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UNIVERSITI MALAYSIA SARAWAK

CENTRE FOR
PRE-UNIVERSITY STUDIES

explore unravel excite

SCIENCE-PLORATION 2023

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Foreword

The Sciencepleration Camp is an initiative of the Centre for Pre-University Studies, UNIMAS (PPPU), which aims to increase the interest in science among secondary school students. It is also an effort taken by PPPU towards the achievement of Sustainable Development Goals 4 in providing equal quality education and promoting lifelong learning opportunities for all. On top of that, this camp supports Sarawak's Digital Economy Strategy in nurturing an integrated ecosystem to foster inclusive digital society, by building the right foundations to grow our local digital economy.

This camp has two main objectives and one of them is to inspire and nurture future generations of experts in the fields of science, technology, engineering, and mathematics (STEM). By the same token, it is also held to increase the visibility of PPPU as one of the best options for post-secondary education for local students. In this camp, the activities are designed to provide an authentic experience to the participants by combining learning with visually stimulating, sensory-rich and simple hands-on science experiments. When learning science is made this fun, it will surely be more effective and engaging for everyone.

It is hoped that these activities would nurture the participants' interest in science and inspire them to develop a strong sense of self through learning by exploration and discovery. In the future, they may consider embarking onto tertiary education in the field of STEM, and that would a great reward to our society.

Associate Professor Dr Ruhana Hassan
Director
Centre for Pre-University Studies
UNIMAS

Note for Participants

The activities outlined for this Camp are to be carried out with close supervision from the experts, within the allocated venues. Engage your interests, ask questions, and relate what you have learned to your experiences.

Let's together make learning fun and rewarding!

Contents

UNIMAS

Scienceploration Camp

Activity 1: Making Sense of Your Senses

OBJECTIVE(S):

1. To define the five main human senses
2. To identify the role of neurons in the nervous system
3. To relate the human senses with the nervous system

INTRODUCTION:

The nervous system must receive and process information about the world outside in order to react, communicate, and keep the body healthy and safe. Much of this information comes through the sensory organs: the eyes, ears, nose, tongue, and skin. Specialised cells and tissues within these organs receive raw stimuli and translate them into signals the nervous system can use. Nerves relay the signals throughout the nervous system, which interprets them as sight (vision), sound (hearing), smell (olfaction), taste (gustation), and touch (tactile perception).

APPARATUS:

- Box
- Headphones
- Cloth
- Laptops

MATERIALS:

- 3 items with distinctive surfaces
- 2 items with distinctive smell
- Colour blind test card
- Video of audio hearing test
- 3 items with distinctive taste

METHOD:

This activity will be divided into five stations; each section will require participants to use all their senses to complete the activity.

Station 1: Handy Box

- Use your sense of touch to guess all 3 items in the mystery box.

Station 2: Smelly Cat

- Use your sense of smell to guess all the items in the box.

Station 3: See Saw

- Use your sense of sight to identify the numbers and letters.

Station 4: Hear Hear

- Use your sense of hearing for the frequency limit test.

Station 5: Taste This

- Use your sense of taste and guess the taste of the food provided.

RESULTS:

Activity 1: Handy Box

Guess the items in the box:

Box 1: _____

Box 2: _____

Box 3: _____

Activity 2: Smelly Cat

What do you think are inside the box?

Box 1: _____

Box 2: _____

Activity 3: See Saw

What are the numbers in the images that you see?

Image 1: _____

Image 2: _____

Image 3: _____

Image 4: _____

Eye test result: _____

Activity 4: Hear Hear!

State the frequency when you cannot hear anything.
Answer: _____ Hz

Activity 5: Taste This

State the flavours of the sweets.

Sweet 1: _____

Sweet 2: _____

Sweet 3: _____

DISCUSSION:

1. Impulse received from sensory receptor is sent to the _____ for information processing.
   (A) brain
   (B) lungs
   (C) eyes
   (D) heart

2. The chemical that helps the transmission of impulse between neurons is called _____.
   (A) amylase
   (B) sodium
   (C) neurotransmitter
   (D) calcium

3. _____ is an example of involuntary actions controlled by autonomic nervous system.
   (A) Reading
   (B) Running
   (C) Walking
   (D) Breathing

REFERENCE(S):

Teaching Expertise (2022). *21 Nervous system activities for middle school*. Available at: https://www.teachingexpertise.com/classroom-ideas/nervous-system-activities-for-middle-school/ .

Neuroscience for kids - Experiments and activities (2017). Available at: https://faculty.washington.edu/chudler/experi.html.

NOTES

Activity 2: Fireworks

OBJECTIVE(S):

1. To observe the density of different liquids.
2. To observe the relationship between temperature and the density of water.
3. To observe the rate of diffusion in liquids with different temperatures.

INTRODUCTION:

Density is a fundamental parameter essential in reflecting how closely packed are the particles in a solid, liquid and gas matter. Specifically, the density of a material can be defined by the mass per unit volume for the material. In a liquid matter, particles are arranged considerably close together that move in random motion throughout a container. The level of compactness will eventually influence the density of a matter. Every matter possesses different value of density, for instance, distilled water has a density of 1.000 g/mL, salt water with 1.025 g/mL while sugar water or sucrose is 1.100 g/mL. When other liquid that is denser than water is introduced into the water, the liquid will sink down to the bottom but following a random manner based on how the particles move while considering the diffusion effect.

APPARATUS:

- Beaker
- Jar
- Pipette
- Aluminium foil
- Timer

MATERIALS:

- Water-based Artificial Colouring
- Vegetable oil

METHOD:

PART 1:

1. Fill a jar with room-temperature water.
2. Pour a thin layer of cooking oil into a beaker.
3. Drop a few artificial colouring into the beaker and stir.
4. Pour the mixture of oil and artificial colouring into a jar filled with room temperature water.
5. Observe the changes.

