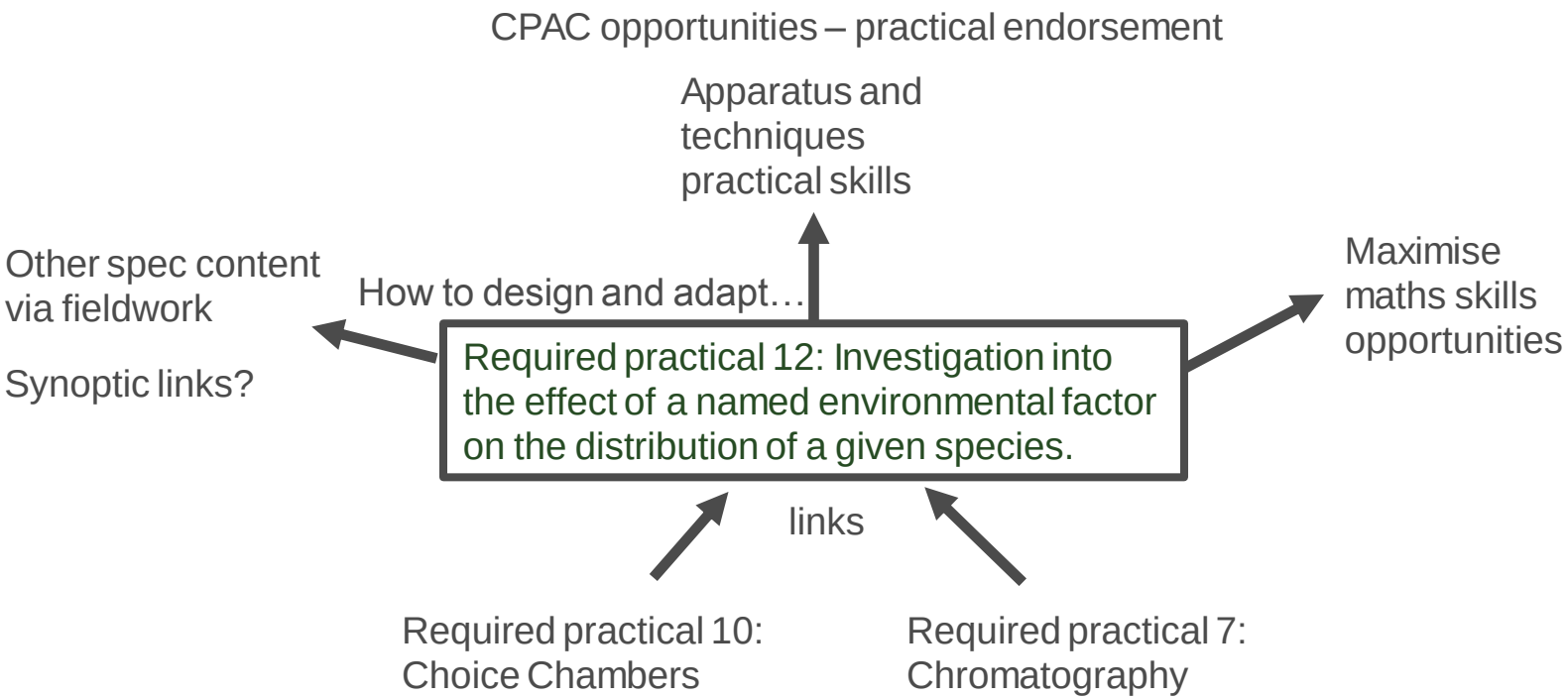
A-level Biology: Fieldwork and beyond

Mark Ward
Field Studies Council

FSC
BRINGING ENVIRONMENTAL UNDERSTANDING TO ALL

Aims



Also Field Studies Council aspirations…

- Environmental awareness
- Benefits of outdoor learning
- 'Real science'?

