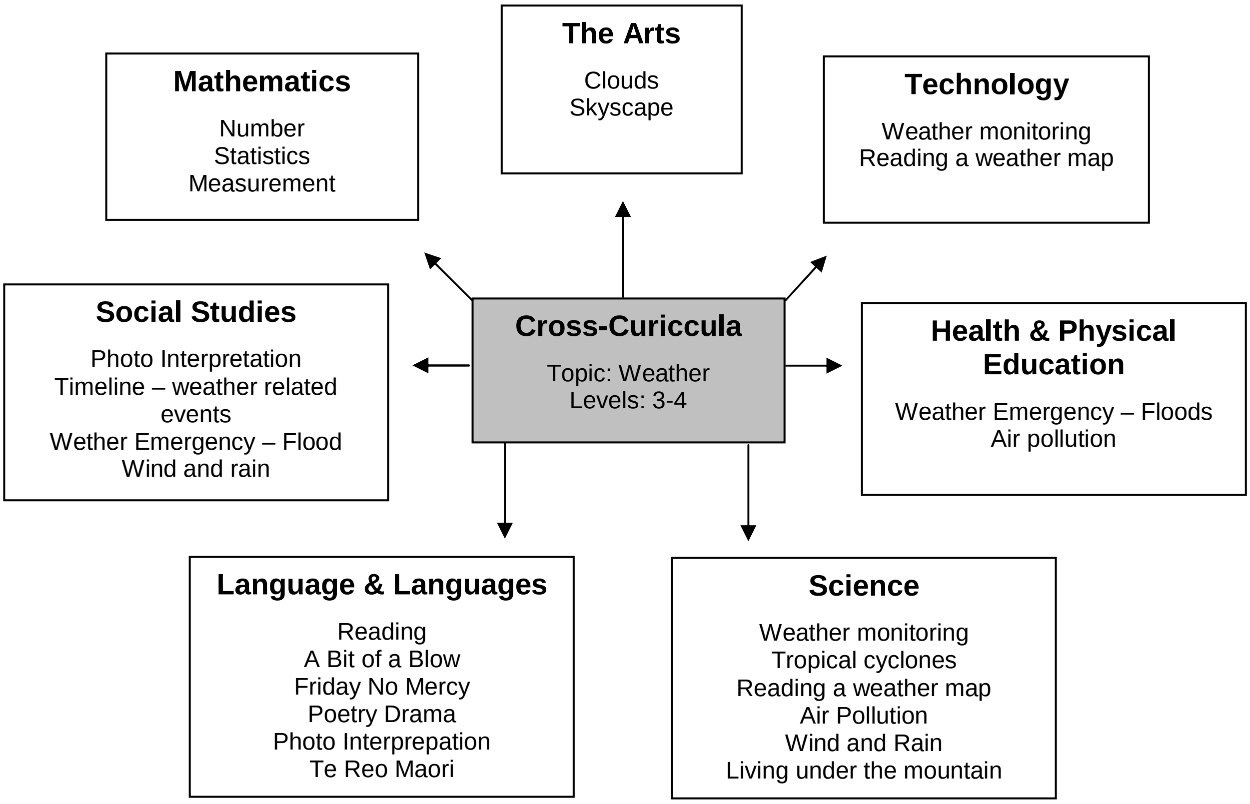
Contents

Cross-Curricula



Curriculum Links

Science

- ♦ **NSPE&B (Making sense of Planet Earth and Beyond)**

- ♦ **Achievement Aims**

  Investigate how people's decisions and activities change planet Earth's physical environment, and develop a responsibility for guardianship of planet Earth and its resources.

- ♦ **Possible Learning Experiences**

Level 1

– Observe temperature
– Talk about seasonal changes in relation t birthdays, holidays and seasonal events

Level 2

– Record daily weather conditions for a month using instruments such as thermometers, rain gauges, and wind direction indicators, and comparing this record with an equivalent record produced three months earlier
– Compare their own daily weather records with the weather reports in newspapers and on radio and TV

Level 3

– Investigate the major features, including the water cycle that characterise Earth's water preserves

Level 4

– Investigate the major factors and patterns associated with weather, and use given data to predict weather. Use weather maps-and/or satellite pictures to construct a table of data, to develop reading and interpreting skills construct a timeline showing dates of natural disasters in New Zealand's history caused by the weather, eg: Cyclone Bola
– Investigate unusual weather patterns linked to geological events such as major volcanic eruptions
– Make a model barometer to find out how they work
– Use barometers to record atmospheric pressure over a period of time

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- ♦ **MSNSRT (*Making Sense of the Nature of Science and its Relationship to Technology)***

Level 4

– Plan and carry out a 'fair test' on the reliability of weather reports

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- ♦ **MSLW L.4 (*Making sense of the Living World*)**

– Research and examine some of the solutions to pollution on land and sea

Social Studies *Social Organisations and Processes Level 4*

♦ Achievement objective

Understand and demonstrate ways people reshape their social organisations in response to challenge or crisis.

♦ Learning Activity

Level 4

Students interview a member of a civil defence organisation to find out how people in New Zealand prepare for and respond to an emergency. They then prepare an action plan to show how people in their school should respond to an emergency in their school.

Level 2

Students identify a problem that has arisen in the classroom or playground. They consider possible solutions and consequences in order to choose and implement a solution.

Maths

♦ Statistics

Classify events (such as weather events, eg no, rain) from their experience as certain, possible and impossible.

Level 2

- collect and display category data and whole number data in pictograms, tally charts, and bar charts as appropriate
- talk about the features of their own data display, make sensible statements about the situation represented by a statistical data display drawn by others

Level 3

- collect and display discrete numeric data in stem-and-leaf graphs, dot plots and strip graphs, as appropriate
- talk about the features of their own data display
- make sensible statements about an assertion on the basis of the evidence of a statistical investigation

Level 4

- plan statistical investigation
- collect appropriate data
- choose and construct quality data displays (frequency tables, bar charts and histograms) to communicate significant feature sin measurement data
- collect and display time series data
- report on distinctive features of data

Number

Level 1 ***Students should be***

- developing a number sense by exploring number in the contexts of their own experiences and the world around them
- exploring the meaning of digits in any 2-digit whole number

Level 2

- developing a number sense by exploring number in the context of their everyday experiences and the world around them
- counting, recording and comparing numbers

Level 3

- extending their understanding of the number system
- exploring the use of decimals and fractions in society

Level 4

- relating fractions to decimals
- talking about the use of percentages in everyday contexts

– saying decimals as percentages

Measurement

♦ Achievement objectives

Level 1

- order and compare lengths, masses and volumes (capacities) and describe the comparisons using measuring language
- measure by counting non-standard units

Level 2

- carry out practical measuring tasks, using appropriate metric units for length, mass, and capacity
- demonstrate knowledge of the basic units of length, mass, area, volume (capacity, and temperature making reasonable estimates
- perform measuring tasks, using a range of units and scales

Level 3

- carry out measuring tasks involving reading scales to the nearest graduation

Technology

♦ Technological knowledge and understanding

- Students observe weather forecasting and reporting in their environment
- Observe the way weather reports are made available for the public
- Invite a weather expert to discuss features of weather maps etc
- Investigate how weather instruments, weather vanes, barometers work

♦ Technological capability

- Students collect weather data using standard instruments
- Students invent and create their own weather measuring devices
- Students forecast or report on weather data to their school community

♦ Technology and society

- Students discuss the importance of weather forecasting and data analysis to the general public and specific groups, eg: farmers, civil defence

♦ Assessment

- Students demonstrate their knowledge of weather map and their weather measuring devices

Activity 1

Reading

A bit of a blow *School Journal Part 2 No 1 1991*

♦ Comprehension/interpretation

1. What was the first weather event that woke him up?
2. What did the tornado sound like as it approached?
3. What was the scene like outside the house?
4. Why were some people crying?
5. How did emergency services help?
6. Why was the power off the next day?
7. Why was the school soccer field out of bounds?
8. How much did the steel girder weigh?
9. What was the weather like when he went to bed?
10. What speed did the tornado probably reach?