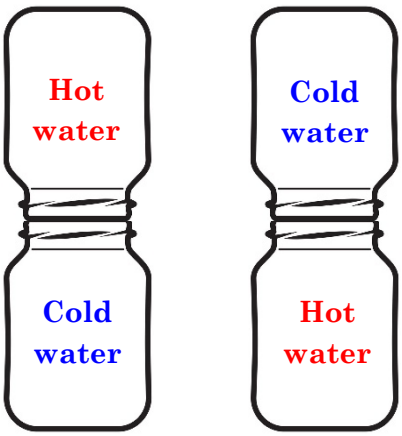
Oil + Artificial Colouring

Experiment setup for PART 1

Expected results: _____

PART 2:

1. Fill two jars with hot and cold water.
2. Using a pipette, apply several drops of blue artificial colouring in the cold water and red artificial colouring in the hot water.
3. Cover the hot water filled jar with aluminium foil.
4. Turn the jars upside down where the cold water is at the bottom.
5. Carefully, take off the aluminium foil and observe.
6. Repeat step 4 with hot water at the bottom.

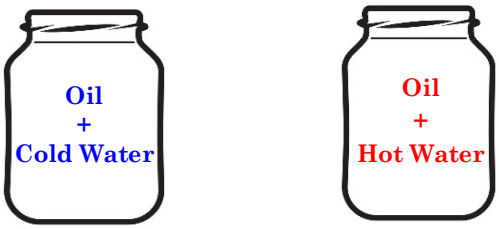


Experiment setup for PART 2

Expected results: _____

PART 3:

1. Fill two jars with hot and cold water.
2. Pour some vegetable oil into the jars filled with hot and cold water.
3. Keep pouring the oil until you have a layer of oil floating above the water.
4. Starting the timer, apply a few drops of artificial colouring into the jars.
5. Continue recording the time until any changes are observed in the jars.



Experiment setup for PART 3

Expected results: _____

RESULTS:

Part 1:

1. Based on your observation, which liquid appeared at the top?

   ☐ Water ☐ Oil

2. Where was the artificial colouring layer after 30 seconds?

   ☐ Top of the oil layer

   ☐ Bottom of the oil layer

   ☐ Top of the water layer

   ☐ Bottom of the water layer

3. Did the artificial colouring remain in the same layer after 1 minute?

   ☐ Yes ☐ No

Part 2:

1. With the cold water at the bottom, did the artificial colouring remain in layers?

   ☐ Yes ☐ No

2. With the hot water at the bottom, did the artificial colouring remain in layers?

   ☐ Yes ☐ No

Part 3:

1. Based on your observation, did the artificial colouring dissolve with the addition of hot water?

   ☐ Yes ☐ No

2. If yes, how long did it take for the artificial colouring to be dissolved in hot water?

   _____

3. Based on your observation, did the artificial colouring dissolve with the addition of cold water?

   ☐ Yes ☐ No

4. If yes, how long did it take for the artificial colouring to be dissolved in cold water?

   _____

DISCUSSION:

Part 1:

1. Which liquid is denser?

   ☐ Oil ☐ Water

2. What happened to the artificial colouring after 1 minute?

   ☐ Dissolved ☐ Remain as droplets

   Explain your answer: _____

Part 2:

1. Which water is denser?

   ☐ Cold Water ☐ Hot Water

2. What would happen if you left the jars with hot water at the top for 1 hour?

   ☐ Layers would remain ☐ Layers would disappear

Part 3:

1. What are the factors that contribute to the result in Part 3?

   ☐ Temperature of the water

   ☐ Concentration of the water

   ☐ Density of the water

   ☐ Colour of the solutions

NOTES

Activity 3: Finger Binary

OBJECTIVE(S):

1. To learn about the concept of finger binary.
2. To practice one-handed finger binary counting.
3. To practice simple addition with one-handed finger binary.

INTRODUCTION:

The finger binary method is a technique for counting and showing binary numbers using the fingers on one or both hands. In this system, each finger stands for a single binary digit, or bit. As a result, it is possible to count from zero to 31 with one hand, or up to 1023 using both hands.

For this activity, a "down" finger represents a nonzero number and an "up" finger represents binary zero.

APPARATUS:

- Finger binary chart
- Practice example

MATERIALS:

- None

METHOD:

PART 1: Finger binary values.

1. Start with an open right hand.
    a. Each relaxed, open finger takes the value of 0.
    b. The open right hand now represents 0.

2. Bend the thumb to close toward the palm of the hand.
    a. Closed right thumb takes the value of 1.
    b. The right hand with only closed thumb represents the value of 1.

3. Open the right hand again and bend the index finger to close toward the palm of the hand.
    a. Closed right index finger takes the value of 2.
    b. The right hand with only closed index finger represents the value of 2.

4. Open the right hand again and bend the middle finger to close toward the palm of the hand.
    a. Closed right middle finger takes the value of 4.
    b. The right hand with only closed middle finger represents the value of 4.

5. Open the right hand again and bend the ring finger to close toward the palm of the hand.
    a. Closed right ring finger takes the value of 8.
    b. The right hand with only closed ring finger represents the value of 8.

6. What is the value of a closed little finger?

PART 2: Simple finger binary addition

1. Start with an open hand.
2. Bend the thumb and the index finger.
    a. The closed right thumb takes the value of 1.
    b. The closed right index finger takes the value of 2.
    c. Therefore, the right hand with only closed right thumb and right finger represents 1+2 which equals to 3.

3. Open the right hand again and bend the thumb and the ring finger.
    a. The closed right thumb takes the value of 1.
    b. The closed right ring finger takes the value of 8.
    c. Therefore, the right hand with only closed right thumb and right finger represents 1+8 which equals to 9.