My challenge:

Use RP 12 as an example to show you how you can design a rich, synoptic learning experience (even using limited habitats at or near your school).

AQA

Requirements

Required practical 12: Investigation into the effect of a named environmental factor on the distribution of a given species.

Apparatus and techniques covered (not full statements).

a. use appropriate apparatus to record a range of quantitative measurements
b. use appropriate instrumentation to record quantitative measurements
h. safely and ethically use organisms to measure: plant or animal distribution
k. use sampling techniques in fieldwork
l. use ICT such as data logger to collect data or use software to process data

Indicative apparatus: tape measures, random number tables, species identification chart, quadrats (could use point quadrat).

Amount of choice in RP12

Increasing independence →			
Least choice	**Some choice**	**Many choices**	**Full investigation**
• Teacher chooses the species and the environmental factor to be investigated. • Students use random sampling to investigate the distribution of the species. • Experiments fully specified in terms of equipment and method.	• Teacher allows a limited choice of environmental factors. • Students use random sampling to investigate the distribution of the species. • Experiment probably fully specified by teacher.	• Teacher allows a choice of species and environmental factors. • Students use random sampling to investigate the distribution of the species. • Outline method provided by teacher.	• Student decides on a question. • Student researches methods for carrying out the experiment then chooses equipment, materials, justifying all choices.

Opportunities to observe and assess different practical competencies for CPAC (see practical handbook)

RP12 suggested activity

Investigation into distribution of dandelions in a lawn not treated with herbicide and a lawn treated with herbicide using a point quadrat.

See practical handbook.

Method from student sheet

You are provided with the following:

- point frame (also called a point quadrat or pin frame)
- two tape measures.

You should read these instructions carefully before you start work

1. Before going to the lawn, generate 10 sets of random co-ordinates.
2. Go to the lawn where one site is an herbicide-treated lawn and the other an untreated lawn (your teacher will tell you which area is treated). Make sure you can identify a dandelion plant by the shape of its leaves.
3. Lay out the tapes at right angles and place the point quadrat at the first set of co-ordinates.

Method from student sheet

4. Use the pointers in the point frame to record the dandelions at this position. Look at the plants hit by the points and attempt to identify them. As each pointer is lowered, you must record any dandelion that is "hit" by the pointer, in the tally chart. Repeat this at the position determined by each set of co-ordinates.
5. Take 100 pointer samples in each site, ie 10 placements of the point quadrat.
6. Carry out the data collection from the two sites. Then add up the total number of dandelion plants in each of the two sites.

$$\%\ cover\ of\ dandelions = \left(\frac{no.of\ dandelion\ plants\ hit}{total\ no.of\ pointersamples}\right) x\ 100$$

For each of the stages of the suggested method how can we improve or modify the procedure to cover as many skills as possible?

Stage 1

1. Before going to the lawn, generate 10 sets of random co-ordinates.

Ideas to improve or modify?

- Random number tables.
- Use random number button on calculator.
- Use =randbetween(1,99) on spreadsheet.
- Use phone numbers (middle two digits).

What happens if two co-ordinates are the same?

Also discuss:

- Different numbers of co-ordinates/sample size?
- How can we estimate minimum sample size?

Cumulative mean method – estimating minimum sample size

Quadrat no.	Hits on dandelion	Cumulative total	Cumulative mean (1 d.p)
1	10		

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Cumulative mean method – estimating minimum sample size

