Programmed instruction: an experiment with a programmed text: self-pacing versus group pacing

Hope, Barbara F.

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RAINFALL IN BRITAIN
1. Can you answer this RIDDLE?
   WHAT IS EVERYWHERE BUT CANNOT BE SEEN.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1. AIR</td>
<td>2. AIR is made up of different gases which cannot be seen. We say that these gases are i________.</td>
</tr>
<tr>
<td>Invisible</td>
<td>One of these invisible gases that make up the air is a gas which comes from water and is called __________ vapour.</td>
</tr>
<tr>
<td>water</td>
<td>When water changes into a gas which mixes with the air we call this gas __________ __________.</td>
</tr>
<tr>
<td>water vapour</td>
<td>Can you see water vapour in the air?</td>
</tr>
<tr>
<td>No</td>
<td>The invisible water vapour gas is formed from water which is not itself a gas but a l________ which can be seen.</td>
</tr>
</tbody>
</table>
| 6. Liquid | 7. When water is a LIQUID it can be seen, it is ________, but
when water is a GAS it cannot be seen it is ________. |
<table>
<thead>
<tr>
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<th></th>
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</thead>
<tbody>
<tr>
<td>8. Visible</td>
<td>9. There is a great deal of water vapour gas in the air. Where do you think all this water vapour comes from?</td>
</tr>
<tr>
<td>Invisible</td>
<td></td>
</tr>
</tbody>
</table>
| 10. LIQUID | 11. Streams, rivers, puddles, ponds, lakes, reservoirs seas all contain water and are all possible sources of
GAS                                                                                                           |
| 7. Visible | 8. Water is VISIBLE when it is a __________ but is INVISIBLE when it is a __________. |
| Invisible  |                                                                                                                                 |
| 10. Water  | 12. Wet roads and pavements dry because the water on them ________ and changes to water vapour. |
| wherever it may be. |                                                                                                                                 |
| 10. Water | 11. When water changes to water vapour we say that it EVAPORATES. Rivers, lakes, seas provide a constant supply of water
vapour as the water in them E ________ and mixes with the air. |
| vapour |                                                                                                                                 |
12. EVAPORATES
Fill a glass or jar with water.
Mark the level of the water and leave it for a few days.
When you look again at the water you will find that the water level is (higher/lower)

13. LOWER

14. Why has the level fallen?

15. The water level falls because the water in the glass evaporates and mixes with the air as water vapour.
You cannot see the water vapour evaporating because it is ____________

16. When water evaporates it changes to very tiny particles (called molecules) of water called Water Vapour that ____________ with the air.

17. Evaporates
One way to make water evaporate quickly is to heat it.
Notice how quickly the wet clothes dry on a w________ sunny washing day.
19. As you boil a kettle of water the heat produces a great deal of water vapour. Look carefully at a kettle when it is boiling. Where does the steam start, right next to the spout or a little distance away?

20. The gap between the steam and the spout is filled with the tiny particles of water vapour that pour out of the kettle but which are invisible.

21. When the water is boiling you cannot see the tiny particles of water vapour that are coming out of the spout but you can see a cloud of ______. If you hold a cold mirror in the jet of steam coming out of the kettle, the cold surface of the mirror will soon be covered with drops of ______.

22. When the water in the kettle is boiled it is changed to water vapour which rushes out of the kettle, but once away from the source of heat the tiny particles slow down and cool down. As the particles slow down and cool they join other particles of water vapour in the air and form droplets of water which are visible as ______.
24. steam

25. The invisible particles of water that come from a boiling kettle are called ________________ but the visible droplets of water are called.

25. water vapour steam

26. When the kettle is boiling is there any steam to be seen 3 or 4 feet away from the spout.


27. The water droplets at the edge of the cloud of steam become invisible as they are soaked up or a ________________ by the air.

27. absorbed

28. Just as a sponge absorbs water so the air is like a huge sponge that can absorb ____________.

28. water vapour

29. Water vapour is evaporating all the time from rivers, lakes, seas etc. As more and more water evaporates the water vapour formed rises and is ________________ by the air.