♦ Vocabulary

Find words similar in meaning (synonyms) to these:

main beam	p.23	burst	p.22
loud rattle	p.19	researchers	p.23
caved in	p.22	violent whrilwind	p.20
velocity	p.23	waterproof covers	p.21
ruined	p.20	unachievable	p.23

♦ Analysis

Imagine you were involved in an event like this

How would you feel?

What would be your concerns?

How would you respond?

How could a family prepare for a situation like this?

Who would be involved in the event after the tornado to help return life to normal?

Reading

Friday of No Mercy *School Journal Part32 No 1 1986*

♦ Comprehension

1. How many other passengers were on the bus with Sarah?
2. Why did the driver suddenly stop the bus?
3. What was the car driver most concerned about?
4. How did Sarah feel when she didn't know if she could go home?
5. How did Sarah get home eventually?
6. What was the thing that made Duncan saddest?
7. How high was the water in the morning?
8. What did they do with some of their furniture and toys?
9. Why did Brooke and Duncan start crying?
10. What were some of the first things they did when they returned home?

♦ Vocabulary

Find synonyms (words similar in meaning) for these words:

shock	p.35	flowing	p.33
frightened	p.35	securely	p.34
compassion	p.32	traveller	p.32
tool	p.38		

♦ Interpretation

1. Why is this article called 'Friday of NO MERCY'?
2. How would you feel in a situation like this?
3. Who helped in this crisis?
4. Who will be involved in the clean up?
5. What preparation can be made for an event like this?

Activity 2

Poetry/Drama

♦ Study the two poems and see if you can find some examples of the following:

Simile	a figure of speech that likens one thing to another, eg: as slippery as an eel, roars like a lion.
Metaphor	a figure of speech that compares something with something unrelated implying a resemblance, eg: the wind is a lion roaring
Alliteration	the use of the same sound at the start of words occurring together, eg: round the ragged rock
Onomatopoeia	the use of naturlaly suggestive words for effect, eg: crash, beep, buzz

♦ Questions

Do the writers appear to feel positive or negative about the storms? (explain using words from the poems).

How do the writers cope with the storms, ie: what actions do they take.

♦ Activities

- write your own storm poems using interesting words and some of the techniques listed above.
- Dramatise these poems by stamping your feet, flicking on and off the lgiht switches, making noises to imitate the wind. Present these to the class in groups
- Enhance one of these poems on your own, in an illustrated poem format using illustrations to enhance the effect of your poem.

Storm Day ***by Bernard Gadd***

The wind today
is sending its squalls
over and over
my windows like waves.
And the glass rattles
like stones caught
by the sea. But I'm not
on an ocean, I'm not
icy with scare,
so I smile at the gusts
and grin at the rain
thaty they fling at me, fling
again and again.

Who's Afraid of Thunderstorms? ***by Marlene Bennetts***

Above,
thunder sounds –
hundreds of zebras running an African plain –
and lightning flashes brighten my room.
On, off, on, off,
as if someone is
flicking the light switch.
The wind moans and
slashes the rain against the window-glass.
I'm not afraid,
I'll keep my head
under the blankets
until the storm goes away.

Activity 3

Photo Interpretation *Photos supplied by the Taranaki Daily News*

Weather Unit

♦ Photo 1 *Umbrella Man*

1. Where is this happening?
2. What is happening in this photo?
3. What type of weather has caused this event?
4. What are some of the likely effects of this type of Event?
5. How can people prepare for this type of event?

Partial Disclosure

♦ Photo 2 *Letter Box Kid*

1. What is happening here?
2. What is this boy sittingon, why?
3. What has happened here?
4. What has caused this emergency?
5. Who will be involved in this emergency?

♦ Photo 3 *Waves Crashing*

1. What is happening here?
2. what has contributed to this event?
3. what are the dangers to people in an event like this?
4. What measures have been taken to try and avoid this happening?
5. What damage to land could result from this?

♦ Photo 4 *Sitting on the Dirt*

1. What is the lady doing?
2. Why is she looking upset?
3. What has happened to her garden?
4. What weather event may have caused this?
5. What clean up will be necessary after this event?

♦ Photo 5 *Comfort*

1. What is happening in this photo?
2. What has happened before this photo?
3. What weather event was probably involved?
4. What does the lady have in her arms?
5. How can people help in situations like this?

Umbrella Man

Letter Box Kid

Waves Crashing

Sitting on the Dirt

Comfort

Activity 4

Maths

Number Statistics

♦ The Taranaki Regional Council monthly rainfall and river report for June 1997

1. How many dats of rain (>0.5 mm) were recorded at North Egmont?
2. How does this comapre with the normal rainfall for June?
3. How does it compare with June 1996?
4. Which station has had the lowest rainfall for June?
5. Which station has had about half its normal rainfall for June?
6. Which station had the lowest number of rainy days?
7. How high was the Waitotarta River reached on record?
8. What direction did most of New Plymouth's wind come from?
9. Was this the same for Okoki?
10. What percentage of wind came from the northwest for New Plymouth?
11. What was the difference between the maximum wind speed recorded at New Plymouth and Okoki?
12. What was the mean wind speed for New Plymouth?

Extra – make up some questions on your to try with your classmates

♦ Activities

(a) Find out the average amount if rain that fell on the days it rained in a chosen area, eg: Everett Park – 109 m in 10 days – 10.9 mm per rainy day

(b) Round the June 1997 minimum river heights to two decimal places

(c) Round the June 1997 mean river height to one decimal point

(d) Add two wind direction percentages for Okoki that account for more than 505 of the wind direction

Graphing

♦ Composite bar graph

Graph the percentage of monthly normal rainfall with percentage of June rainfall for 1996. You will need a double bar graph using two colours.

♦ Pie graph

Complete a pie graph for wind direction for June in New Plymouth or Okoki.

♦ Stem and leaf graph

Construct a tem-and-leaf graph for number of rainy days at the stations around Taranaki. NB: Information on stem-and-leaf graphs can be found in the glossary of 'Mathematics in the New Zealand Curriculum'.

♦ Line graph

Make a line graph of maximum and minimum river heights of the eight rivers listed.

28 July 1997

Taranaki Regional Council monthly rainfall and river report for June 1997

Table 1 Rainfall

Station	Sub-region	Monthly				Year to date		
		Number of rain days (>0.5 mm)	Total monthly rainfall (mm)	% of monthly normal (%)	% of June 1996	1997 total to date (mm)	% of normal for year to date	% of 1996 at same time
North Egmont	Egmont Ntnl Park	21	626	114	91	258	88	68
Mangorei	New Plymouth	11	104	65	94	550	73	63
Waiwhakaiho*	Egmont Village	10	125	64	64	767	83	64
Everett Park	Inglewood	10	109	58	74	694	74	68
Kaka Road	Okoki	8	87	46	55	672	69	54
Mangaoapa Road	Purangi	10	85	43	63	552	58	52
Pohokura Saddle	Pohokura	10	75	45	55	561	65	53
Duffy's Farm	Hawera	11	46	40	37	370	65	74
Punehu*	Pihama	10	97	91	83	470	87	91
Durham Street	Patea	10	61	51	46	498	70	69
Waitotara	Waitotara Valley	11	92	63	50	502	72	70