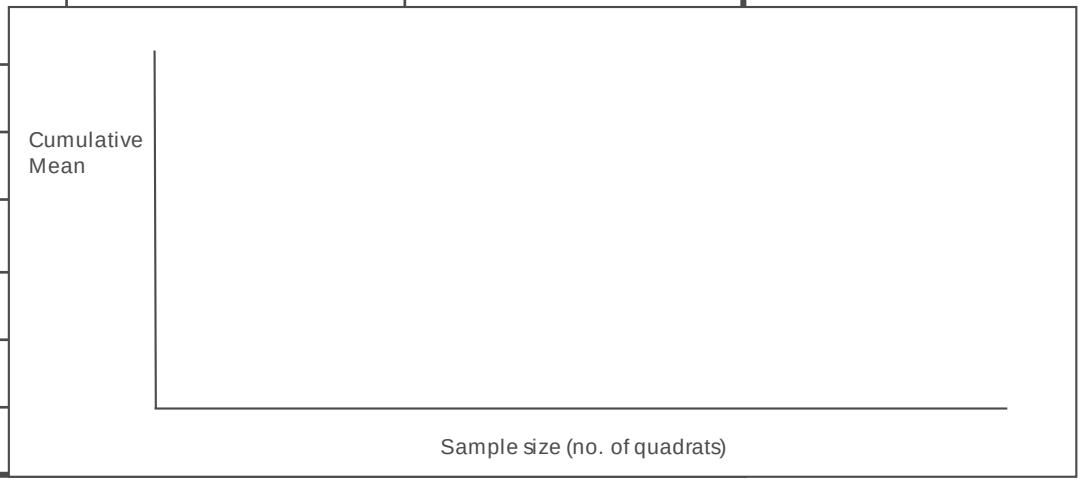
Quadrat no.	Hits on dandelion	Cumulative total	Cumulative mean (1 d.p)
1	10	10	

Cumulative mean method – estimating minimum sample size

Quadrat no.	Hits on dandelion	Cumulative total	Cumulative mean (1 d.p)
1	10	10	10.0

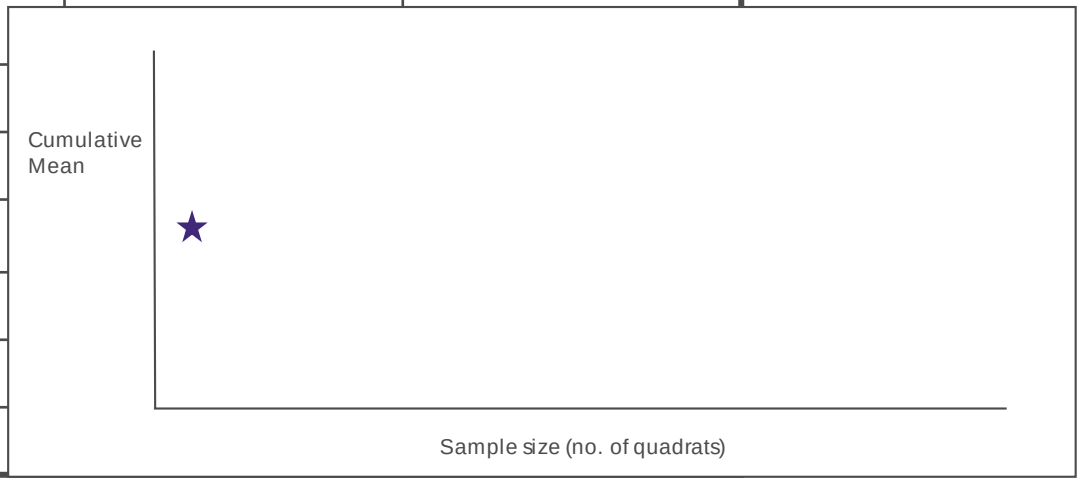
Cumulative mean method – estimating minimum sample size

Quadrat no.	Hits on dandelion	Cumulative total	Cumulative mean (1 d.p)
1	10	10	10.0



Cumulative mean method – estimating minimum sample size

Quadrat no.	Hits on dandelion	Cumulative total	Cumulative mean (1 d.p)
1	10	10	10.0



Cumulative mean method – estimating minimum sample size

Quadrat no.	Hits on dandelion	Cumulative total	Cumulative mean (1 d.p)
1	10	10	10.0
2	20		