29. absorbed

30. We said that air is like a sponge because it can hold a lot of water vapour. But, a sponge can only hold a certain amount of water. If you dip a sponge into a bowl of water and then lift it out some water ____________ out of the sponge.
<table>
<thead>
<tr>
<th>30. drips falls etc.</th>
<th>31. A sponge can hold a lot of water but when there is too much for it to hold what happens to the water it cannot hold?</th>
</tr>
</thead>
<tbody>
<tr>
<td>31. It falls out (or similar)</td>
<td>32. The sponge loses water when there is too much for it to hold. Like a sponge air can hold a lot of water vapour. But like a sponge air reaches a point when there is water vapour for it to hold.</td>
</tr>
</tbody>
</table>
| 32. too much | 33. Which of these statements is correct?  
(1) Air can hold all the water vapour formed by evaporation.  
(2) Air reaches a point at which it cannot hold any more water vapour. |
| 33. (2) | 34. Air reaches a point at which it cannot hold any more water vapour. When something is very wet we say it is soaked or saturated. When the air cannot hold any more water vapour it is very wet and we say it has reached saturation point. |
| 34. Saturation | 35. When air cannot hold any more water vapour it has reached saturation point. |
| 35. Saturation | 36. As the water vapour pours out of a boiling kettle at first it is absorbed by the air nearby. But so much water vapour is coming out of the kettle that air near to the spout soon reaches saturation point. |
36. Saturation

37. The tiny particles of water vapour cannot be absorbed by the saturated air near the spout so as these tiny particles cool they join with other particles to form droplets of water called **steam**.

38. Steam

39. A few feet away from the kettle spout the air has not received as much water vapour from the kettle. Will this air a few feet away have reached **saturation point**?

40. Saturation point

41. No

42. A few feet from the kettle the air has not reached saturation point and is able to **absorb** the droplets of water that form steam.

43. Absorb.

44. If the kettle boils for only a minute or so the cloud of steam does not grow much bigger as the air a few feet away from the kettle is able to absorb the **droplets** of water.

45. droplets of water

46. What happens to the cloud of steam if you let the kettle boil for a few minutes or more?
| 42. It grows larger. | 43. The cloud of steam becomes so large that it fills the whole room. 
So much water vapour is pouring out of the boiling kettle that all the air in the room reaches _______ and is unable to absorb the droplets of water. |
<table>
<thead>
<tr>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>44. The air in the kitchen becomes saturated with invisible water vapour from the kettle and more water vapour keeps pouring out it changes into _______ droplets of water.</td>
<td></td>
</tr>
<tr>
<td>44. Visible</td>
<td>45. How can you tell when the air in the kitchen has reached Saturation Point.</td>
</tr>
</tbody>
</table>
| 45. Because you can see the steam (or similar) | 46. You can see the droplets of water either floating about as steam or running down the walls, windows and fittings. 
When water changes to water vapour we say it EVAPORATES but when water vapour changes to water we say it CONDENSES. 
Water droplets can be seen when the air reaches Saturation Point because the water vapour can _______. |
| 46. Condenses | 47. When invisible water vapour changes to visible water droplets we say that it _______. |
| 47. Condenses | 48. Fill a bath with hot water and you can tell when the air in the bathroom has reached saturation point and the water vapour has condensed by the amount of _______ to be seen. |
48. steam
49. In a cool bathroom the cool moist air has a low temperature and it also has a low __________

50. condense
51. In a heated bathroom the higher temperature of the warm moist air makes the Saturation point higher and the air is able to __________ a lot more water vapour.

52. in a cool bathroom
53. In a cool bathroom where the cool moist air has a lower Saturation Point and the water vapour quickly condenses to droplets of water.

In a warm bathroom there is very little steam to be seen as the air can absorb a great deal of water vapour because it has a __________ Saturation Point.

53. High (er)
54. Cool moist air and warm moist air have different __________
54. Saturation Points.

55. The cool moist air and the warm moist air have different Saturation Points and they are also at different temperatures.

55. temperatures

56. The Saturation Point of warm moist air is higher than the Saturation Point of cool moist air and it also has a higher temperature.

56. temperature

57. If warm moist air is cooled will the Saturation Point remain the same?

57. No

58. Saturation Point

58. If the temperature of warm moist air is lowered the Saturation Point is also lowered.

When you change the temperature of the air you also change its temperature.

59. The Saturation Point of air depends upon its temperature.

60. Air absorbs more water vapour than air.
60. warm
cold

61. What do you see when warm air is cooled to Saturation
Point?

61. droplets of
water

62. When warm air is cooled to Saturation Point the invisible
water vapour condenses to visible droplets of water
such as can be seen in clouds of ________.

62. steam.