Note: * = NIWA station

Table 2 Rivers

River and site	Recorded height (m)						Record length (years)
	Maximum		Minimum		Mean		
	June 1997 Max	Max over entire record	June 1997 min	min over entire record	June 1997 Mean	June mean over entire record	
Waitotara at Rimunui Stn	3.935	16.7	0.l559	0.39	0.917	#	3 ½
Tawhiti at Duffy's Farm	0.417	1.34	0.218	0.08	0.256	0.375	11 ½
Waiwhakaiho at SH3*	2.603	4.40	0.764	0.68	0.931	1.057	17
Waitara at Bertrand Road	3.277	10.07	1.404	1.08	1.840	2.250	17
Waitara at Mangaoapa Road	3.536	9.95	1.510	1.27	1.793	#	5 ½
Manganui at Everett Park	2.636	7.0	0.555	0.35	0.810	#	5 ½
Punehu at Pihama*	0.686	2.20	0.315	0.25	0.377	0.438	27
Waiongana at SH3a	1.995	4.78	1.295	1.17	1.421	1.471	16 ½

Note: * = NIWA station

Table 3 Wind

Sub-region	Percentage of month with winds from following directions								Speed (km/h)	
	North	NE	East	SE	South	SW	West	NW	Mean	Maximum
New Plymouth	12.7	21.3	12.4	10.1	28.3	8.3	4.0	2.9	11.3	70.0
Okoki	3.3	13.5	17.5	32.8	15.6	9.9	5.1	2.2	10.5	56.7

General comments

June rainfall totals (Table 1) show that taranaki was considerably drier than normal in most areas with the only exception being high on the northern slopes of the mountain. The low rainfall is reflected in Table 2 which shows below average river levels for the time of year in most areas. Coastal areas received near average rainfall for June, which has helped to bring their year-do-date totals close to normal. Annual rainfall totals in most other areas are below average and well down on this time last year.

Only one Heavy Rainfall Warning was issued by the Met Service during June and did not result in any major flooding in Taranaki.

G Best
HYDROLOGIST

Activity 5

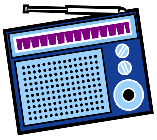
Weather Emergency – Flood

Imagine your home is in an area prone to flooding. There has been heavy rain and water levels are rising around your home. You have been instructed by civil defence to evacuate your home and move to higher ground.

♦ From the list below choose the 10 most important items that you should take with you

Be prepared to explain your choices to the rest of the class. You may work with a partner or in a small group.

family photo album



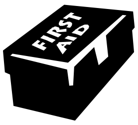
radio and batteries

warm clothes

torch

important documents
eg birth certificates/passports

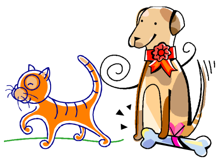
gas stove



video games

first aid kit/multifunction knife

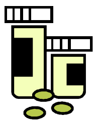
pets/pet food



armchair

gumboots

chocolate bars



personal medication

paper and pen

drinks

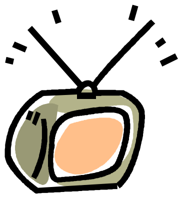
lawnmower

magazine/books

warm blankets

canned food

packet food/canned food



TV/video games

buckets

toothbrush

spade

inflatable boat

What could you do with some of the important things that you could not take with you?

♦ Extra

Contact civil defence by fax to find out how people in New Zealand prepare and respond to an emergency.

Prepare an action plan to show how people in your school should respond to an emergency,
eg: tornado or damage causing winds.

Civil defence fax no. in New Plymouth 06 757 8019

Activity 6

Timeline of weather related events

♦ Some destructive storms in New Zealand's history

February 1936	Cyclonic storm over much of the North Island.
August 1948	Tornado at Hamilton – 3 people killed
November 1967	Tornado at Woodville
April 1968	Ex tropical cyclone 'Giselle' (Wahine storm)
August 1976	Ex-tropical cyclone 'Alison'
July 1976	Severe wind damage in the Te Aroha district
March 1988	Ex-tropical cyclone 'Bola'
October 1988	Damaging wind affects Canterbury
March 1990	Cyclone Hilda causes flooding in Taranaki
August 1990	Damaging tornado hits Bell Block and Inglewood
December 1996	Cyclone Fergus causes floods in Northland and Coromandel
January 1997	Cyclone Drena causes damage to Taranaki coast

Arrange the weather events on a timeline. You may wish to research other weather-related events or other civil defence events, eg: earthquakes. You may also wish to include significant events in your family's history, eg: Dad born, moved house, started school.

♦ Note: To make your timeline more attractive you may wish to illustrate with pictures or graphics

Activity 7

Weather monitoring technology

♦ Below are some of the instruments used for monitoring weather

- This can be useful to help find out the climate of the area you live in and how much it changes throughout the year
- You can also find out whether your climate is suitable to grow certain plants
- You can also find out which months of the year are the most suitable for certain events, eg: school cross-country, sports day, gala day, planting seeds

Anemometer

An instrument for measuring wind, usually consisting of 3 or 4 cups on spokes. You can make one of these using straws for spokes and hot glue on half ping pong balls for cups.

Barometer

An instrument that measures air pressure. Generally falling air pressure forecasts bad weather and rising air pressure indicates good weather approaching. You can make one by inventing a bottle in a jar, part filled with water. When the water is high in the bottle the air pressure is high, when low in the bottle, air pressure is low.

Rain gauge

An instrument used to measure rainfall. These sometimes consist of a hollow cylinder containing a long narrow tube. The tube is connected to a funnel at the top.
You can make one of these using funnels, jars and tubes. There are many possible designs.

Sunshine recorder

An instrument measuring the duration of sunshine each day at a particular place. The sun's rays are focused onto special paper and burn a tract as it travels across the sky.

Thermometer

An instrument used to measure temperature. Some thermometers can measure the minimum and maximum for the day.

Weather vane

An instrument which indicates the direction the wind is blowing. You can make one of these following the plan in S.I.T.E. newsletter.

Become a weather monitor

Monitor the weather over a period of time. In groups take responsibility for measuring weather in different parts of the outside school environment. Use existing technology or design and create your own.

You could monitor wind direction, wind speed, rainfall and temperature over the period of a month or measure changes from month-to-month throughout the year.

You may find some interesting variations from site-to-site throughout the school.

Questions based on your weather monitoring findings

Where in the school would be a good place to:

1. Eat lunch – sunny, warm, sheltered
2. Plant a tree that liked rain but not wind
3. Plant a tree that likes warm temperatures and wind
4. Have a fernery, ie: wet, shaded
5. Position the school incinerator, ie: smoke blows away

Activity 8

Tropical cyclones

♦ Read the information about tropical cyclones provided by the METSERVICE

See if you can answer some of the following questions:

1. Where did the word cyclone probably come from?
2. How are cyclones named?
3. What usually happens when a cyclone leaves the tropics?
4. Why do the Met Service not issue cyclone warnings too early?
5. What factors contributed to sea levels being raised during cyclone Drena?
6. During which months are cyclones most common in New Zealand?
7. During which months are there no cyclones in New Zealand?
8. What is a possible reason for the increase in cyclones and the longer cyclone season recently?
9. Why are cyclones useful to the earth as a whole?
10. Convert 50 knots to kilometres per hour

♦ Vocabulary

Find the meanings of the following words:

conducive	implemented	compact
dichotomy	erratically	complacent
centrifugal	latitude	significant
centripetal	maintain	torrential

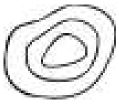
Refer to Appendix

Activity 9

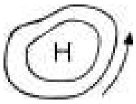
Reading the Weather Map

♦ Some background information

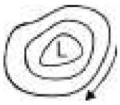
The weather map we see on TV and in the newspaper with lines, arrows, numbers and symbols on it is called a MSL (mean sea level) chart. It shows what is happening at the surface where most of us are.



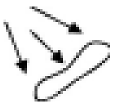
The plain lines that curve across the chart are called 'isobars'. The air pressure is the same along the distance on the line. Some of the lines have numbers on them. These show the air pressure a barometer would indicate on this line.



Groups of isobars that show where the pressure is higher than anywhere else are called 'highs' or 'anticyclones' and are shown by a letter H. anticyclones move in an anticlockwise direction in the southern hemisphere.



Groups of isobars that show where the pressure is lower than anywhere else in the area are called 'lows' or 'depressions' and are shown by the letter L. depressions move in a clockwise direction in the southern hemisphere.