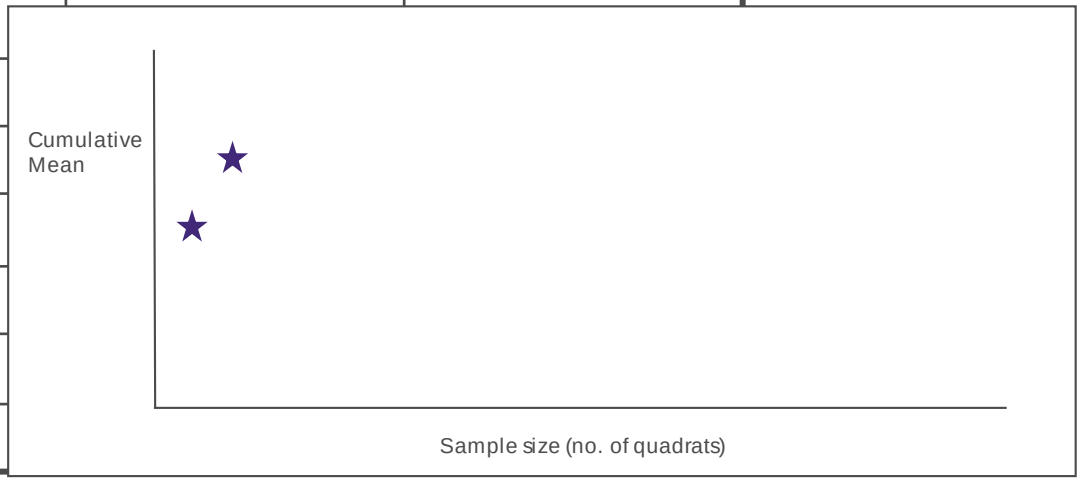
AQA

Cumulative mean method – estimating minimum sample size

Quadrat no.	Hits on dandelion	Cumulative total	Cumulative mean (1 d.p)
1	10	10	10.0
2	20	30	

Cumulative mean method – estimating minimum sample size

Quadrat no.	Hits on dandelion	Cumulative total	Cumulative mean (1 d.p)
1	10	10	10.0
2	20	30	15.0



Cumulative mean method – estimating minimum sample size

Quadrat no.	Hits on dandelion	Cumulative total	Cumulative mean (1 d.p)
1	10	10	10.0
2	20	30	15.0
3	30	60	