63. A cloud of steam and a cloud in the sky are very similar as
they are both made up of tiny ________ of ________.

63. drops
water

64. Clouds are formed when air reaches Saturation Point. When air is
cooled, the Saturation Point is lowered, the air cannot hold as much water vapour so the "spare"
water vapour ________ to droplets of water.

64. condenses

65. The droplets of water settle on particles of dust that float
in the air and we see ________ in the sky.

65. clouds

66. When you see clouds in the sky or steam in a room it is a sigh
that the air has reached ________ ________. 
68, Saturation Point.

THIS IS THE END OF THIS SECTION.

NOW GO ON TO THE NEXT SHEET.
Section Two

CLOUDS

AND

RAIN
1. You know that rain comes from ________ in the sky.

2. Sometimes we get a day of steady continuous rain but on other days we get short heavy ________ of rain.

3. Sometimes we get continuous or st_______ rain.

4. Steady rain with small, light drops is called DRIZZLE. Steady rain can be drizzle, or it can have ________ raindrops.

5. Raindrops can be heavy or light. Light rain with small, light drops is called ________.

6. We do not get heavy showers of rain and continuous rain from the same cloud.

We get different kinds of rain from ________ clouds.
6. different

7. Look at Panel 1 and find the CUMULUS cloud. Does this cloud stretch across the sky like a sheet, or is it piled up in a heap?

7. It is piled up in a heap.

8. The Latin word for heap is CUMULUS (Say it as Cue - mew - lus ) How many heaped-up clouds can you find on panel 1? Write down their names.

8. Two
Cumulus
Cumulo
Nimbus

9. heap

9. CUMULUS is the Latin word for a pile or a ______.

10. NIMBUS is the Latin name for RAIN.
So the proper name for a heaped-up rain cloud from which rain falls is C__________ N__________.

10. Cumulo
Nimbus

11. Clouds have Latin names ending in US like CUMULUS.
When the two names are joined together, the end of the first word changes too as it does in CUMULO-NIMBUS.

What is the Latin word for rain?

11. NIMBUS

12. We usually get short, heavy showers from heaped up Cumulo-Nimbus clouds.
When Cumulo-Nimbus get very big we sometimes get Thunderstorms from them.
When there is a thunderstorm what sort of rain do we get heavy or light.
12. heavy

13. We get very heavy rain from thunderstorms.
   From ordinary heaped-up cumulo-nimbus clouds we get short, heavy __________ of rain.

13. Showers.

14. We do not get drizzle (light rain) from Cumulo-Nimbus clouds.
The rain we get from heaped-up CUMULO-NIMBUS clouds is always __________.

14. heavy

15. Draw a copy of Panel 2.
   Then on your copy, write in the box of Cumulo Nimbus cloud the kind of rain it gives (two words)

15. show me your drawing

16. You know that Cumulo-Nimbus clouds give heavy showery rain.
   Like NIMBUS the Latin name NIMBO also means __________.

16. rain

17. There is another kind of cloud that gives rain as well as Cumulo-Nimbus.
   Look at Panel 1 and find the name of this other rain cloud.

17. Nimbo-Stratus

16. Look at the shape of the Nimbo-Stratus cloud on Panel 1.
   Is it piled up like the cumulus cloud or is it stretched across the sky like a sheet?
18. Stretched across the sky like a sheet.

19. The Latin name for a sheet is STRATUS.
   So a nimbo-stratus cloud is a _______ of cloud from which steady _______ falls.

19. sheet

20. Nimbo-stratus clouds give us days of steady, heavy rain or steady light rain called _______.

20. drizzle

21. Steady continuous rain or drizzle comes from
   n _______ - s _______ cloud.

21. nimbo-stratus

22. On your copy of Panel 2 put the words
   STEADY RAIN! or DRIZZLE in the box in the cloud that gives this kind of rain.

22. Show me your drawing

23. The sheet of cloud that gives steady, continuous rain, or steady drizzle is called _______ - _______ cloud.

23. nimbo-stratus

24. Short heavy showers come from heaped up c _______ - n _______ clouds.
So far we have looked mostly at Cumulo-nimbus and nimbo-stratus clouds.

Write down the parts of their names that tell you they are rain-clouds.

NIMBO and NIMBUS both mean rain.

The other parts of the names tell you which family nimbo-stratus and cumulo-nimbus clouds belong to.

Cumulo-nimbus clouds belong to the CUMULUS family.
Nimbo-stratus belongs to the ______ family.

The two families of clouds are stratus and ______.

LOOK AT PANEL 1.