4. Open the right hand again and bend the index finger and the ring finger.
    a. The closed right index finger takes the value of 2.
    b. The closed right ring finger takes the value of 8.
    c. Therefore, the right hand with only closed right thumb and right finger represents 2+8 which equals to 10.

5. What does a right hand with only bent index, middle, and ring finger represent?

RESULTS:

Part 1:

The value of a closed little finger is _____

Part 2:

The right hand with only bent index, middle, and ring finger represents:

☐ + ☐ + ☐ = ☐

DISCUSSION:

Discuss the value that each of the following right hands represent:

	☐ + ☐ = ☐
	☐ + ☐ + ☐ = ☐
	☐ + ☐ + ☐ = ☐

NOTES

Activity 4: A1Z26 Cipher

OBJECTIVE(S):

1. To learn about A1Z26 cipher as a simple substitution code.
2. To practice finger binary counting on one hand.

INTRODUCTION:

A1Z26 cipher is a basic substitution cipher that replaces each letter of the alphabet with its corresponding numerical position in the alphabet. For example, A is 1, B is 2, C is 3, and so on. This cipher can be used to encode messages or secret codes that can only be deciphered by those familiar with the system. A1Z26 cipher is frequently utilised in escape rooms, puzzle games, and other situations that require secret communication.

APPARATUS:

- Finger binary chart

MATERIALS:

- Pen
- Paper

METHOD:

PART A: A1Z26 cipher chart

1. Observe the following table.
2.

A	B	C	D	E	F	G	H	I	J	K	L	M
1	2	3	4	5	6	7	8	9	10	11	12	13

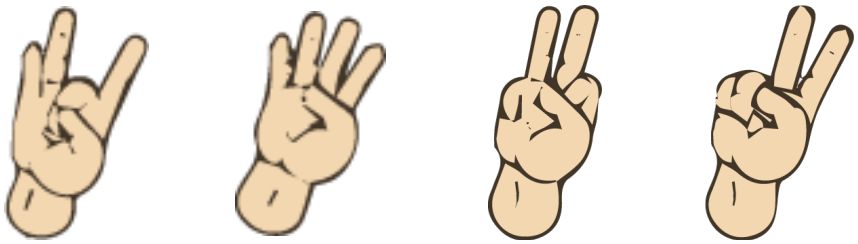
N	O	P	Q	R	S	T	U	V	W	X	Y	Z
14	15	16	17	18	19	20	21	22	23	24	25	26

3. Observe each column.
    a. In A1Z26, each number represents a letter.
    b. A is represented by 1.
    c. Z is represented by 26
    d. 13 represents M.

4. What does 13-1-20-8 represent?

PART B: A1Z26 with finger binary

1. Determine the highest value that can be represented with one hand in finger binary.
2. Observe the highest value required to represent a letter in A1Z26 cipher. Notice that the highest value to represent a letter is lower than the highest value that can be represented with on hand in finger binary.
3. Decrypt the following sequence of finger binary using A1Z26 cipher.



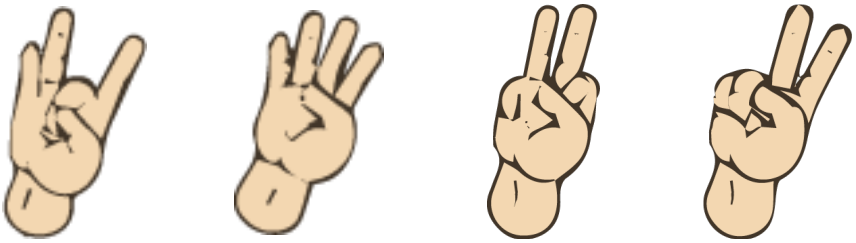
RESULTS:

Part A:

13-1-20-8 represents_____

Part B:

Finger Binary



Number

Letter

DISCUSSION:

Encrypt your nickname using A1Z26.

The letters of your nickname are: _____

The numbers representing your nickname are: _____

Try representing your nickname in binary finger.

REFERENCE(S):

Lyman, P. E. (2021) *The do-it-yourself escape room book: A practical guide to writing your own clues, designing puzzles, and creating your own challenges*. New York, NY: Skyhorse Publishing.

NOTES

Activity 5: ChemyChromatic

OBJECTIVE(S):

1. To separate marker inks or food colouring mixtures using chromatography.
2. To observe different colours constituents of the marker inks and the food colouring mixtures.

INTRODUCTION:

Chromatography is a technique used to separate mixtures. The mixture will be separated by passing it through another substance or medium, where the components of the mixture will move across the medium at different speeds. In this experiment, we will be using filter paper as the medium to separate coloured components in marker inks and food colourings.

The different coloured components in the marker inks or food colourings will move at different speeds through the filter paper, allowing us to separate all the coloured components that contribute to the formation of the mixture colour. Some components will move faster, some will move slower. This will separate the components that is available in the mixture.

APPARATUS:

- Beaker
- Assorted colour marker pens

MATERIALS:

- Filter paper
- Artificial food colourings
- Water

METHOD:

1. Place a filter paper flat on the table.
2. Draw a thick circle around the centre of the filter paper using the food colouring mixtures and marker pen.
3. Fold the filter paper into exact halves. Continue making another two folds, bringing the outer edge to the centre line.
4. Open the folded filter paper neatly, forming a cone with pleated arrangement.
5. Fill a petri dish or a beaker with just a bit of water.
6. Place and balance the cone-shaped filter paper on the beaker with the tip of the cone just touching the water. Do not let the drawn coloured circle get into the water.
7. Leave the setup and observe what happens as the water begins to flow upward through the filter paper.
8. After a few minutes, take the filter paper and place it in the oven to dry.
9. Once it is dry, observe the results.