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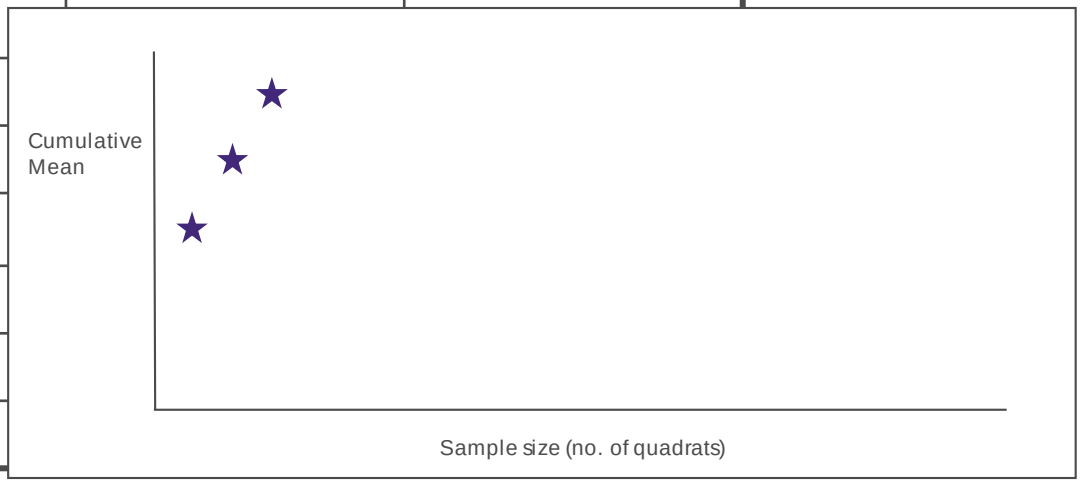
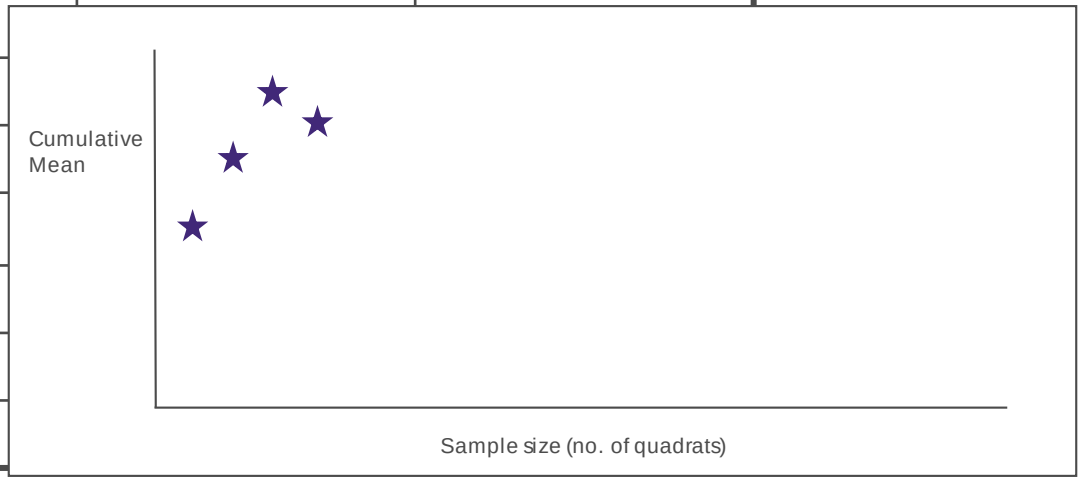
Cumulative mean method – estimating minimum sample size

Quadrat no.	Hits on dandelion	Cumulative total	Cumulative mean (1 d.p)
1	10	10	10.0
2	20	30	15.0
3	30	60	20.0



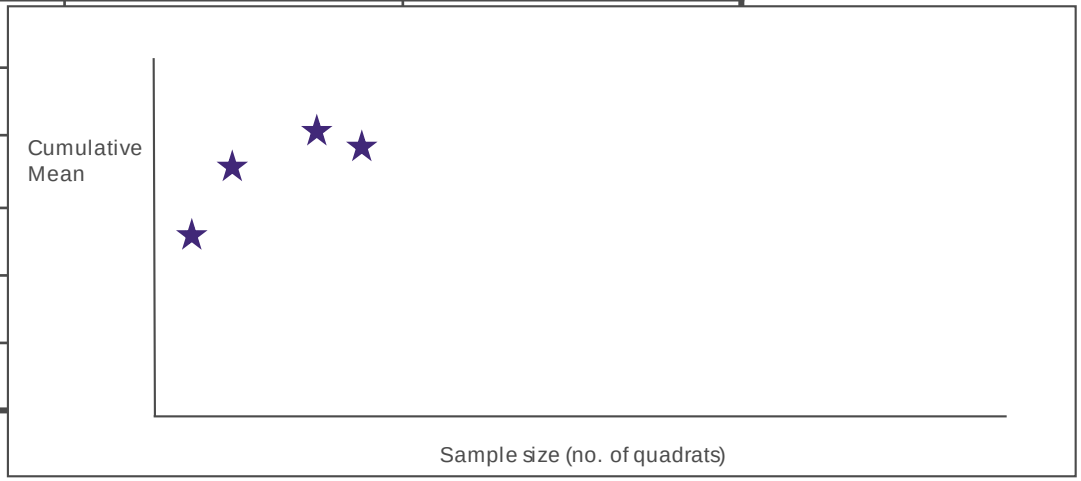
Cumulative mean method – estimating minimum sample size