Which clouds are called by their family name only; the high, low or middle clouds.

LOOK AT PANEL 1 AGAIN.

What is the name of the highest wispy "mares-tail" clouds.

CIRRUS clouds are very high up where the temperature is very low.
So instead of being made of tiny droplets of water CIRRUS clouds are made of tiny crystals of ______.
Just as clouds that give rain are called NIMBUS (or NIMBO) the clouds that are so high up they are made completely of ice crystals are called C______ clouds.

Stratus clouds that give rain are called nimbo-stratus.

Stratus clouds that are very high up and made of ice crystals are called ______________ RO-STRATUS.

Cumulus clouds made of tiny ice crystals are called ________ CUMULUS.

CIRRO-CUMULUS and CIRRO-STRATUS clouds are made completely of tiny _______ of ________.

CIRRO-CUMULUS and CIRRO-STRATUS are not shown on Panel 1 as they are not so often seen as the mares-tail wispy _______ clouds.

Unlike the other clouds only the cirrus clouds are made completely of _______ of ________.
When there are clouds in the sky we do not always get rain falling from them.

The only clouds which do not give rain are the clouds made of crystals of ice. So we do not get rain from Cirrus clouds.

Cirrus clouds, which are made only of tiny crystals of ice, do not give rain.

Look at your copy of Panel 2. Only the box for Cirrus is blank. The other boxes show what kind of rain falls from these clouds. Does rain come from Cirrus clouds?

No rain. On your copy of Panel 2 write NO RAIN or NONE in the box for the Cirrus cloud.

Your copy of Panel 2 is now complete and should look like the one below.

Write down the name of the cloud on Panel 2.
GO ON TO THE NEXT SHEET.
MAIN CLOUD TYPES

CIRRUS - 6m
50,000 ft

CIRROSTRATUS

CUMULUS

CUMULONIMBUS

ALTOCUMULUS

ALTOCUMULUS

ALTOCUMULUS

STRATOCUMULUS - 1 mile

NIMBOSTRATUS

CUMULUS

NIMBOSTRATUS

BEN NEVIS
HOW

CLOUDS

FORM
Clouds only form when air reaches saturation point and water vapour (condenses/evaporates).

1. Condenses

2. In spite of their different shapes all clouds are formed in the same way, by air expanding and cooling so that water vapour condenses. The opposite of expansion is compression. When you pump up a bicycle tyre you force or com_____ a great deal of air into a small space.

3. Compress

As you pump up the tyre, the connection between the pump and the tyre, and the bottom of the pump both get hot because the air is being com_____ ed.

4. Compressed

When air is compressed it becomes warm and its temperature (falls/rises)

5. Rises

What happens to the temperature of air as it is compressed?

6. It rises

When you pump up a tyre, you use the pump to compress air. When the tyre is punctured or when you undo the valve, the compressed air escapes and e_______.

7. It escapes
<p>| | | |</p>
<table>
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</thead>
<tbody>
<tr>
<td>6. expands.</td>
<td>7. When the compressed air in the tyre escapes the air expands. When air is compressed its temperature rises but when air expands its temperature falls.</td>
<td></td>
</tr>
<tr>
<td>7. falls</td>
<td>8. The temperature of air falls when the air expands.</td>
<td></td>
</tr>
<tr>
<td>8. expands</td>
<td>9. When compressed air escapes from a bicycle tyre the air expands and its temperature falls.</td>
<td></td>
</tr>
<tr>
<td>9. falls</td>
<td>10. Air is not always compressed before it expands. Sometimes air is forced to rise over hills.</td>
<td></td>
</tr>
<tr>
<td>10. expands</td>
<td>11. Air expands when it is forced to rise over hills.</td>
<td></td>
</tr>
<tr>
<td>11. rise</td>
<td>12. If air is forced to rise it expands.</td>
<td></td>
</tr>
</tbody>
</table>
12. falls
13. When air rises its temperature falls because as it rises it ____________.

13. expands
14. When air rises, it expands and cools. When the air temperature is lower, the saturation point of the air is also ____________.

14. lower
15. So when the air rises, expands and cools its saturation point is lower. When the saturation point of the air is lower, the water vapour in the air (evaporates/condenses) onto particles of dust in the air.

15. condenses
16. When air rises the water vapour condenses into tiny droplets of _______ or crystals of _______ which settle on particles of dust in the air.