RESULTS:

1. Which colour marker pen or food colouring mixtures have you chosen to draw the thick circle at the centre of the filter paper?

2. How long did you wait until you remove the filter paper out from the beaker?

3. How many colours can you detect on the filter paper at the end of the experiment?

DISCUSSION:

Based on your experiment, discuss the following situations/observations:

1. What is the purpose of water in this experiment?

2. Why must you ensure that the coloured line does not touch the water when you first place the cone over the beaker?

3. What is the possible cause(s) for the separation of the coloured components on the filter paper?

REFERENCE(S):

Rohrig, B. (2015). Eating with Your Eyes: The Chemistry of Food Colorings - American Chemical Society. American Chemical Society. https://www.acs.org/education/resources/highschool/chemmatters/past-issues/2015-2016/october-2015/food-colorings.html

Giddings, J. C., & Keller, R. A. (2023, May 12). Chromatography | Definition, Types, & Facts. Encyclopedia Britannica. https://www.britannica.com/science/chromatography

How marker is made - material, manufacture, making, history, used, product, machine, History, Raw Materials. (n.d.). http://www.madehow.com/Volume-3/Marker.html

NOTES

Activity 6: Graph Paper Programming

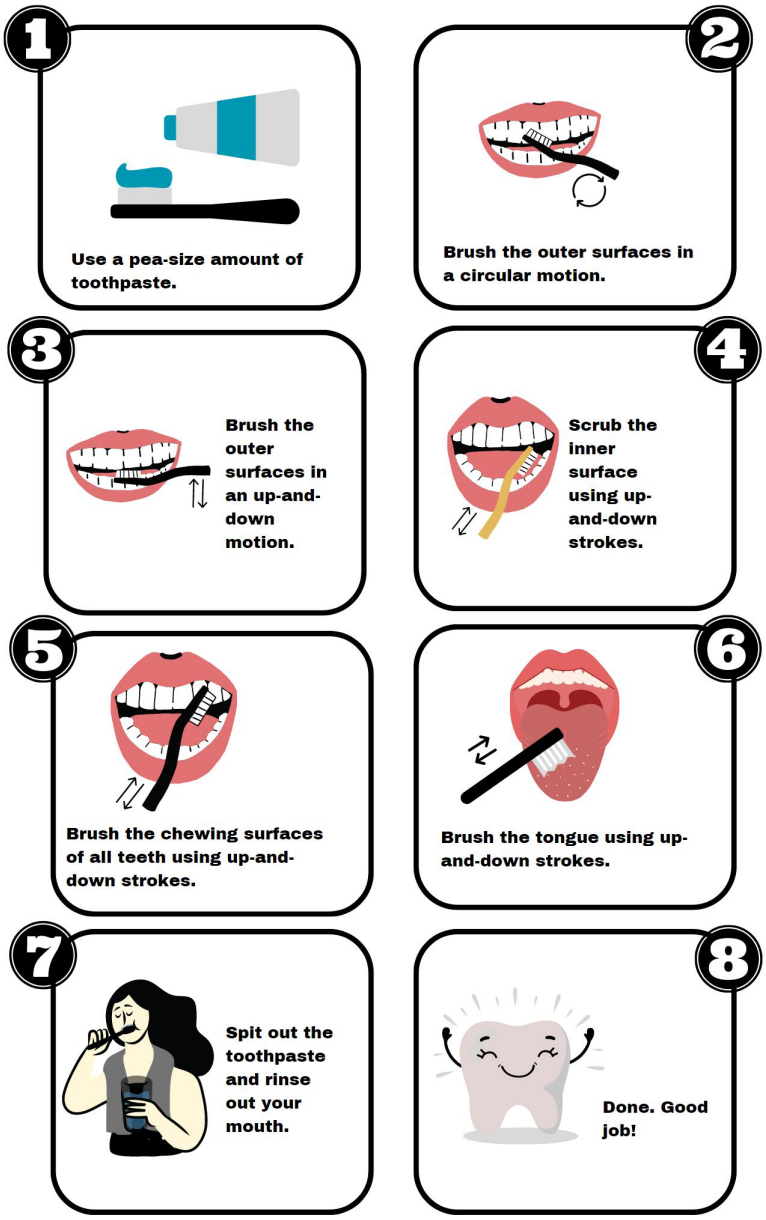
OBJECTIVE(S):

1. To learn about algorithms in computer science.
2. To replicate how computer works by following algorithms.

INTRODUCTION:

An algorithm is a list of commands or steps that must be followed to complete a task or solve a problem effectively. Although algorithm might sound complicated, it is present in almost every aspect of our daily life. An example of algorithm used in our daily life includes the steps to brush our teeth.

HOW TO BRUSH YOUR TEETH?



Graph paper programming is a visual approach to teaching programming concepts that involves using graph paper as a platform to represent code. This technique is designed to help us learn the fundamental principles of computer programming using a visual of the step-by-step process. Through this hands-on approach, you will gain a better understanding of how algorithms work and their use in creating complex designs. So, get ready to flex your problem-solving skills and learn more about the fascinating world of algorithms in this activity!