Winds flow almost directly along the isobars (clockwise for lows – anticlockwise for highs). We can tell the direction of the wind at any place on the amp.

We can also tell the strength of the wind. If the isobars are close together the wind strength is strong. If the isobars are apart the wind strength is weak.

Hills and mountains also influence the weather. The wind acts on these in the same way that water flows over between and around rocks in a river. So as the water rushes between boulders, the wind blows strongly through gorges.

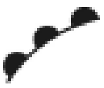
Troughs and ridges

These are shown by a deviation in the isobar lines in a High (ridge of high pressure) or Low (trough of low pressure).

Fronts

Fronts mark the boundary between warmer air and colder air in a depression. When a front passes a place it is likely to become warmer or colder than before.

When cold air is advancing we have a cold front indicated by triangular symbols toward where the front is moving.



When warm air is advancing we have a warm front marked by a semi-circular symbols towards where the front is moving.

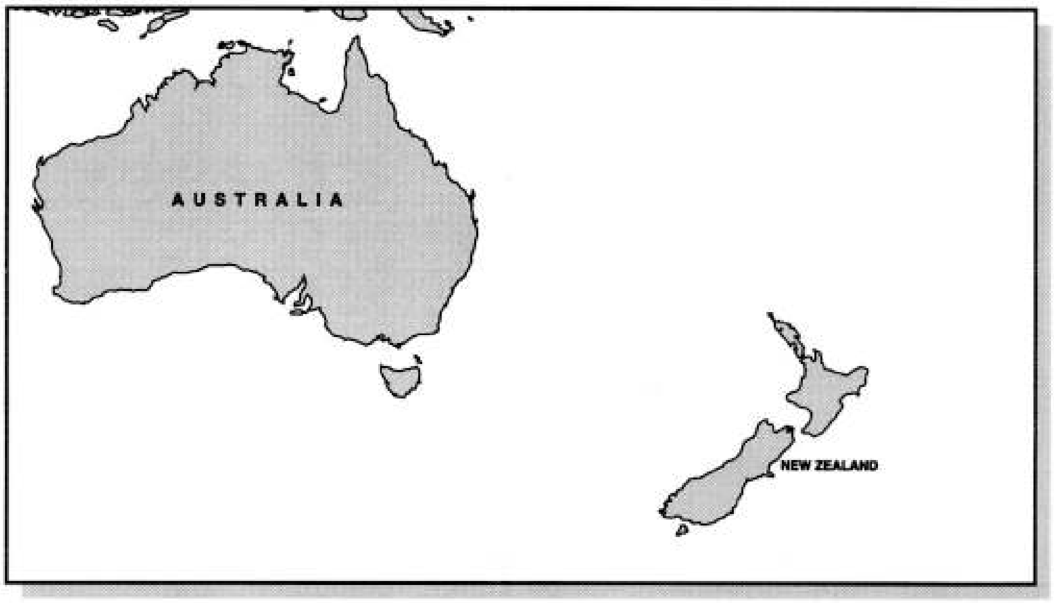
When we have neither warm nor cold air advancing we have a stationary front; shown by triangles and semi-circles on opposite sides of the line.

When there is not much temperature difference along the front we have an occluded front marked by triangles and semi-circles on the same side of the line.

Anticyclones are usually associated with fine weather. Usually this is true, but there is often cloud which sometimes gives rain. Anticyclones usually have light winds because of well spaced isobars.

Depressions usually bring (rainy) cloudy weather with higher winds due to the close isobars.

On the map of New Zealand and surrounds mark the following:



A high with a ridge in it to the northeast of New Zealand with three isobars 1025 at the centre to 1015 at the outside.

A low with a trough in it to the west of New Zealand with three isobars going from 1000 in the centre to 1010 at the edge.

A cold front coming off the centre of the low to the northwest

Show the direction the air will be circulating in the highs and lows

A low with close isobars which would bring strong northerly winds to Taranaki

Study the weather map for Friday January 10

What is approaching from the north?

What type of weather will it probably bring?

What direction (clockwise/anticlockwise) with the wind be moving?

What direction would the wind be coming from in Auckland?

What type of front is over the South Island?

What type of weather is coming from the southwest?

Study the weather map for Monday May 5

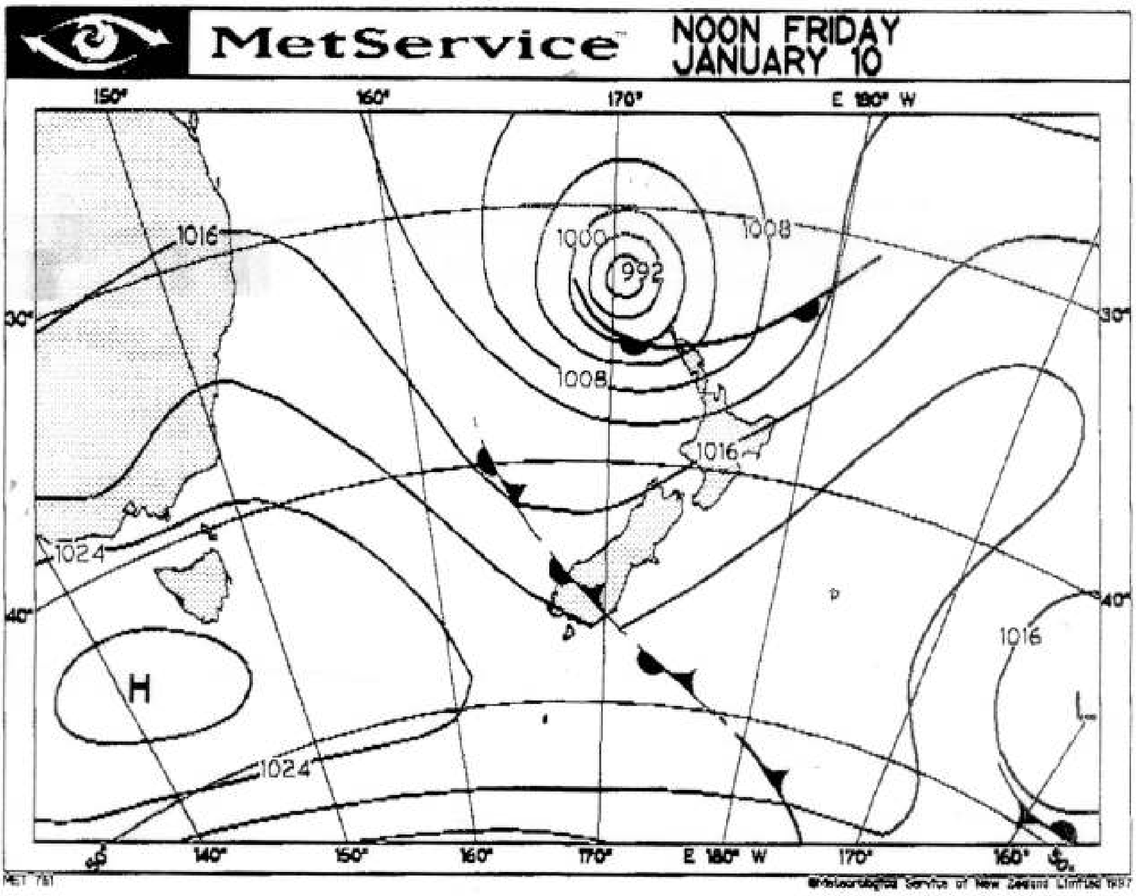
What type of weather pattern is over New Zealand?