16. droplets of water, crystals of ice
17. As the air rises high above the earth the water vapour in the air condenses. A mass of droplets of water or crystals of ice forms high above the earth. When this happens we see it as a _______ in the sky.

17. cloud
18. Clouds form when the air expands and the temperature falls, and water vapour in the air _______.
18. condenses 19. The temperature falls and clouds form when air rises and

19. expands 20. Cumulus and Stratus clouds are different shapes because of the
different shapes because of the different ways in which air rises
to form them. When air is forced to rise over hills a sheet
of clouds forms.

When air rises over hills or mountains clouds form.

20. Stratus 21. Stratus clouds form when air is forced to rise over high
ground.

21. rise 22. When air is made to rise over hills or mountains clouds form.

Copy this diagram and put in a cloud.

22. This is how your diagram should look.

In the box is the title of the diagram Diagram showing how clouds form.

Write this title underneath your drawing and fill in the missing word.


Sparks flying from the top of a bonfire and floating upwards
and steam rising are two examples of the rule that warm air
On a warm sunny day the sun heats the ground which in turn warms the layer of air above it.

**Layer of Warm Air**

The warm air rises.

On sunny days the hot ground warms up the layer of air above it. "Bubbles" of warm air form and rise, often at speeds of one or two yards per second.

Although the air is warm to begin with as it rises it expands and its temperature falls.

When the temperature of the expanding air falls the saturation point is lower and water vapour condenses onto dust particles.

When the water vapour in the expanded air condenses we see heaped up clouds.

When warm air rises and cools and water vapour condenses CUMULUS and CUMULOC-NIMBUS clouds are formed.

The warm air rises and cool air takes its place.

Copy this diagram on your copy, label the arrows Cool Air or Warm Air.
30. Show me your diagram.

31. **DIAGRAM SHOWING HOW_____ AND _____ CLOUDS FORM.**

Write this title underneath your diagram and fill in the missing words.

31. CUMULUS
CUMULONIMBUS

32. On a dull day when no sun appears, the sky is covered with a sheet of _____ cloud.

32. stratus

33. On fine days, the sun warms the ground and fluffy piled up _____ clouds may form.

33. Cumulus

34. Go on to the next sheet.
HOW RAINDROPS FORM
1. Clouds are made of very small light droplets of ________ and tiny crystals of ________.

| 1. water ice | 2. The only clouds which have just crystals of ice and no droplets of water are ________ clouds. |

2. **CIRRUS**

| 2. CIRRUS | 3. The other clouds can have both droplets of water and crystals of ice depending on the height and temperature of the cloud. The water droplets and ice crystals do not fall to the ground because they are very ________. |

3. small light etc.

| 3. small light etc. | 4. Raindrops fall to the ground so they must be (lighter/heavier) than the cloud water droplets. |

4. heavier

| 4. heavier | 5. You have probably noticed that Cumulus clouds gradually change shape; you can watch this happening if you have time. Clouds change shape because the air and water droplets inside them are moving all the time. When cloud water droplets collide they join and make a (bigger/smaller) droplet. |

5. bigger

| 5. bigger | 6. As these bigger droplets float about they bump into and join with other cloud water droplets. When these bigger droplets are too heavy to float they will ________ to the ground. |
6. Fall

7. When the bigger droplets are too heavy to float they fall to the ground as ________.

8. Rain

8. Here is another way in which raindrops can be formed; the top of a cloud may be very high and very cold. Instead of water droplets the top of the cloud will be made up of ________ ________.

9. Ice crystals

9. The ice crystals may get too big to float or they may be blown towards the bottom of the cloud. When they reach a part of the cloud where the temperature is above freezing point the ice crystals will m ________.

10. Melt

10. When the ice crystals melt they may bump into and join the cloud water droplets until they are too ________ to float.

11. Heavy

11. When the ice crystals which have melted make drops that are too heavy to float the drops fall to the ground as ________.

12. Some of the rain that falls is collected in a RAIN GAUGE (GAUGE rhymes with RAGE)

A rain gauge is used to ________ rain.
12. collect
    measure
c. etc.

13. Every day the rain water collected in the jar is measured.

The rain water is collected in a rain gauge.

14. The rain gauge might be placed so that it is sheltered by buildings or dripped on by trees. Will it still measure the amount of rain fall properly.

15. No
    It would collect too little or too much rain.
    To work properly a rain gauge must be not by
    be dripped on or sheltered.

