. Return guppies, snails and plants into the location designated by your teacher.
3. Using a strainer, rinse the gravel several times with tap water and return to the designated container.
4. Remove the label, clean and dry the 4L container that served as the Ecojar. Return the container and lid to the appropriate location.
5. Complete Self-Assessment
6. Refer to Steps For Success Ecojar Checklist and complete the appropriate portion.
7. Return your folder to the teacher.

Task 6: Not Another Fish Story - Your Conclusions, Analysis and Applying Your Knowledge Section

1. Everyone in the group must complete their own conclusions, and analysis. See Table 5. Also complete the Applying Your Knowledge questions.
2. Refer to Steps For Success Ecojar Checklist and complete the appropriate portion.
3. Return the completed folder with everyone's work to the teacher.

Getting Hooked on Ecojars

Chemical and Biological Analysis of the Ecojar

Table 3: Chemical Analysis

| | | | | | | | | | |
|---|--|--|--|--|--|--|--|--|--|
| DATE | | | | | | | | | |
| NAME OF PM | | | | | | | | | |
| NAME OF CLT | | | | | | | | | |
| Temperature (°C) | | | | | | | | | |
| Ammonia, NH ₃ , ppm | | | | | | | | | |
| Nitrate, NO ₃ ¹⁻ , ppm (mg/L) | | | | | | | | | |
| Nitrite, NO ₂ ¹⁻ , ppm (mg/L) | | | | | | | | | |
| Total Hardness, ppm | | | | | | | | | |
| Total Alkalinity, ppm | | | | | | | | | |
| The pH value | | | | | | | | | |

Table 4: Biological Analysis

| | | | | | | | | | |
|---------------------------|--|--|--|--|--|--|--|--|--|
| DATE | | | | | | | | | |
| NAME OF PM | | | | | | | | | |
| NAME OF BLT | | | | | | | | | |
| # of snails | | | | | | | | | |
| # of guppies | | | | | | | | | |
| Description of plant life | | | | | | | | | |
| Colour of the water | | | | | | | | | |

Getting Hooked on Ecojars

Table 5: Conclusions and Analysis of the Ecojar

Complete the chart below.

| | VARIABLE MEASURED | <input type="checkbox"/> INCREASE <input type="checkbox"/> DECREASE <input type="checkbox"/> STAYED THE SAME OR <input type="checkbox"/> FLUCTUATED UP AND DOWN | DESCRIBE AND ANALYZE THE IMPACT THE VARIABLE HAS ON THE CLOSED ECOSYSTEM IN THE ECOJAR |
|---|---|--|--|
| A | Temperature (°C) | | |
| B | Ammonia, (NH ₃), ppm | | |
| C | Nitrate (NO ₃ ¹⁻), ppm | | |
| D | Nitrite (NO ₂ ¹⁻), ppm | | |
| E | Total Hardness, ppm | | |
| F | Total Alkalinity, ppm | | |
| G | The pH value | | |
| H | Snails | | |
| I | Guppies | | |
| J | Plant life | | |
| K | Colour of water | | |

Getting Hooked on Ecojars

Applying Your Knowledge

1. a) What is an ecosystem? _____

- b) What are the two main parts of an ecosystem? _____

2. The ecosystem your group built is a closed ecosystem.
How does it differ from natural ecosystems? _____

3. Why was a closed ecosystem used for this activity? _____

4. The plants and algae require carbon dioxide for photosynthesis.
Where did the carbon dioxide come from? _____

5. The plants, animals and algae require oxygen for respiration.
Where did the oxygen come from? _____

6. How do the plants get the nutrients they need for survival? _____

7. What would cause a high level of ammonia in the ecojar? _____

8. What is the purpose of the light? _____

9. What do you think will happen if all the plants and algae die? _____

Getting Hooked on Ecojars

Answer Key

(Applying Your Knowledge Questions)

1. a) What is an ecosystem?

An ecosystem consists of all the interacting parts of a biological community and its environment. It is a group of living organisms along with the abiotic components that form a self-regulating system through which energy and materials are transferred.

b) What are the two main parts of an ecosystem?

The two main parts of an ecosystem are the biotic and abiotic components.

2. The ecosystem your group built is a closed ecosystem.

How does it differ from natural ecosystems?

A closed system differs from a natural ecosystem because substances cannot enter or leave the system.

3. Why was a closed ecosystem used for this activity?

A closed system was used for this activity because it provided a more controlled environment for students to study the interactions developed between the abiotic and biotic components of the system.