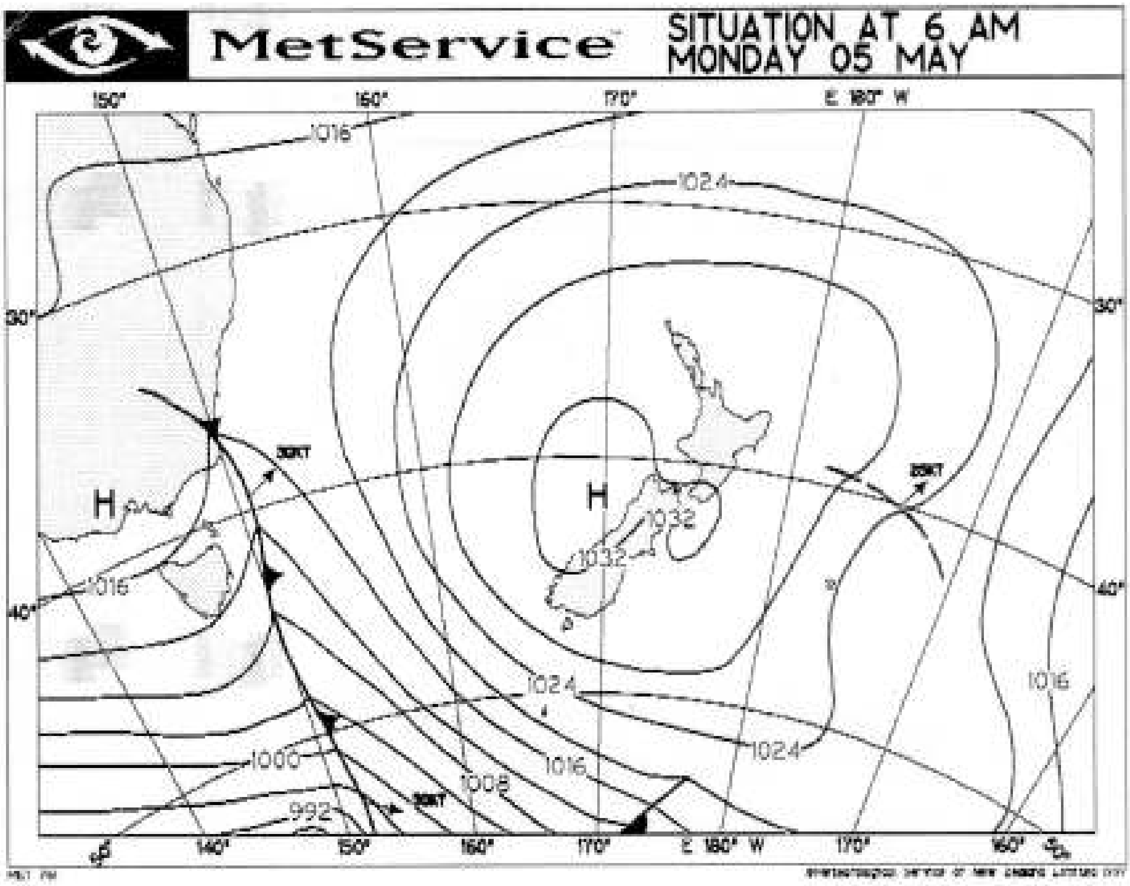
What will the wind be like?

What will the weather probably be like?

What type of front is approaching from the southwest?

What type of weather pattern is coming from the south?


MetService
NOON FRIDAY
JANUARY 10
150°
160°
170°
E 180° W
1016
1000
1008
992
30°
1008
1016
1024
40°
H
1016
L
1024
140°
150°
160°
170°
E 180° W
170°
160°


MetService
SITUATION AT 6 AM
MONDAY 05 MAY
150°
160°
170°
E 180° W
1016
1024
30°
H
H
1032
1032
1016
40°
1024
1016
1024
1000
1016
1008
992
140°
150°
160°
170°
E 180° W
170°
160°

Activity 10

Air pollution match up

♦ Match the titles in Column A to the definitions in Column B

Column A	**Column B**
The Greenhouse Effect	A gas produced naturally when animals breathe and plants decay and artificially when burning fossil fuel
Atmosphere	The heat energy trapped by carbon-dioxide gas in the atmosphere keeping the earth warm
Carbon Dioxide	A gas found in a layer about 25 km above earth absorbing the sun's UV rays
Methane	Chemicals invented by humans used in air conditioners, refrigerators, some aerosols and polystyrene manufacture
Chlorofluorocarbons (CFCs)	A gas contributing to the greenhouse effect produced by rotting rubbish bacteria in rice paddies and animal waste
Global warming	The destruction of the ozone layer caused by CFCs attacking ozone gas
Deforestation	The clearing of the earth's forests, leading to carbon dioxide being released and less CO_2 being absorbed
Ozone	The increase in the earth's temperature due to the greenhouse effect
The Ozone Crisis	The layer of gases containing nitrogen, oxygen and carbon dioxide surrounding the earth

♦ Extra

Write on the topic of solving the problems of ozone depletion and global warming. Suggest ways that we as individuals and as a world community can avoid further global warming and ozone depletion

eg
1. by reducing carbon dioxide release
2. stopping production and use of CFCs
3. stopping rainforest destruction/plant trees
4. improving public transport
5. setting up recycling centres

Activity 11

Wind and rain

♦ Beaufort Wind Scale

Civil defence monitors wind around the region during an event by asking local volunteers to use the beaufort scale in their area.

Fill in the description of effect around us with the jumbled descriptions below, alternatively make up your own description based on your school or home environment, eg, tree outside brushes against window, rubbish bin blows over.

Beaufort Wind Scale

Beaufort number	Descriptive term	Wind speed in kilometre per hour	description of effect around us
0	calm	0 – 2	
1	light air	2 – 5	Smoke drifts
2	light breeze	6 – 11	
3	gentle breeze	12 – 19	
4	moderate breeze	20 – 29	Small branches are moved. Raises dust
5	fresh breeze	30 – 39	
6	strong breeze	40 – 50	
7	near gale	51 – 61	
8	gale	62 – 73	Breaks twigs off trees. Walking against wind difficult
9	strong gale	74 – 86	
10	storm	87 – 100	
11	violent storm	101 - 115	

- ❑ Large branches in motion. Whistling heard in telephone and power lines
- ❑ Smoke rises vertically
- ❑ Very rarely experienced. Widespread damage
- ❑ Leaves and small twigs in constant motion. Light flags extended
- ❑ Signs, fences blown down, some damage
- ❑ Small trees sway. Crested wavelets form on inland waters
- ❑ Wind felt on face. Leaves rustle. Flags stir
- ❑ Trees uprooted. Considerable structural damage occurs
- ❑ Whole trees in motion. Inconvenience felt when walking against wind

♦ Rainfall at various Taranaki sites

Use the table and study the data about rainfall around Taranaki

What is the average rainfall near where you live?

Name a location that has approximately twice the rainfall of another

Name two areas that have similar rainfall

Generally speaking what happens to rainfall figures as we increase altitude?

Location	Altitude (m)	Average rainfall (mm)
North Egmont	955	7000
Dawson Falls	945	5877
Stratford Mountain House	846	6370
Stratford	311	2019
Pohokura Saddle	300	1822
Egmont Village	198	1963
Inglewood	195	2317
Eltham	183	1550
Hawera	105	1173
Huatoki, New Plymouth	70	1548
Patea	42	1159
New Plymouth Airport	30	1529
Opunake	27	1239
Cape Egmont	08	1425

Activity 12

Clouds

♦ Clouds are made up of billions of tiny water drops or ice crystals floating in the sky

Although there are many types, there are three main types; cumulus, stratus and cirrus clouds

Cumulus clouds

Look like fluffy cotton wool and are often around when the sky is blue. They are formed by the sun warming up moist air. As the moist air rises it is cooled so it turns to water droplets. Cumulus clouds form about 500 metres up.

Stratus clouds

When you see a high sheet of low cloud this is probably stratus cloud.
This cloud form occurs when warm moist air rises up slowly over a bank of cold air.