16. If you have two containers outside, they will both collect rain
    (An empty tin, an old saucepan or two glass jars will do, any two containers with straight lines.
    You can measure the depth of water with a ruler or with two sticks. If you measure the wetted part of the sticks with a ruler you can find the depth of rain water.
    You will find that even if the containers are different sizes they will both collect the depth of rain water.

17. The two containers collect the same depth (but not the same total amount) of water, because rain falls at the same rate into both containers.
    It may take a month for an inch of rain to fall so we measure the depth of rain that falls each day in hundredths of an inch.
Every day the rain in the jar of the rain gauge is poured into a glass measuring cylinder like the one in the diagram.

The cylinder is marked in $\frac{1}{100}$ths of an inch.

If the cylinder is filled to the second mark it holds $\frac{2}{100}$ths of an inch of rain.

The person who measures the depth of rain fall writes down the figure each day. The rain is collected for measuring in a rain gauge.

The person who has been writing down the rainfall figure for each day adds up these figures at the end of each month. The total of all the daily figures gives the amount of rain which has fallen during the month.

Let us suppose that last year ANYTOWN had 5" of rain in July, 3" of rain in August and $3\frac{1}{4}$" in September.

In which of these three months would you choose to go to Anytown on your Summer Holidays this year?

August is the driest month.

Would you expect Anytown to get the same amount of rain in July, August and September this year as fell last year?

No.

As you would expect there is a different amount of rain in the same months in different year. Let's work out the average rainfall for July August and September for Anytown using the rainfall figures for the last 3 years.

<table>
<thead>
<tr>
<th></th>
<th>July</th>
<th>August</th>
<th>September</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last year</td>
<td>5&quot;</td>
<td>3&quot;</td>
<td>$3\frac{1}{2}$&quot;</td>
</tr>
<tr>
<td>Year before last</td>
<td>$2\frac{1}{2}$&quot;</td>
<td>4&quot;</td>
<td>$3\frac{1}{2}$&quot;</td>
</tr>
<tr>
<td>Year before that</td>
<td>$1\frac{1}{2}$&quot;</td>
<td>$3\frac{10}{12}$&quot;</td>
<td>3&quot;</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>3&quot;</td>
<td>$3\frac{1}{2}$&quot;</td>
</tr>
</tbody>
</table>
23. Cont.... Work out the average rainfall for July and September.

24. July 3"
September 3½"

24. Now you know the average figure, which of these months would you choose to go to Anytown for a holiday?

25. July

25. All sorts of people use the published rainfall figures?
Holiday makers use them to choose when and where to go, and farmers use them to decide what crops to grow and when to plant them and harvest them.
If we add up the twelve monthly rainfall totals we get the amount of rainfall in the y_______.

26. year

26. If we add up the annual rainfall for a number of years and find the average we would have the average _________ rainfall.

26. annual

27. The average annual rainfall for the British Isles is 26.06 inches.
A figure like 26.06" is used for comparing the average rainfall of the British Isles with the rainfall of other countries.
Farmers and others who use the rainfall figures find it more useful to know the average rainfall for each of the twelve _______s instead of the average total for the year.

27. months

28. On frame 23 you worked out the average rainfall for 3 months over the last 3 years. If you worked out the average for each month over a number of years you would get a set of twelve figures like these figures for PLYMOUTH.

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC
4.3 3.1 2.7 2.1 2.4 2.0 2.6 2.9 2.9 3.3 4.5 4.5
These figures give the a ______ m ______ rainfall for PLYMOUTH.
Another way to show the average monthly rainfall is to make a graph like this.

**BUXTON.**


This makes it easy to see which months are drier and which are wetter.

Which are the months with the lowest average rainfall?

March
May

Average rainfall can be shown as a set of 12 figures or as a graph.

Both methods give the _______ monthly rainfall.
OROGRAPHIC RAIN
1. Before you can answer the next few questions you must know the 4 main points of the compass. Which of these diagrams is correct?

If you choose this diagram go to Frame 5

If you choose this diagram go to Frame 2.

2. Sorry, but you have got East and West back to front.
   My way of remembering which way round they go is to say that Wales is to West.
   Now make a copy of this diagram and fill in the letters for the points of the compass.

3. Another way is to spell WEST and put the arrow for North inside the word like this.

4. Look at Map 1 on the Panel.
   At the side of the map are the average rainfall graphs for the towns marked.
   Which coast of Britain has most rain East or West?
   Go to Frame 6

5. Look at the map 1 on the panel.
   At the side of the map are the average rainfall graphs for the towns marked.
   Which coast of Britain has more rainfall East or West?

