Rainfall

Key Stage: 2

Strand:

Mathematics: Number (Learning Unit: 6N1 Decimals (IV))
Data Handling (Learning Unit: 6D2 Broken line graphs)

General Studies: People and Environment (Core Elements: effects of natural changes of the environment on people and how people respond to these changes)

Objectives:

(i) To perform mixed arithmetic operations of decimals
(ii) To read and discuss broken line graphs
(iii) To construct broken line graphs
(iv) To describe the changes in climate and rainy season and impact of that
(may collaborate with General Studies)

Prerequisite Knowledge:

(i) Performing multiplication and division of decimals
(ii) Recognising the concept of millimetre (mm), area and volume

Resources Required: World maps, globes and computers

Related Links:

Hong Kong Observatory: www.hko.gov.hk
Weather China: http://en.weather.com.cn/
Meteorological Service Singapore: www.weather.gov.sg

Description of the Activity:

Situation providing for students before learning

In nature, water over ocean or on the surface of the earth evaporates into the atmosphere and forms water vapour. It becomes cooler as it rises in the atmosphere. The water droplets in the sky come together to form clouds. Some clouds are light and puffy, while some are dark and heavy. Convection or rising air keeps the water droplets suspended in the air. However, the water droplets fall when they become too large and heavy to remain suspended in the air. Water falling from clouds in the form of rain, snow, hail or other forms is called precipitation.

(Source from: https://www.hko.gov.hk/en/education/weather/rain/00044-why-does-it-rain.html)

The learning and teaching activities below are about rainfall.

Activity 1

1. Teacher introduces the rainfall amount data in the Internet and discusses with students. For example, the rainfall amount data of Hong Kong provided on the website of the Hong Kong Observatory, please refer to https://www.hko.gov.hk/en/cis/monthlyExtract.htm.
2. Teacher uses the above website to select the rainfall amount one year randomly, and demonstrates the use of the Excel to construct a broken line graph.
3. Teacher may discuss with students the cautions while constructing a broken line graph with Excel.
4. Students read broken line graphs and discuss the characteristics of broken line graphs.

Question for discussion:

1. Which months are the rainy season in Hong Kong this year? How do you find out?

Notes for Teachers:

1. The teacher points out that the unit for measuring rainfall amount is millimetres instead of millilitres. It is assumed that the rainfall amount is averagely distributed over the entire rainfall amount, so even if the rainwater is collected by pillar containers with different base areas, the height of the collected rainwater can be roughly the same. When the area of the rainfall range is known, the volume of rainfall amount can be estimated from the height of the collected rainwater, so measuring the rainfall amount by the unit of height can reflect the rainfall condition objectively. For details, please refer to the following Hong Kong Observatory YouTube channel (Chinese version only): https://www.youtube.com/watch?v=G85fdPo0xPk
2. When the teacher guides the students to use the Excel to construct a broken line graph, the teacher may remind the students to select the appropriate graph type.

Activity 2

1. Students collect rainfall amount data in Hong Kong for 3 consecutive years in the past 5 years from the above website of the Hong Kong Observatory.
2. The teacher guides the students to use the Excel to construct a broken line graph based on the data.
3. Students work in groups of 2 to construct a broken line graph.
4. Students copy and paste the constructed broken line graph into the teacher's preset Word file (Worksheet 1).
5. Students use Word to integrate the broken line graphs of rainfall amount of Hong Kong for 3 consecutive years.
6. Students read broken line graphs and discuss the characteristics of broken line graphs.
7. Students complete the Word file and submit it online.
8. Students give group presentations.

Questions for discussion:

1. What are the similarities and differences between the above three consecutive years of rainfall amount data?
2. Which months normally are the rainy season in Hong Kong?

Notes for Teachers:

1. After students construct a broken line graph, the teacher may guide students to check whether the information on the graph is completed, such as the title of the graph, the names of the two axes, etc.
2. Students use the Excel to construct a broken line graph for one year at first, and then paste the broken line graph into a Word file. By modifying the data, the Excel can automatically output another broken line graph.

Activity 3

1. Students collect rainfall amount data at the Hong Kong Observatory and Weather China / Meteorological Service Singapore. Refer to
   - ☐☐Rainfall amount in Dunhuang (Weather China) (Chinese version only)
   - ☐☐http://www.weather.com.cn/forecast/history.shtml?areaid=101160808&month=3
   - ☐☐Rainfall amount in Singapore (Meteorological Service Singapore)
   - ☐☐http://www.weather.gov.sg/climate-historical-daily/
2. Students discuss and compare rainfall amount data for the past year for Hong Kong and Dunhuang / Singapore.
3. Students complete Worksheet 2.