Quadrat no.	Hits on dandelion	Cumulative total	Cumulative mean (1 d.p)
1	10	10	10.0
2	20	30	15.0
3	30	60	20.0
4	10	70	17.5



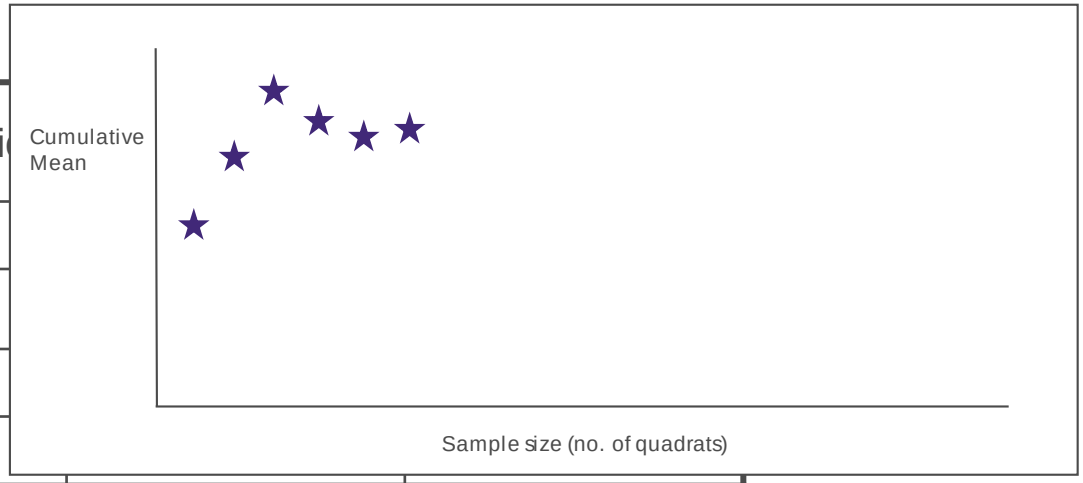
Cumulative mean method – estimating minimum sample size

Quadrat no.	Hits on dandelion	Cumulative total	Cumulative mean (1 d.p)
1	10	10	10.0
2	20	30	15.0
3	30	60	20.0
4	10	70	17.5
5	10	80	16.0



Cumulative mean method – estimating minimum sample size

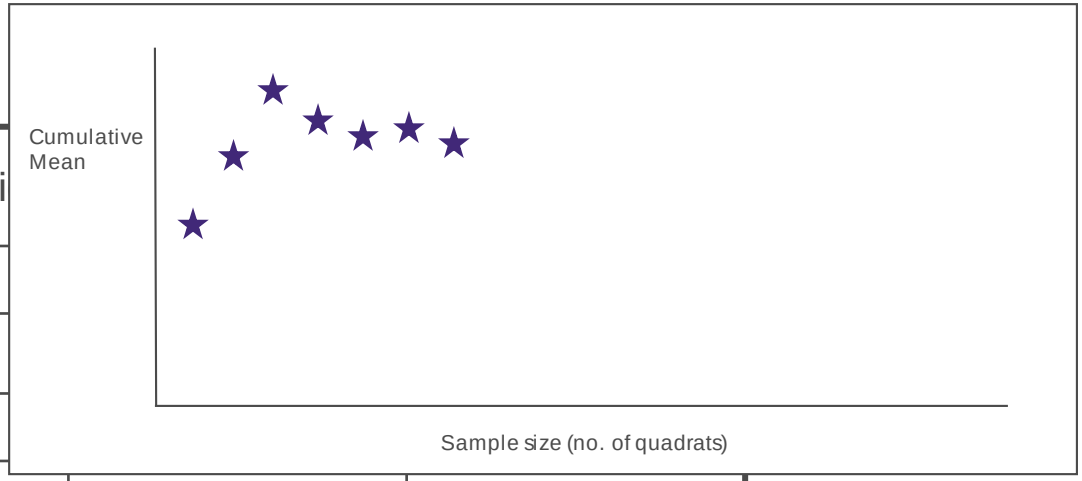
Quadrat no.	Hits on dandeli		
1	10		
2	20		
3	30		
4	10		
5	10	80	16.0
6	20	100	16.7