6. Now look at Map 2 which shows the areas of high and low land.
   On which coast is the highest land East or West?
Map 3 shows that the areas with the most rain are in the 
(East/West).

Both the heaviest rainfall and the highest land are in the

You will remember that one way in which rain is produced
is when air __________ over hills and mountains.

The wind often blows from the West.
When the wind comes from the west it is moist because it has
blown over the __________

When the moist westerly wind blows over the mountains and high
ground on the west of Britain the air rises, expands and its temperature
__________.

When the air temperature falls the water vapour in the moist air condense
into particles of dust in the air and a sheet of cloud forms.

What is the name for a sheet of clouds?
| 12. Stratus | 13. As the air continues to rise more condensation takes place, raindrops form and rain falls over the hills and m_________. |
| 13. mountains | 14. Rain falls over mountains because air is blown over them and forced to rise. The Greek word for mountains is OROS. Rain caused by moist air rising over mountains is called OROGRAPHIC rain. Which three letters in OROGRAPHIC mean mountains? **Oro**. |
| 14. ORO | 15. Orographic rain comes from clouds formed when air rises over mountains. Stratus cloud forms in this way so most orographic rain comes from _______——_______ clouds. |
| 15. nimbo-stratus | 16. The west coast of Britain has the highest rainfall. Much of this rain is caused by air rising over the mountains and is called o_________phic rain. |
| 16. orographic | 17. The west coast of Britain has the highest land and has a lot of ________ rain. |
| 17. orographic | 18. RAIN SHADOW. When the wind blows from the sea onto the west coast of Britain is it dry or moist? |
18. Is the mountain slope facing the wind called the **WINDWARD** or the **LEEWARD** slope?

A - Windward - Go to frame 23.
B - Leeward - Go to frame 20.

19. You say the slope facing the wind is called the Leeward slope, but LEE means shelter so the leeward slope is the sheltered slope. The leeward slope is opposite the windward slope.

20. Copy the diagram below.
The wind has changed direction so be careful when you label the slopes.

21. Which side of the mountain would be sheltered from the wind?

22. leeward

23. Which side does the wind blow onto windward or leeward?

24. The moist westerly wind often blows onto the west coast of Britain.

Orographic rain falls over the mountains and high lands. When the wind reaches the low-land on the leeward side is it moister or dryer?
The town likely to have most rain is Town ___.

Which town is in the Rain Shadow?

Town B is in the R S of the mountains.

Look at the graphs on Map 1.

If you travel from Fort William through BUXTON and BIRMINGHAM to YARMOUTH each town is further east than the one before. The graphs show that the more easterly the town the ________ rain falls.

Look at the rainfall graphs on Map 1 and the areas of high land on Map 2.

The wind often comes from the west, so which two of the towns on the map are on the windward side of high land?

Fort William Buxton.

Which 2 towns have the lower rainfall?
30. Birmingham and Yarmouth.

31. Birmingham and Yarmouth have low rainfall because they are on the leeward side of the high land in the __________.

32. Rain Shadow

Which graph belongs to which town?

33. Town B is in the __________

34. GO TO THE NEXT SHEET.
CONVECTIONAL
RAIN
<table>
<thead>
<tr>
<th>1. OROGRAPHIC rain comes from Nimbo-Stratus clouds so it is usually steady continuous rain or drizzle. We get sudden heavy showers of rain from _______ clouds.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. You know that cumulus clouds form when air is warmed by the ground and rises in &quot;Bubbles&quot;. Cumulus clouds only form when the sun _______ the ground.</td>
</tr>
<tr>
<td>3. CONVECTION</td>
</tr>
<tr>
<td>4. Only when the sun heats the ground are Cumulus and Cumulo-Nimbus clouds formed and c _______ currents set up.</td>
</tr>
<tr>
<td>5. Cumulus and Cumulo-Nimbus clouds are most likely to form in the (hottest/coldest) part of the country.</td>
</tr>
<tr>
<td>6. Look at Map 4, which shows the average temperatures in July. Which part of the country is the hottest?</td>
</tr>
<tr>
<td>2. heats</td>
</tr>
<tr>
<td>warsms etc.</td>
</tr>
<tr>
<td>3. When bubbles of warm air rises, cool air falls to take its place.</td>
</tr>
<tr>
<td>These air movements are called CONVECTION CURRENTS. Both Cumulus and Cumulo-Nimbus set up c _______ Currents</td>
</tr>
<tr>
<td>4. CONVECTION</td>
</tr>
<tr>
<td>5. hottest</td>
</tr>
</tbody>
</table>
6. South or (South East)

7. Very large, towering Cumulo-Nimbus clouds are called thunder clouds.

Which part of the country is likely to get most thunder clouds the north or the south?