Cirrus clouds

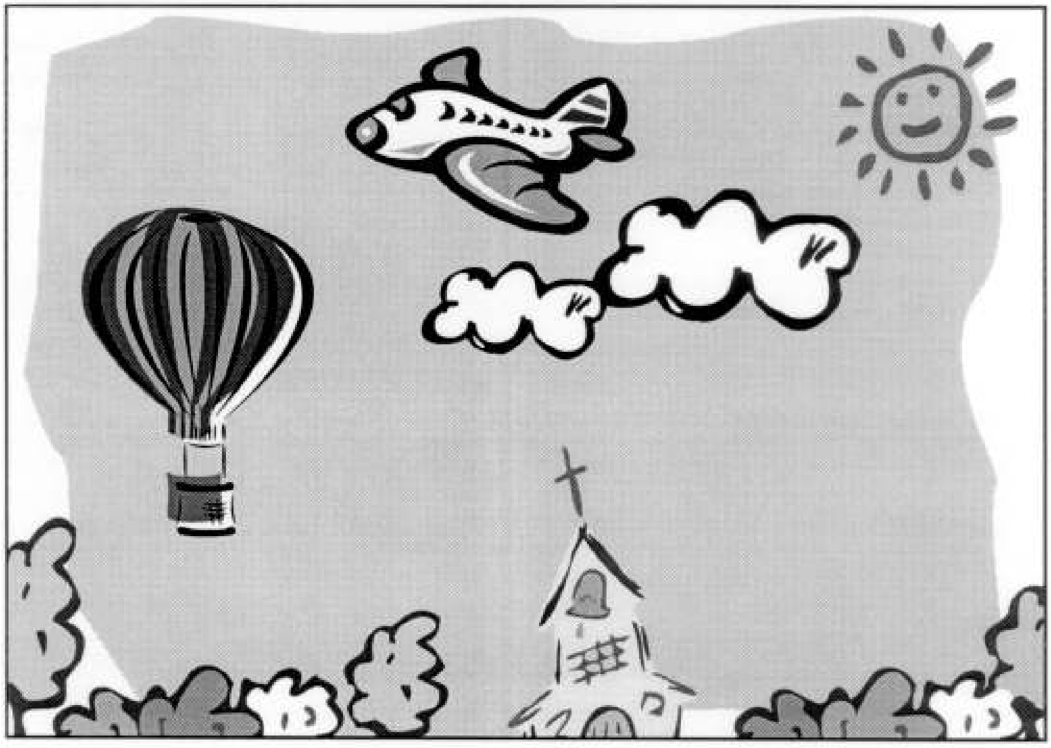
Cirrus clouds form very high up in the sky and are made of ice crystals rather than water as it is so cold up there. These clouds are often wispy in appearance and sometimes look like the tail of a horse.

There are many sub-categories of these clouds which are named according to their formation and how high they are in the sky.

Activity Art

Sketch as many types of cloud over a period of days and try to categorise them.

Draw and paint a sky-scape and add features to it such as buildings, trees, aeroplanes, hot air balloons, birds, parachutes, helicopters, leaves, lightning.



Activity 13

♦ Below is some Māori reo to practise when you are talking about the weather

Although these are not all the words possible to explain weather, they will give you a good start.

weather – *āhua o te rangi or huarere*

weather forecast – *tirorangi ortohu huarere*

cold – *makairiri*

hot – *wera*

windy – *Hauhau*

warm – *mahana*

cloudy – *tāmaru*

sunny – *rāhana*

snow/icefalling – *hukarere*

frost – *hukapapa*

snow – *pūmā*

stormy – *tūpuhi*

thunderstorm – *marangai*

flood – *waipuke*

showers – *hāuaua*

cold wind – *hauanu*

heaha teāhua o t era? .... what is the weather like today?

e whiti te rā.. the sun is shining

he ra uaua .... it is wet

tino wera te ra .... it is hot

kei te tino wera t era ne?................................ it is hot today isn't it?

tino makariri te ra .... it is cold

he makariri te tonga .... the south wind is cold

Seasons of the year – *Ng wa o te tau*

spring – *kōanga*

autumn – *ngāhuru*

summer – *raumati*

winter – makariri

Pupuhi mai an ate hau ki tōku aroaro .... The wind is blowing toward my face

Ka rongo tōku tinana kit e hauanu .... My body feels the cold wind

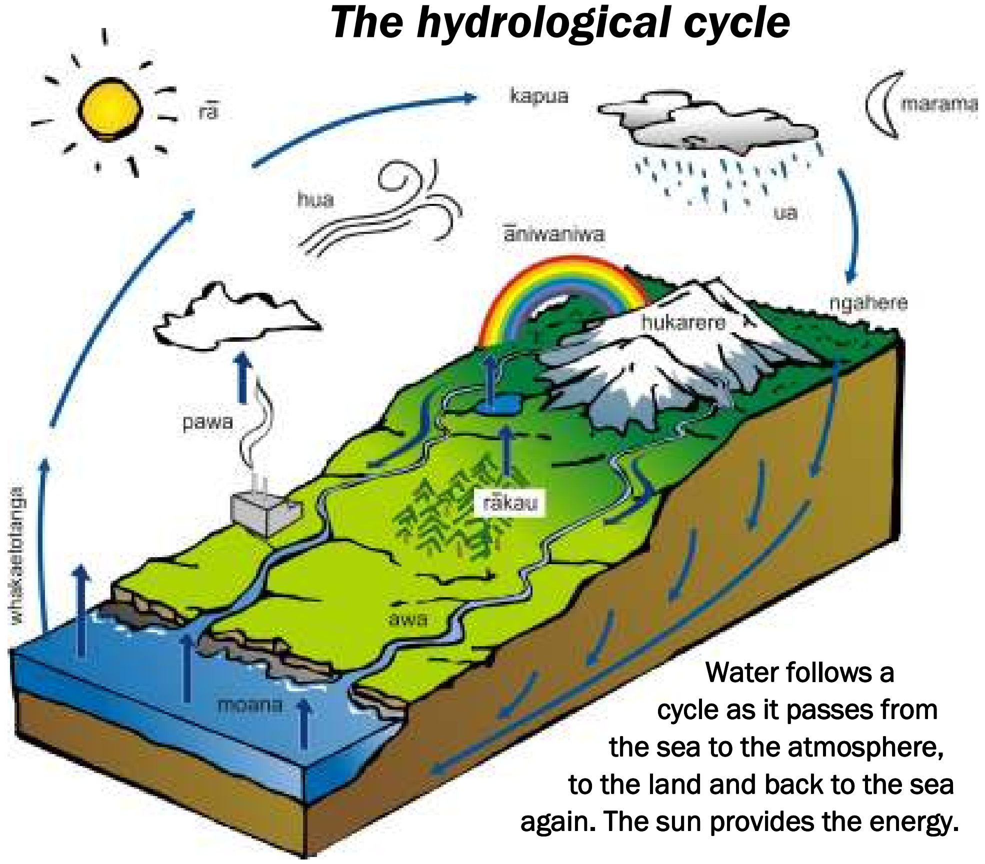
Kurawhiu an ate hukarer................................ The hail was lashing down

Kua uhia te whenua kit e hukapapa .... The land has been covered in frost

He kaha te hau ne?... The wind is very strong isn't it?

References: He Pūranga Tākupu A Taranaki
The Reed Dictionary of Modern Māori

The hydrological cycle



.See if you can identify these Māori words and find their English translations

Sun..	Rainbow	Atmosphere above earth ....
Clouds......................................	Rain	Smoke...
Moon..	Bush	Trees ....
Wind...	Snow............................	Evaporation ....
Rivers.......................................	Sea	

Answers: Sun - rā, Evaporation - Whakaetotanga, Sea - moana, Rivers -awa, Smoke- pawa, Moon - marama, Rainbow - āniwaniwa, Bush - ngahere, Snow - hukarere, Trees - rākau, Wind - hau, Atmosphere above the earth - rangi,Rain - ua.