AQA

Cumulative mean method – estimating minimum sample size

Quadrat no.	Hits on dandeli		
1	10		
2	20		
3	30		
4	10	70	17.5
5	10	80	16.0
6	20	100	16.7
7	8	108	15.4



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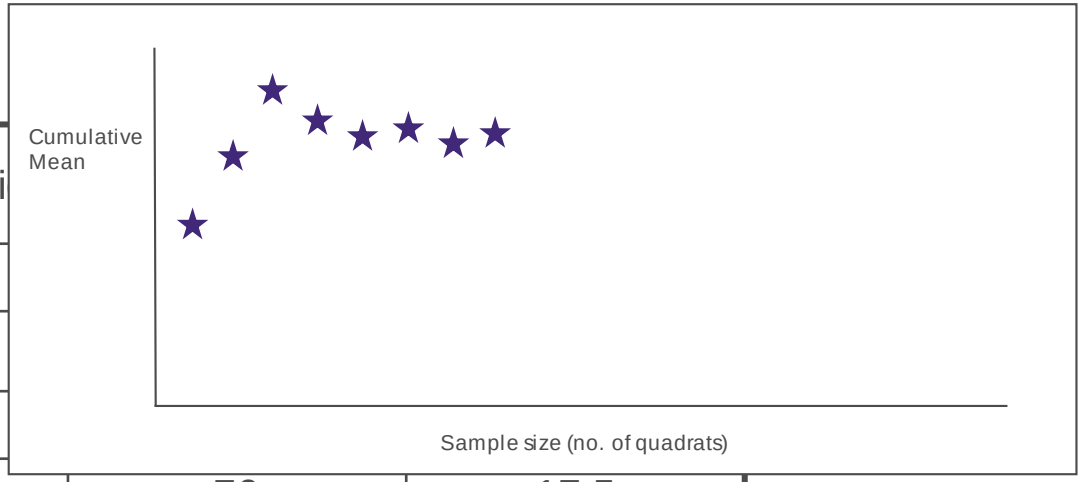
Cumulative mean method – estimating minimum sample size

Quadrat no.	Hits on dandeli		
1	10		
2	20		
3	30		
4	10	70	17.5
5	10	80	16.0
6	20	100	16.7
7	8	108	15.4
8	23	131	16.4