Questions for discussion:

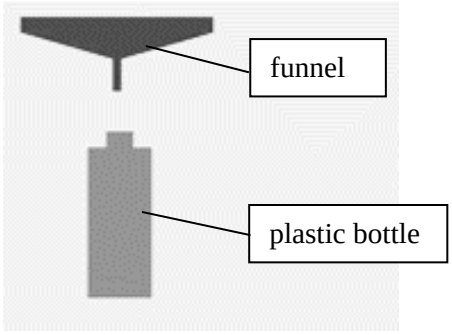
1. Which months are the rainy season in Dunhuang, China / Singapore?
2. The school will plan for arranging P6 students to go Dunhuang, China / Singapore as an academic exchange group during the summer vacation. Do we need to bring rain gear?
3. Describe the changes in rainfall amount between two regions. Why is such a difference?

Notes for Teachers:

1. Weather China uses precipitation amount instead of rainfall amount.
2. The teacher may select the annual data of rainfall amount of the two regions as comparison.
3. If necessary, data from other places outside Hong Kong and Dunhuang, China / Singapore can be used for reference and support students' conclusions.

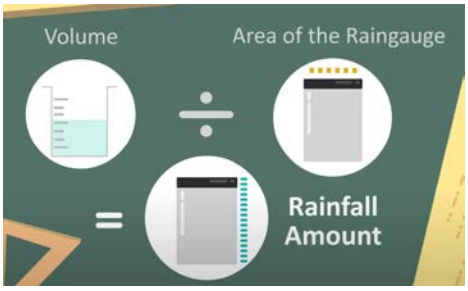
Activity 4

1. Teacher introduces and explains a raingauge to students. (Refer to point 1 of the "Notes for Teachers")
2. According to the Hong Kong Observatory's video, the raingauge is composed of a funnel and a plastic bottle. (Figure 1)



(Figure 1)

3. According to the Hong Kong Observatory's video, the formula for calculating rainfall amount: rainfall amount = volume of rainwater ÷ area at the top of the raingauge (i.e., the opening area of the funnel. (Figure 2)



(Figure 2)

4. Students work in groups of 4 to make raingauges and measurements.
5. Each group of students is assigned 4 funnels of different sizes (funnels W, X, Y and Z) and a plastic bottle.
6. Students divide up to work for measuring and calculating the area of the funnel and the base area of the plastic bottle, and record on the Worksheet 3.

Notes for Teachers:

1. Teacher may briefly introduce the equipment used by the Hong Kong Observatory to measure rainfall amount to arouse students' interest. Refer to the following Hong Kong Observatory YouTube channel:

   ☐ Online Video Course on Weather Observation: Equipment - Raingauge
   https://www.youtube.com/watch?v=gq7iGLZN1uw
2. Teacher prepares 4 funnels of different areas and labels them as funnels W, X, Y and Z.
3. Teacher instructs the students to measure the area of the funnel, ie, calculating the opening area of the funnel.

4. Formula for calculating rainfall amount:

$$\text{Rainfall amount} = \frac{\text{volume of rainwater}}{\text{area of raingauge (funnel)}} = \frac{\text{B} \times \text{h}}{\text{A}}$$

Base area of the plastic bottle (B)

The height of rainwater in the plastic bottle (h)

Area of funnel (A)

5. **Extended Activity:** Teacher may discuss with students how to derive a formula for calculating rainfall amount and why a funnel is used to collect rainwater.

Activity 5

1. Students collect rainfall amount on appropriate days.
2. Students complete Worksheet 4.
3. Teacher displays the data with all the groups together and instructs the students to compare the data from other groups.

Questions for discussion:

1. Does the size of the funnel have any effect on the rainfall amount?
2. Why is the rainfall amount collected by each group different?
3. Why does it rain, but the raingauge fails to collect the rainwater?

Notes for Teachers:

1. Place the raingauge in an open and stable area in the school and fix its position so as not to overturn the raingauge before collecting rainwater.
2. Raingauges are used to collect rainwater for one day. Teacher may arrange for students to place raingauges at designated times, and students can record the height of rainwater in plastic bottles at the same time on the next day.
3. When students read the height of rainwater in the plastic bottle, they can put a white paper behind the plastic bottle to facilitate reading, and read in eye level.
4. The weather is unpredictable. If there is no rainfall amount during the activity, and the raingauge cannot be used to collect rainwater directly, teacher may carry out Activity 6.