Activity 14

♦ Living under the Mountain

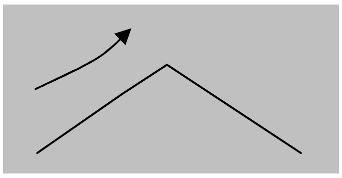
Mount Egmont/Taranaki has a big influence on our climate here in Taranaki and our weather would be quite different if it wasn't for the mountain.

The mountain affects the moisture in the air. When the moisture from the air condenses on the mountain it turns to rain or snow. In other words the mountain alters moisture in the air.

When we see a cap on the mountain people often say that it means it is going to rain.

There may be a scientific reason for this as the cap is made from moist air condensing on the cold mountain top. This could show that there is a lot of moisture in the air and maybe rain on the way.

The mountain also causes orographic rain; this is rain that is caused when moist air is forced up until it gets cold and condenses and forms rain.



The other important feature of the mountain is that it is on a piece of land that protrudes into the ocean (a peninsula). This area of land is often the first land mass that weather systems encounter when they come off the ocean. So quite often large masses of heavily saturated air turn to rain when they come across the land with the mountain on it. If the mountain wasn't there some of the rain would pass over.

The mountain sometimes shelters certain parts of the region from cold wind and rain depending on which direction the weather is coming from.

Much of Taranaki's wind and rain moves up and around the mountain, instead of going right over the top of the peak. This is due to the conical shape of the mountain. In other mountainous areas such as the Southern Alps of New Zealand, the wind and rain go up and over the mountains dropping much of their rain on one side.

Rainfall and altitude
The higher we go up the mountain the more rain we tend to encounter. This is because as we go higher the air becomes colder and turns more wet air into rain, or snow if it gets really cold.

Graph the table from page 25 figures using a line graph. Or draw an outline of the mountain and plot in the altitude and average rainfall figures.

Because our mountain is steep, the rain gets from the mountain to the sea quickly. This means that rivers rise quickly and floods can occur without a lot of warning.

An example of this is the Manganui River which has risen by 2.6 metres in 15 minutes.

Measure of rainfall
Measure the rainfall at your home for a period of time and compare your results with other parts of the region.

Bibliography

The Climate and Weather of the Taranaki Region, C S Thompson

The Greenhouse Effect and the Ozone Layer, Ron Thomas and Jan Hipgrave, MacMillan Publishing 1991.

Making sense of the Weather Map, New Zealand Meterological Service

The New Zealand Weather Book, Whitcoulls Publishers 1985

Weather, John Farndon, Harper Collins Publishers 1992

Weather and Climate, MacDonald Junior Reference Library, BPC Publishing 1973

Weather Science Resource Unit, Level 1 Number 12, Department of Education

Tropical cyclones – background information

Cyclone FERGUS interfered with New Year travel plans of many when it dumped over 400 mm (more than a foot) of rain over the Coromandel as 1996 came to a close. Then, a dozen days later, DRENA gave six hours of storm force winds to Auckland on a Friday evening, followed by sea over-topping the sea-wall at Coromondel.

Who dreamed up these names, and why did they visit New Zealand?

Forming a tropical cyclone
FERGUS and DRENA started their lives in the tropics, feeding off the extra energy available from warm seas. When sea surface temperatures are warmer than 26 degrees, and the upper air conditions are conducive, tropical thunderstorms, breeding off the evaporated sea, start to gang together so that the heat their rain releases causes air pressure inside them to drop. This draws-in more moist air. At the equator, wind can only blow in straight lines, and a pressure imbalance is relieved as it forms. But FERGUS and DRENA formed near ten degrees south, where the effect of the spinning earth forces wind to blow in curves, turning the growing gang of thunderstorms into a spiralling cluster. The indrawn air was insufficient to compensate for falling air pressure within the thunderstorms. a positive feedback look formed with lowering air pressure leading to more indrawn air, more rain, more pressure fall, etc.

A 'cyclone' is a generic term meaning an area of rotating wind (it either comes from the Greek Kuklos (to rotate) or Cyclops (one-eyed monster). The word 'depression', when applied to a weather map, simply means an area of low pressure. When winds rotating around a cyclone in the tropics build to gale force (averaging 34 knots/62 km/hr or more), the feature is called a 'tropical cyclone' and given a name. Areas of low pressure in the tropics that do not meet this requirement are called 'tropical depressions' and remain nameless.

Naming a tropical cyclone
Once formed, each tropical cyclone is given a name to help in its identification. This is done by the appropriate Tropical Cyclone Warning Centre. These names are prepared well in advance by the Tropical Cyclone Committee of the Geneva-based World Meteorological Organisation (WMO). There are several Tropical Cyclone Warning Centres around the world and each keeps its own list, usually made up from names typical of that part of the world. The lists are used in alphabetical order, but occasionally letters such as Q V and Z are skipped. Tropical cyclones were once just given numbers. The idea to use names was experimented with during the WW2 (when USA was bombing Japan) and implemented in the 1950s. For a while only girl names were used, but in the late 1970s boy-names were added.

FERGUS was named by the Brisbane Tropical Cyclone Centre on Boxing Day. DRENA was named by the Fiji Tropical Cyclone Warning Centre whilst in the eastern Coral Sea on 4 January. Fiji and Brisbane were at different stages of their cyclone-naming alphabet, hence the alphabetical dichotomy.

Hurricanes and typhoons
A tropical cyclone will keep gathering momentum while it can feed on warm-moist-air (over warm seas). Its growth slows once it has developed an 'eye' – an area of light winds and almost clear skies at the centre of the spiral. This eye is surrounded by the 'eye-wall', a ring of wind and torrential rain which houses 80 percent of the total energy of the system. The eye forms when centrifugal forces within the cyclone help air to sink into its heart; a typical eye is 10 to 30 km across, but may be 100 km across at its top. In the eye-wall, centrifugal forces and centripetal forces are combined so that winds reach 'hurricane force'.

A 'hurricane force wind' is defined as any wind averaging 64 knots/118 km/hr or more, and comes from the Caribbean *hurucan* (devil or big-wind). Tropical cyclones with winds of hurricane strength (or force) are classified in most parts of the world as being of hurricane intensity, given a hurricane warning and called hurricanes (note that warnings for winds of hurricane force in New Zealand are called 'storm warnings'). About Asia such a tropical cyclone is referred to as a **typhoon**, a term which either comes from the Chinese words *tai fung* (wind that strikes) or, possibly, from the Greek monster *Typheous* (the father of all storms).

DRENA grew to be a hurricane; it had a classical eye when it was near New Caledonia (but the eye-wall was so compact that it didn't make land fall). Satellite imagery of FERGUS did not show an eye.

Leaving the tropics
When a tropical cyclone moves out of the tropics (the trophic of Capricorn is 22 South), it encounters sea water cooler than 26°C and the fuel supply of moist air is no longer rich enough to maintain the system. First signs of this are when it loses its eye, or when cold (near cloud-free) air breaks through the eye-wall, or when its canopy of upper clouds is sheared away by encountering stronger winds aloft. The system can no longer maintain an eye-wall and so wind and rain areas start to fan out and spread themselves more thinly over a wider area.

When a tropical cyclone enters the 'sub-tropics' and 'mid-latitudes' it brings a wealth of warm air into the cooler environment.

A depression (area of low pressure on a weather map) in the mid-latitudes gets its energy from the difference in temperature between the cold and warm air it draws in. sometimes a 'former tropical cyclone' encounters a patch of very cold air and uses the energy of this temperature difference to reactivate its wind and rain. This is what happened to Cyclone Bola in March 1988, and to Cyclone Giselle (behind the Wahine sinking in Wellington in April 1968).

Upon observing a tropical cyclone move out of the tropics, forecasters like to then refer to the system as 'former tropical cyclone', 'ex-tropical cyclone', 'deep depression of tropical origin', or even 'extra-tropical cyclone (extra means 'out of'). These terms are usually misinterpreted by the general public as being a downgrading of the system or a change of mind by the forecasters. While it is true that these cyclones can behave erratically (and the erratic forecasts reflect this), the actual change from tropical cyclone to a mid-latitude depression is already allowed for in the warnings and no 'downgrade' in warning is intended.