4. The plants and algae require carbon dioxide for photosynthesis.

Where did the carbon dioxide come from?

The carbon dioxide came from the respiration of all the living things in the ecojar (algae, aquatic plants, snails, guppies).

5. The plants, animals and algae require oxygen for respiration.

Where did the oxygen come from?

Plants and algae carry out photosynthesis to produce the oxygen required for the respiration of all the living organisms.

Getting Hooked on Ecojars

6. How do the plants get the nutrients they need for survival?

The fish and snails in the aquarium produce a toxic waste called ammonia. The bacteria in the aquarium convert the ammonia into nitrate. The plants can use the nitrate as a nutrient to make protein. Plants also produce glucose through photosynthesis. This requires carbon dioxide from the respiration of all the living creatures.

7. What would cause a high level of ammonia in the ecojar?

A high level of ammonia is created from too much waste being produced from the fish and snails. It could also indicate that there is too much decaying organic matter in the ecojar. This could also mean that the level of good bacteria (the one that converts the ammonia to nitrate) is low.

8. What is the purpose of the light?

The aquatic plants and the algae require light for photosynthesis.

9. What do you think will happen if all the plants and algae die?

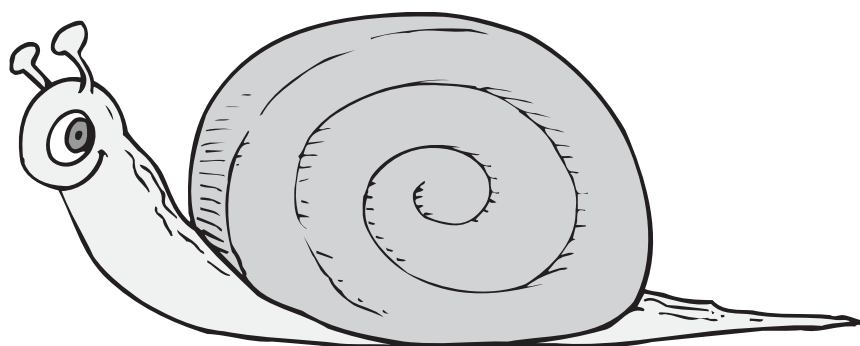
If all of the plants and algae died, then no photosynthesis would take place. Without photosynthesis, there would be no oxygen for all of the living things to respire. As a result, the entire ecosystem would collapse.



Getting Hooked on Ecojars Self-Assessment Tool

(Setup, Data Collection and Dismantling of the Ecojar)

| CRITERIA | GUIDING QUESTIONS | CONTINUUM 1 = LIMITED/ 5= THOROUGH |
|---|--|---------------------------------------|
| Follows Procedures | Did you perform the roles of the PM, CLT and BLT in a positive manner? | 1 2 3 4 5 |
| Use of tools, equipment, and materials | Did you demonstrate the correct use of scientific equipment and materials while doing the chemical analysis? | 1 2 3 4 5 |
| Communication | When you were the CLT and BLT, did you effectively communicate your analysis to the Project Manager? | 1 2 3 4 5 |
| Safety | Did you demonstrate and promote the safe use of scientific equipment and materials? | 1 2 3 4 5 |
| Concentration | Were you always on task? | 1 2 3 4 5 |
| Cleanup | Did you thoroughly cleanup you lab station and assist in putting away materials? | 1 2 3 4 5 |



Getting Hooked on Ecojars This is the Last Catch!

Ranking the Essential Skills Used

Throughout the building, observing and analyzing of your Ecojar, you used several of the **Essential Skills**. Complete the chart below by ranking how often you used the **Essential Skills** for each of the tasks outlined.

(1=none or little usage, 2=some usage, 3=moderate usage, 4=high usage, 5=very high usage)

| Essential Skills | GETTING HOOKED ON ECOJARS – STORE VISIT | ROLE OF PROJECT MANAGER, CHEMICAL AND BIOLOGICAL LAB TECHNICIANS | CONCLUSIONS, ANALYSIS AND APPLYING YOUR KNOWLEDGE |
|-------------------------|--|---|--|
| Reading Text | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| Document Use | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| Writing | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| Numeracy | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| Oral Communication | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| Thinking Skills | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| Working with Others | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| Computer Use | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |
| Continuous Learning | 1 2 3 4 5 | 1 2 3 4 5 | 1 2 3 4 5 |

What can you conclude from the information above?