8. Cumulus and Cumulo-Nimbus clouds set up convection currents. Rain that falls from Cumulo-Nimbus clouds is called convectional rain.

9. Thunder clouds are very large cumulo-nimbus clouds. When there is a thunderstorm the very heavy rain is convectional rain.

10. Where is most of the convectional rain likely to fall?

11. The south has more thunderstorms and convectional rain than the rest of the country.

12. The south has more thunderstorms and convectional rain because in summer its temperature is higher than that of the rest of the country.
13. Since thunderclouds are very big cumulo-nimbus clouds we get downpours of heavy rain from them. What is the name for rain from cumulo-nimbus clouds?

13. Convectional Rain.

14. We get heavy rain from thunderclouds and we may get ice in the form of ________ stones too.

14. hail

15. The top of a thundercloud can be as much as 5 miles high and is very cold. The top of the cloud is very cold and is not made of tiny droplets of water, but tiny crystals of ________.

15. ice

16. You know that clouds change shape because air is moving inside them. In thunderclouds the rising air is called an up draught. The up draught of air is strong enough to carry large cloud water droplets up to the ________ of the cloud.

16. top

17. It is so cold at the top of the cloud that the water droplets freeze ________.

17. freeze

18. As these frozen droplets fall back to the warmer parts of the cloud they collect a coating of tiny droplets of ________.
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>18. Water</td>
<td>19. What happens to the frozen drops with their thin coating of water when they meet the strong updraught of air again?</td>
</tr>
<tr>
<td>19. They are blown upward</td>
<td>20. At the top of the cloud it is very cold and the coating of water around the frozen drops also freezes.</td>
</tr>
<tr>
<td>20. Freezes</td>
<td>21. Every time the frozen drops fall and are carried back up to the top of the cloud they collect a layer of ice.</td>
</tr>
<tr>
<td>21. Ice</td>
<td>22. Each time the frozen drops fall and are carried to the top of the cloud they collect another layer of ice, and each time they collect a layer of ice they get bigger and heavier.</td>
</tr>
<tr>
<td>22. Heavier</td>
<td>23. A hail stone is made up of layers of ice. If you were able to cut one in half it would look like this. It resembles an onion cut in half but the layers are too small to be clearly seen.</td>
</tr>
<tr>
<td></td>
<td>24. The bigger hailstones that have fallen in Britain weighed 5 oz. In America hailstones the size of a tennis ball and occasionally the size of a grapefruit have been reported. One 6th July 1928 large hailstones fell in Nebraska (U.S.A.) one of these was seventeen inches in circumference and weighed 1 ½ lbs. What are hailstones made of?</td>
</tr>
</tbody>
</table>
24. layers of ice

25. When hailstones are too heavy to be blown upwards by the updraught they start to ________ downwards.

25. fall drop

26. When hailstones fall to the ground we say there is a ________ storm.

26. hail storm

26. hail storm

27. Thunderclouds give ________ as well as hailstone.

27. rain

28. Cumulo

29. Which area of England is more likely to have sudden downpours of rain or hail North or South?

28. Cumulo Nimbus

29. South.
RAINFALL IN BRITAIN

NOTE: In some questions only one word is needed for the answer, but other questions need a few words to the answer.

1. The gas formed from water is called ......................................
2. When water changes to a gas we say it .................................
3. When air has absorbed all the moisture it can hold we say it has reached ........................................
4. When warm moist air is cooled it's is lowered and some of the water vapour in the air ..................
5. When the gas formed from water changes back to water we say it ........................................
6. Clouds are formed when warm moist air ....................
7. Clouds are made up of .................. or ..................
8. .................................................................

(a) Name these three clouds shown above.
(b) The cloud in diagram .............. gives heavy showers of rain.
(c) The cloud in diagram .............. gives steady rain or drizzle.
(d) The cloud in diagram .............. gives no rain at all because it is ..................
(e) The cloud in diagram .............. gives both rain and hail.
(f) In the spaces below draw a diagram to show how the clouds in Diagram 1 and Diagram 2 are formed.

DIAGRAM 1.  

DIAGRAM 2.  

.................................................................
.................................................................