During FERGUS the false impression engendered by the word 'downgrading' led to some confusion. When DRENA left the tropics, MetService experimented with simply changing the description from 'Tropical Cyclone DRENA' to 'Cyclone DRENA'. This resulted in less confusion and will be adopted in future for other threatening cyclones.

Impact on New Zealand
There is an art in issuing the first weather warning for an incoming cyclone. If done too early, people on the receiving end either become complacent or think of it as a false alarm even before the event occurs. If done too late, people do not have enough time to take precautions or change plans. From experience (and because of the inbuilt validity period of weather forecasts), MetService has found that 24 hours advance notice of an impending storm is about right. Mindful that many people make travel plans just before New Year, MetService also went into 'CYCLONE WATCH' mode a few days before the first warning was issued.

As a cyclone heads to New Zealand from the tropics, it unravels and becomes less compact. Areas of peak wind and rain tend to do their own thing in response to the surrounding weather systems and terrain. Although the cyclone centre and its track is what the situation reports concentrate on (as a point of reference), it is important to remember that the peak wind and rain areas are straying from the cyclone centre and from each other. Each cyclone is different, but normally the peak impact of rain affects that part of New Zealand with mountains and on-shore winds, and the peak impact of wind may be in another area (normally about the coast and where there are gaps between hills). Early warnings relating to an incoming cyclone usually cover large areas with high amounts of potential wind and rain. The stress here is on the word potential – only a few parts of the regions mentioned will receive the full potential of the cyclone.

With FERGUS rain forecasts lived to their full potential on the Coromandel peninsula. With DRENA the clouds holding torrential rain managed to stay over the Tasman Sea, but the wind lived to its expected potential over the Auckland area.

In Thames many things came together to produce the over-topping of the sea wall.

Earth was closest for the year to the fun on January 2nd; there was a new moon on the 9th and moon was closest for the month to earth on January 10th. These tidal forces combined to raise Thames sea-level by 3.5 metres, one of the highest tides of the year, between 9 and 10 am on Saturday 11th. At this time peak wind and rain from DRENA had already 'been and gone', but the lowest air pressure Thames got from DRENA arrived with the high tide. This pressure was 997 hectopascals, only 15 below average; only capable of raising the sea another 12 cm or .15 metres, not enough to explain the over-topping. The most significant factors were the shifting winds and the shape of the Hauraki Gulf. During the previous evening the peak winds (storm force) came in from the northeast, shunting water into the Hauraki Gulf (or holding it back after a very high tide). Overnight the winds shifted around to a northerly which took the extra sea and herded it in the Firth of Thames, focusing it towards Thames. Two to three metre waves, whipped up by wind at sea, did not held the situation.

Are cyclones becoming more prevalent?
Although text books say the 'cyclone season' in the South Pacific starts November/December, peaks in February and lasts until April/May, the following table of named cyclones (per decade) shows that the season seems to be getting longer. True, our spotting abilities increased markedly when satellites were introduced in the 60s, but the increase in numbers in February and March from the 70s to the 80s is statistically significant. We are unsure as to whether this is just a phase the planet is gong through, or something linked to global warming.

South Pacific 145E to 125 W Number of tropical cyclones per decade per month												
	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
40s			1	8	17	18	16	5				
50s			2	8	21	30	15	7				
60s			6	13	16	23	19	8				
70s		1	5	13	23	25	17	13	2	1		
80S		1	3	12	26	37	31	15	5			

On average a cyclone affects New Zealand 'every year or so' with one the size of BOLA about once a decade.

Tropical cyclones are good news

Tropical cyclones perform a valuable function for the planetary weather. They are fuelled by warm moist air, and convert this into cloud and rain. Some of the energy released by this conversion is used up as wind, and this may be damaging but is usually only a nuisance in any one place for a day or so. The rain can be torrential, but at least it helps flatten the landscape. There is nothing kind about storm surge or over-topping of sea defences – this is deadliest aspect of cyclones.

The clouds that tropical cyclones take into the mid-latitudes help shift energy around the planet and help equalize thermal differences.

Tropical cyclones only form in response to a build-up of energy in the tropical seas, and they manage to dissipate this build-up by sharing it around the world. Without tropical cyclones, energy build-ups may occur unchecked, perhaps initiating some steady-state extreme which would render part of the planet uninhabitable. So, in fact, tropical cyclones are safety valves of the earth's heating system – they prevent the oceans from overheating. Although frustrating, they are also fascinating.

Dangers of a cyclone

- Damaging winds, especially at sea, through narrow straits and around headlands. Flying debris. No food crops can survive hurricane force winds, the leaves are ripped of the trees.
- Heavy and persistent rain. Flooding of low-lying areas washing away bridges. Landslides about the hills.
- Heavy swell, surging onto the coast.
- A 'STORM SURGE' – a rise of the mean sea level caused partly by lower than normal air pressure and partly by piling up of sea water by strong winds. A storm surge may lift the sea level by as much as a couple of metres. If this coincides with a high tide then low-lying stretches may be completely covered in water, and battered by huge waves.

Precaution checklist

Think of the following safety measures when a cyclone is expected:

- Tidy up the yard. Store or secure any objects that may fly in the wind.
- Move small boats to safety. Check moorings.
- Avoid coastal locations that could be swept by storm surge.
- Move animal to shelter.
- Protect windows (pulling the curtains/blinds is sufficient).
- Check torch, radio batteries, tinned food, stores of drinking water.
- Top up fuel tanks.
- Stay indoors during the height of the storm.

Normally this takes a day or so.

METSERVICE

Wind speed guide for use on land (in kilometres per hour) (remember 30-60-90)		
kph	Impact of this wind on land Not significant	Beaufort force comparison
1-10	Rustle, smoke drifts	Light F0-1-2
10-20	Leaves and small twigs in constant motion, flags flap	Gentle – F3
20-30	Small branches move, raises dust and loose paper	Moderate – F4
	The shakers	
30-40	Small trees in leaf shake	Fresh – F5
40-50	Large branches shake, whistling heard in power lines	Strong – F6
50-60	Whole trees shake, hard to walk against the wind	Near gale – F7
	The breakers	
60-70	Breaks twigs, lifts dirt and sand	Gale – F8
70-80	Breaks branches, slight structural damage	Mix of F8 and 9
80-90	Can break commercial signs and chimney pots	Strong gale F9
	The damaging winds	
90-100	Mature tree in leaf may be blown down, power lines damaged, roofing-iron ripped off, delays most aircraft	Storm – F10
100-100	Boats break free from moorings, roofing tiles lift, you can lean 45 degrees into the wind without falling over	Violent storm – F 11
110-120	Blows out windows, snaps power lines, wind sounds like a jet aircraft passing overhead	Still in F11
120-130	Mature trees uprooted, house roofs lifted, camper vans and billboards flipped, moving cars pushed off the road	Hurricane – F12
130-140	Capable of lifting people who are slightly built	
140-160	Aircraft no longer able to be tied down	
160-180	Small cars rolled by wind	
180-200	Mobile homes and camper vans destroyed	
200-220	Trees of 60cm diameter snap off 30cm above ground	
220-240	Rail boxcars pushed over, empty semi-trailer lifted onto single storey rooftops	

The strongest wind officially recorded in New Zealand was 204 kph (gusting 261 kph) at Oteranga Bay on the Wellington south coast during the Wahine storm, 10th April 1968.

A 40 kph wind packs four times the punch of a 20 kph wind.

Winds at sea are usually 50% stronger than winds over the land. For example: A land forecast for 30 kph may mean winds at sea of 45 kph – marine forecasts are given in knots and 45 kph works out to be 25 knots.

1 Knot = 1.85 kph (double it then take off 15% of it)