APPARATUS:

- None

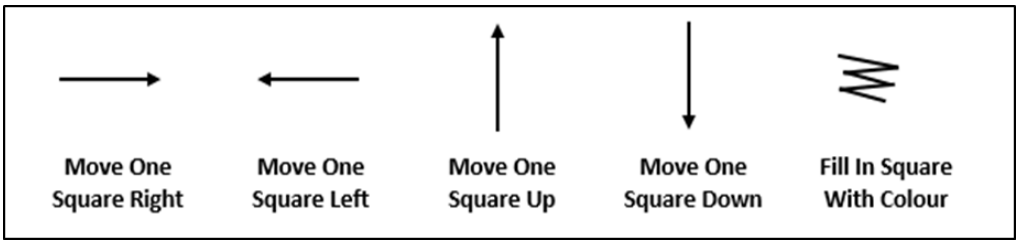
MATERIALS:

- Instruction paper
- Sample image
- Algorithm worksheet paper
- Four-by-fours graph paper
- Pencil
- Eraser

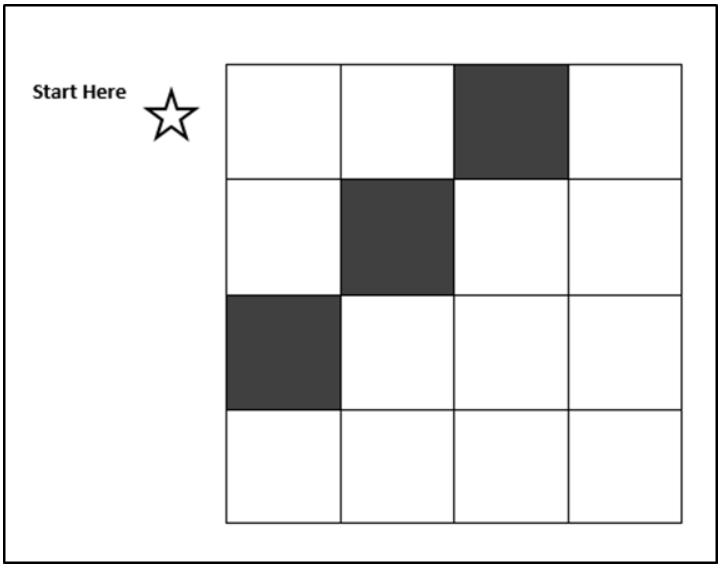
METHOD:

PART 1:

1. Sit with a partner.
2. Select an envelope from your facilitator. Your envelope will contain the following:
    a. One instruction paper



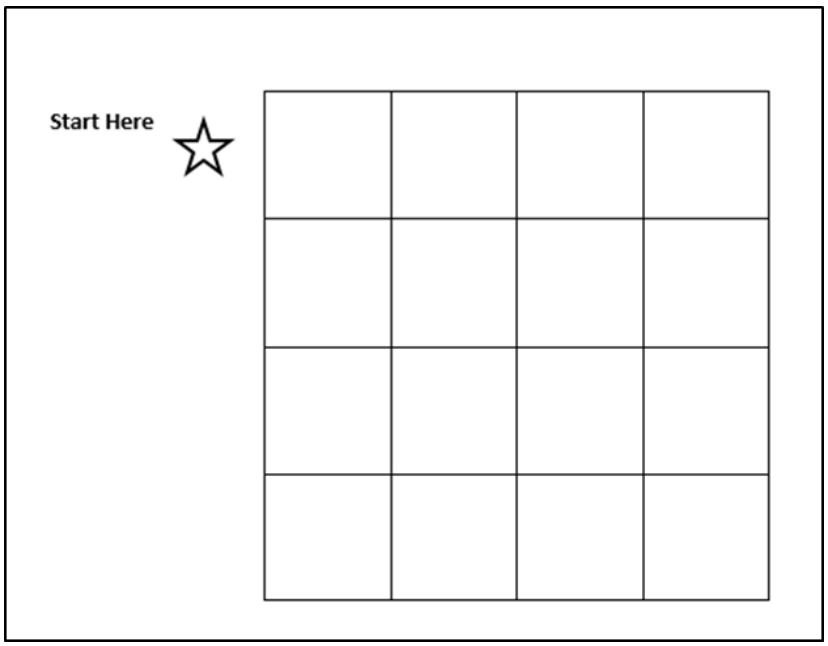
b. One sample image (Hide your sample image from other groups)