Activity 6

If there are no rainy days during the activity, teacher may arrange for students to participate in this activity.

1. Students use preset data, and the formula to calculate rainfall amount.
2. Students complete Worksheet 5.

Question for discussion:

1. Does the size of the area of raingauge's funnel affect the rainfall amount?

Integration and Application:

Science Education:	Water cycle
Technology Education:	Construction of graphs by using computer
Mathematics Education:	Multiplication and division of decimals
	Data collection and handling

This example mainly involves the following generic skills:

1. Collaborative Skills
   - □ Collaborate in groups
   - □ Share the responsibilities and understand the roles of individual members in the production of raingauge

2. Creativity
   - □ Design a tool for measuring the rainfall amount

3. Critical Thinking Skills
   - □ Understand the size of the area of raingauge's funnel is unrelated to the rainfall amount
   - □ Understand the reason why the changes in rainfall amount is different between Hong Kong and Dunhuang, China/Singapore, and determine the reasonability of the reason

4. IT Skills
   - □ Construct graphs by using the Excel

Worksheet 1

1. Use the website of the Hong Kong Observatory to collect the monthly total rainfall amount data of Hong Kong for **3 consecutive years** in the past 5 years, and use the Excel to construct broken line graphs, paste them in the following boxes, and answer the questions.

Year	**Broken line graphs of rainfall amount**
_____	
_____	
_____	

2. Compare the rainfall amount data of the above 3 years, point out one similarity and one difference among them.

Similarity	(Accept reasonable answer)
Difference	(Accept reasonable answer)

We discover and report:

(Accept reasonable answer)

Worksheet 2

The school will plan for arranging P6 students to go Dunhuang, China / Singapore as an academic exchange tour during the summer vacation, we need to understand the local climate environment. First, we will look at the local rainfall amount.

The table below records the monthly rainfall amount of Hong Kong and Dunhuang / Singapore in 2020.

	Rainfall Amount (mm)		
Month	**Hong Kong**	**Dunhuang, China**	**Changi, Singapore***
1	14.8	1	88.4
2	79.8	0	65
3	41.3	2	108.8
4	77.8	3	188
5	352.5	4	255.6
6	397.2	12	233.8
7	125.4	7	205.6
8	448.4	7	103.4
9	708.8	2	150.2
10	142.4	0	78.8
11	5.1	1	220.6
12	1.5	1	253.2

Fill in the blanks or circle the correct answers.

1. (i) Which months are the rainy season in Hong Kong?:_____
(Accept reasonable answer)

(ii) Which months are the rainy season in Dunhuang / Singapore?:_____
(Accept reasonable answer)

2. Rainy months in Hong Kong and Dunhuang / Singapore are (similar / not similar).

3. (i) The average monthly rainfall amount in Hong Kong in this year: 199.6 mm
(Or other reasonable answer)
(fill in the blank with appropriate unit)

(ii) The average monthly rainfall amount in Dunhuang / Singapore in this year:
Dunhuang, China: 3.3 mm
Singapore: 162.6mm (fill in the blank with appropriate unit)
(Or other reasonable answer)

4. During the summer vacation to Dunhuang, China / Singapore, we (require / do not require) to bring rain gear, because (Accept reasonable answer)

* Data is processed manually
Note: The above three sets of data are sourced from the Hong Kong Observatory (http://www.hko.gov.hk), Weather China (http://en.weather.com.cn/) and Meteorological Service Singapore (http://www.weather.gov.sg)

Remarks:

Average monthly rainfall amount recorded by the Hong Kong Observatory and the Meteorological Service Singapore during the period 1981-2010

	Rainfall Amount (mm)	
Month	**Hong Kong***	**Singapore**
1	24.7	234.6
2	54.4	112.8
3	82.2	170.3
4	174.7	154.8
5	304.7	171.2
6	456.1	130.7
7	376.5	154.4
8	432.2	148.9
9	327.6	156.5
10	100.9	154.6
11	37.6	258.5
12	26.8	318.6

* Data is processed manually

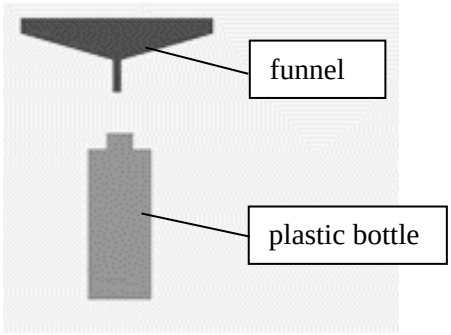
Note:

The above two sets of data are sourced from the Hong Kong Observatory (http://www.hko.gov.hk) and the Meteorological Service Singapore (http://www.weather.gov.sg)
http://www.weather.gov.sg/climate-climate-of-singapore / (1981-2010)

Worksheet 3

Make a raingauge

1. The raingauge is composed of a funnel and a plastic bottle, the funnel will be placed above the plastic bottle. (Figure 1)



(Figure 1)

2. Formula for calculating rainfall amount:

$$\text{Rainfall amount} = \frac{\text{volume of rainwater}}{\text{area at the top of the raingauge (ie,the opening area of the funnel)}} = \frac{B \times h}{A}$$

(B) : Base area of the plastic bottle (B)

(h) : The height of rainwater in the plastic bottle (h)

(A) : The opening area of the funnel (A)

(i) Please fill in the blanks with B, h and A of the above representative.

In the formula, the values of __B__ and __A__ are fixed; the value of __h__ is changed according to the collected rainwater.

(ii) The rainfall amount we calculated is used __h__ as the unit of measurement.

3. We will use 4 different types of funnels and 1 plastic bottle to collect rainwater.

Please record in the table below the measurements and calculations of

(i) Base area of the plastic bottle

(ii) Areas of funnels W, X, Y and Z

Base area of the plastic bottle (cm^2)	**Area of funnel (cm^2)**			
	W	X	Y	Z

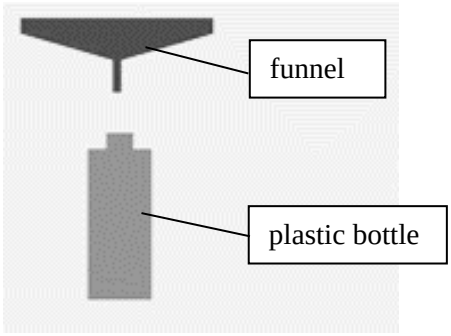
Worksheet 4

1. Does the area of the funnel affect the rainfall amount?

   We estimate: _____

   _____

2. In rainy days, try to collect rainwater with the raingauge that has been made with measuring and calculating the rainfall amount.



(Figure 1)

Formula for calculating rainfall amount:

$$\text{Rainfall amount} = \frac{\text{volume of rainwater}}{\text{area at the top of the raingauge (ie,the opening area of the funnel)}} = \frac{B \times h}{A}$$

Date of collecting rainwater: _____

Results of experiments:

	Funnel	**W**	**X**	**Y**	**Z**
B	Base area of the plastic bottle (cm^2)				
A	Area of funnel (cm^2)				
h	The height of rainwater in the plastic bottle (mm)				
	Rainfall amount (mm) (correct to the nearest tenth)				

We discover:

1. After the experiments, we found that the area of the funnel (will / will not) affect the rainfall amount.

Thinking: Comparing data from other groups, why do groups obtain different results of rainfall amount?

Worksheet 5

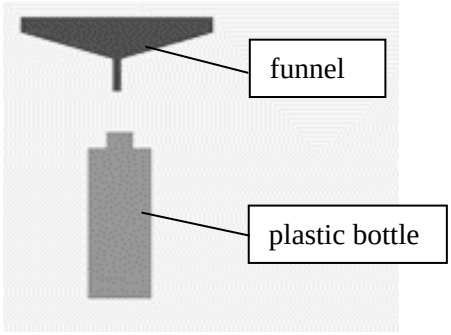
1. Does the area of the funnel affect the rainfall amount?

   We estimate: _____

   _____

2. Tom used a collection tube with a base area of ( ) cm^2 and 4 funnels below with different areas to make a raingauge.

Funnel	W	X	Y	Z
Area of funnel (cm^2)				



(Figure 1)

Formula for calculating rainfall amount:

$$\text{Rainfall amount} = \frac{\text{volume of rainwater}}{\text{area at the top of the raingauge (ie,the opening area of the funnel)}} = \frac{B \times h}{A}$$

Tom used the raingauge to record the following height of rainwater, and now assisting him to calculate the collected rainwater.

Funnel	W	X	Y	Z
The height of rainwater in the plastic bottle (mm)				
Rainfall amount (mm) (Correct to the nearest tenth)				

We discover:

1. After the experiments, we found that the area of the funnel (will / will not) affect the rainfall amount. (Accept reasonable answer)