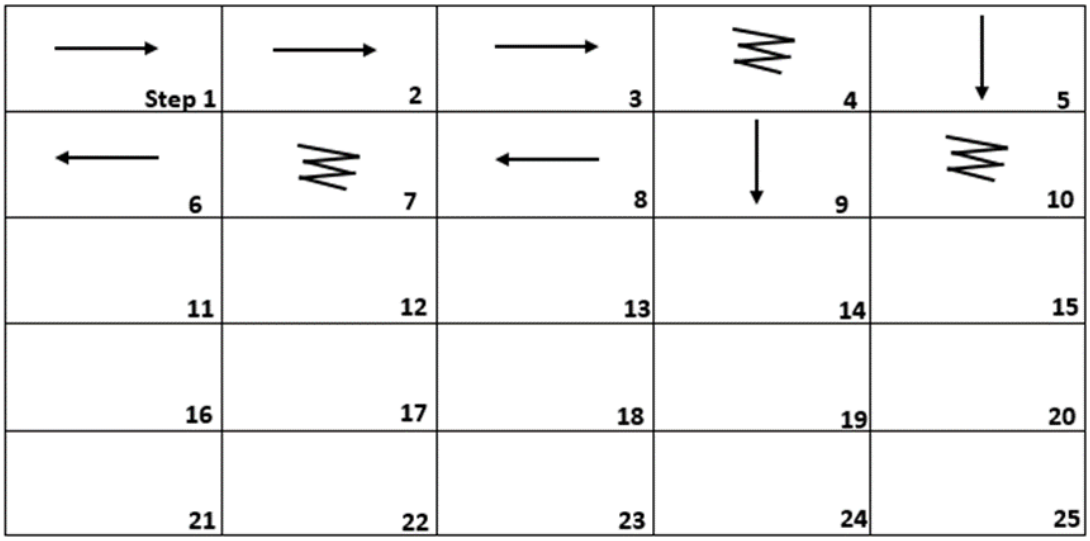
c. One algorithm worksheet

Step 1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

d. One four-by-four grid paper

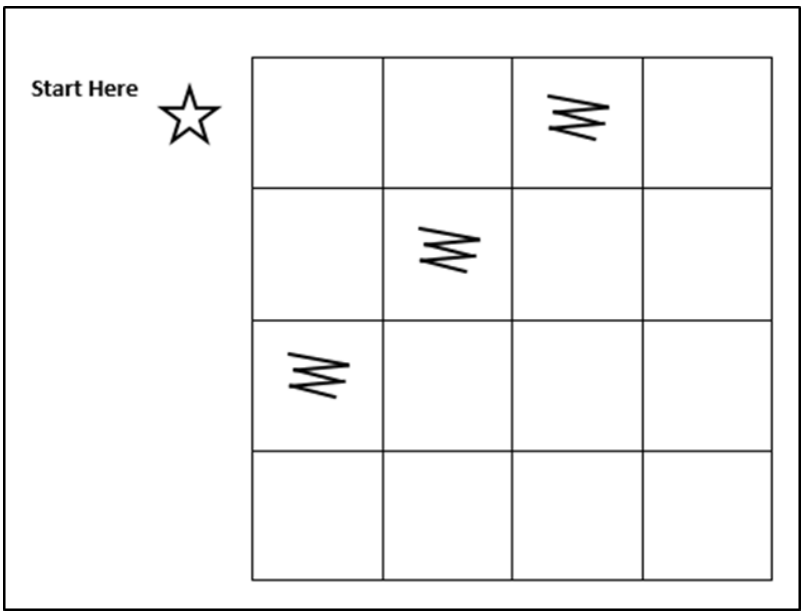


3. Discuss the algorithm with your partner on how to draw that image.
4. Write the algorithm in the algorithm worksheet paper using symbols in the instruction paper.



Part 2:

1. Trade your algorithm worksheet paper with another group. The sample image given before must be kept hidden from the other group.
2. Draw one another's image by using the exchange algorithm on the four-by-four graph paper.



RESULTS:

Part 1:

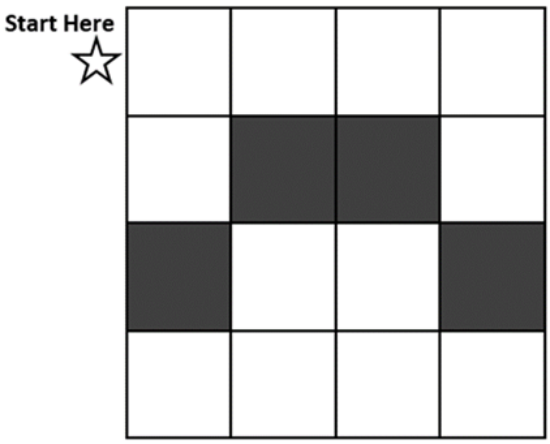


Image 1

Step 1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Algorithm for Image 1

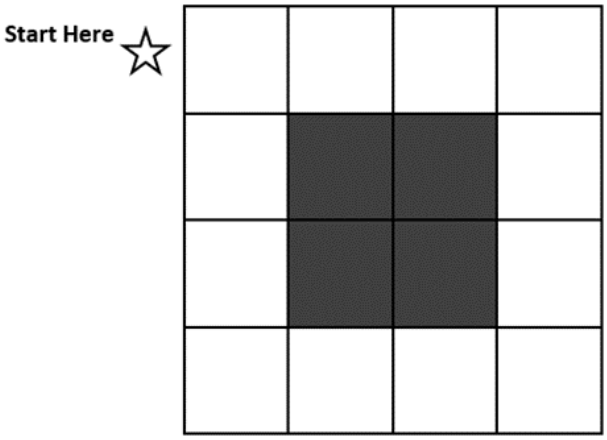


Image 2

Step 1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Algorithm for Image 2

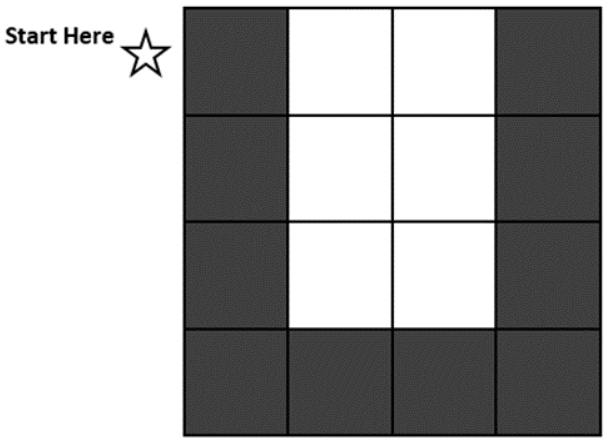


Image 3

Step 1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Algorithm for Image 3

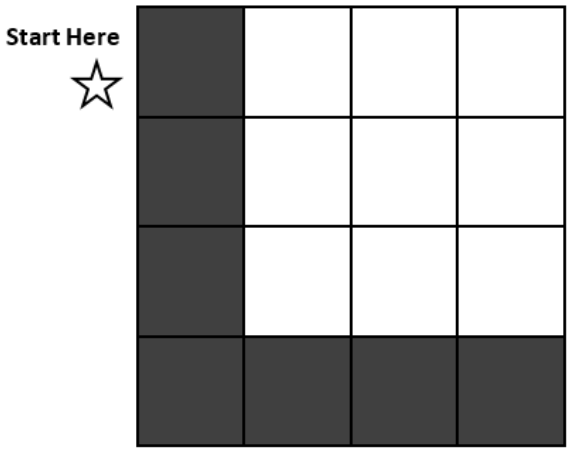


Image 4

Step 1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Algorithm for Image 4

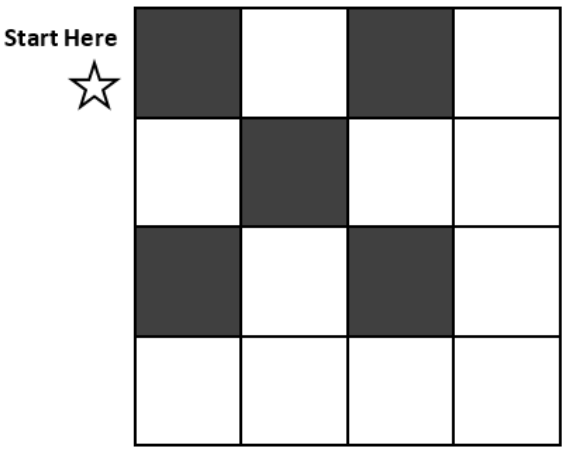


Image 5

Step 1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Algorithm for Image 5

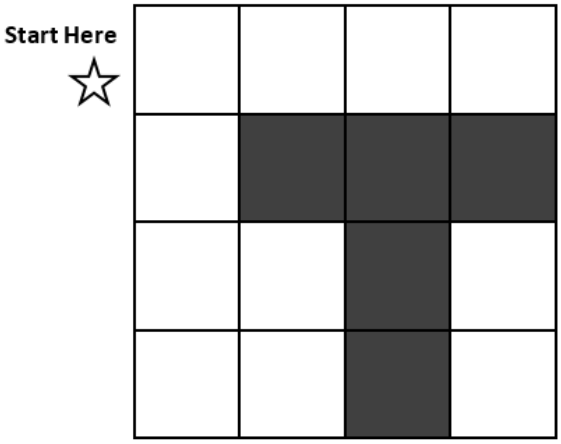


Image 6

Step 1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Algorithm for Image 6

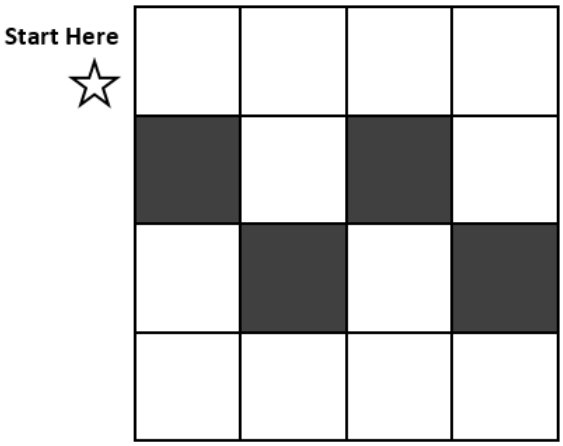
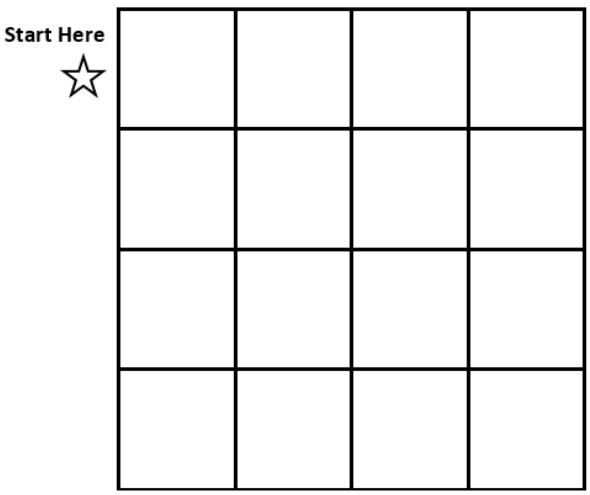


Image 7

Step 1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Algorithm for Image 7

Part 2:



DISCUSSION:

1. What is an algorithm?

   ☐ A type of computer hardware

   ☐ A step-by-step procedure for completing a task

   ☐ A type of computer virus

   ☐ A tool used to draw pictures

2. Give one example of daily activity where you can use an algorithm.

   _____

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Weiskircher, M. (2018). *Graph paper programming*. Available at: https://www.youtube.com/watch?v=-Et82jwh3BM&t=143s

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NOTES

Activity 7: Sorting Algorithm Race

OBJECTIVE(S):

1. To familiarise with algorithms in computer science.
2. To learn about different types of sorting algorithms and their efficiency.

INTRODUCTION:

Algorithms are sets of instructions that computers use to perform tasks. Although they are an integral part of computing, algorithms can also be seen in everyday activities. Consider the task of sorting laundry, for example. By separating dirty clothes into piles based on colour, material, and washing instructions, we can efficiently clean our clothes. Similarly, sorting algorithms help computers organize data by following a specific set of instructions.

Sorting algorithms are particularly important in computer science as they allow programmers to organize large sets of data in a manner that is easily searchable and retrievable. They can be used in a wide range of applications, from sorting search engine results to organizing financial data. In today's data-driven world, sorting algorithms are critical in making sense of the vast amounts of data available to us.

In this activity, we will look at these sorting algorithms

1. **Bubble sort** is the sorting done on the basis of the largest to the smallest element. The largest element is first kept in the last location in the array. Then the second largest element in the second last location and so on.
2. **Selection sort** is when the sorting is done from the smallest element is first sorted and then the second smallest element and so on. Selection sorting is a sorting algorithm where we select the minimum element from the array and put that at its correct position.
3. **Insertion sort** is a simple sorting algorithm that works like the way you sort cards in your hands. The card arrangement is virtually split into a sorted and an unsorted part. Values from the unsorted part are picked and placed at the correct position in the sorted part. The first two elements of the array are compared to which is greater and sorted. move to the next two elements and compare them in ascending order.

Through this activity, we will learn about the efficiency of each sorting algorithm and how to choose the best algorithm for different types of data sets. By understanding the importance of sorting algorithms and how they can be applied in real-world scenarios, we will gain a deeper appreciation of the role that computing plays in our daily lives.

APPARATUS:

None

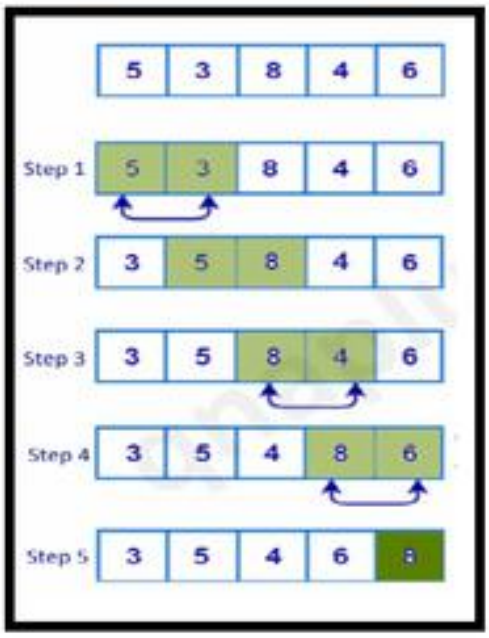
MATERIALS:

- Laptop
- Projector
- Deck of Cards/Paper
- Pen/Marker
- Timer/Stopwatch
- Internet connection (if needed)

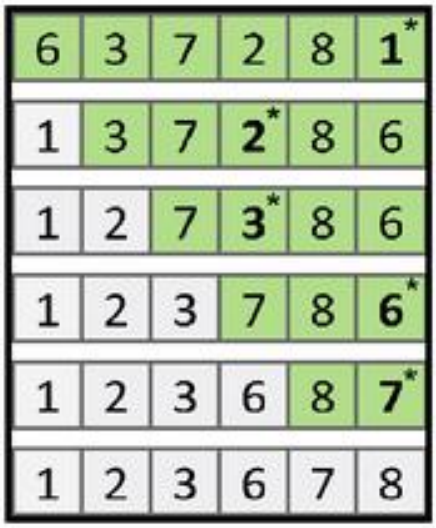
METHOD:

1. Get into a pair or a group. Each group is given a deck of cards/papers.
2. Start the timer and begin sorting the cards in the correct order as quickly as possible using one of the three sorting algorithms - Bubble Sort, Insertion Sort, or Selection Sort.
3. Once you have finished sorting the cards, stop the timer and record the time.
4. Repeat the sorting task using the other two sorting algorithms and record the time.
5. Once you have completed the sorting task using all three algorithms, compare the duration taken by each sorting algorithm.
6. Discuss which algorithm is the most efficient, and why. Think about how the algorithm works and how it compares to the other algorithms.

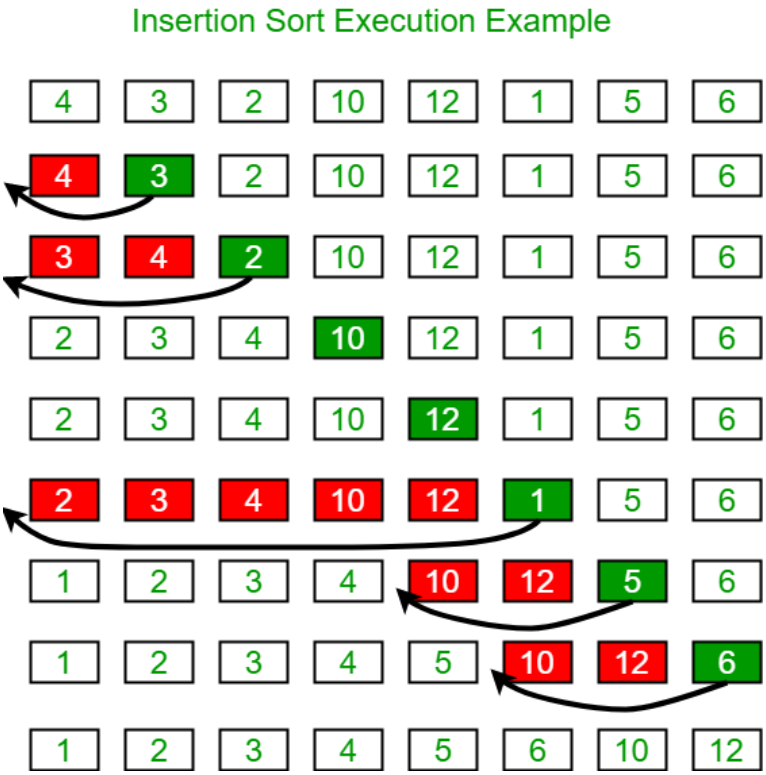
RESULTS:



Bubble Sort



Selection Sort



Insertion sort

DISCUSSION:

1. What is algorithm?
   (A) A type of computer virus
   (B) A physical object used in computing
   (C) A set of instructions for performing a task

2. How do we use algorithm in computer programming?
   (A) To create computer viruses
   (B) To play video games
   (C) To perform tasks and solve problems

3. What are the examples of sorting algorithm?
   (A) Binary Sort and Quick Sort
   (B) Hash Sort and Merge Sort
   (C) Bubble Sort, Insertion Sort, and Selection Sort

4. Which algorithm is the most efficient?
   (A) Bubble Sort
   (B) Insertion Sort
   (C) Quick Sort

5. Why sorting algorithm is important in programming?
   (A) Sorting algorithms make programs run slower
   (B) Sorting algorithms are not important in programming
   (C) Sorting algorithms help programmers organize large sets of data in an efficient manner

6. How choosing the right algorithm can have a significant impact on the efficiency of the program?
   (A) Choosing the right algorithm has no impact on program efficiency
   (B) Choosing the right algorithm can make a program less efficient
   (C) Choosing the right algorithm can make a program more efficient

REFERENCE(S):

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