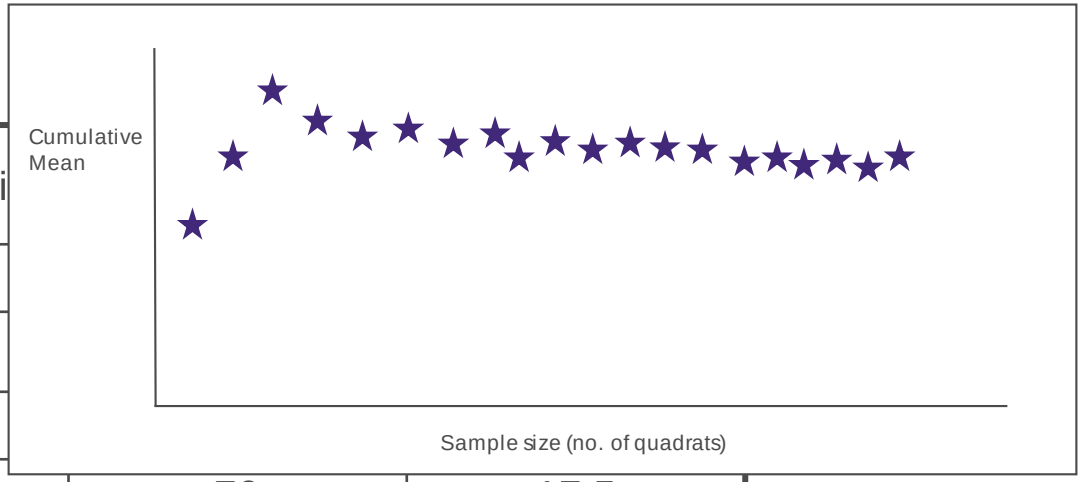


Cumulative mean method – estimating minimum sample size

Quadrat no.	Hits on dandeli		
1	10		
2	20		
3	30		
4	10	70	17.5
5	10	80	16.0
6	20	100	16.7
7	8	108	15.4
8	23	131	16.4
etc			
etc			
etc			

Cumulative mean method – estimating minimum sample size

Quadrat no.	Hits on dandeli		
1	10		
2	20		
3	30		
4	10	70	17.5
5	10	80	16.0
6	20	100	16.7
7	8	108	15.4
8	23	131	16.4
etc			
etc			
20	14	330	16.5



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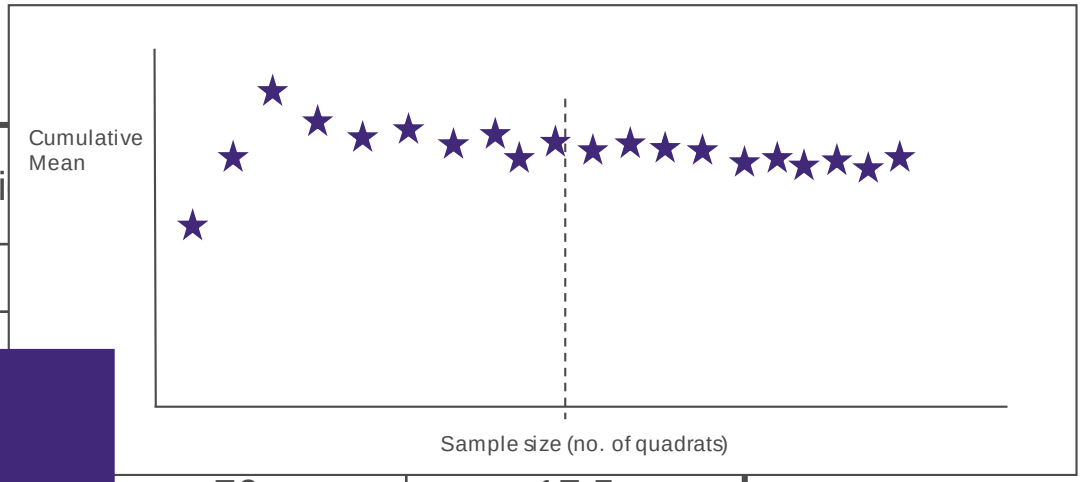
Cumulative mean method – estimating minimum sample size

Quadrat no.	Hits on dandeli		
1	10		
		70	17.5
		80	16.0
		100	16.7
		108	15.4
8	23	131	16.4
etc			
etc			
20	14		



Also Note:

Maths skills covered
- MS 0.2 (appropriate no. of d.p.s)
- MS 0.4 (estimate results…)
- MS 1.2 (arithmetic means)
- MS 1.3 (construct, interpret graphs)

When cumulative mean stabilises no need to put down further quadrats?

eg minimum no. of quadrats = 10?

AQA

Stage 2

2. Go to the lawn where one site is an herbicide-treated lawn and the other an untreated lawn (your teacher will tell you which area is treated). Make sure you can identify a dandelion plant by the shape of its leaves.

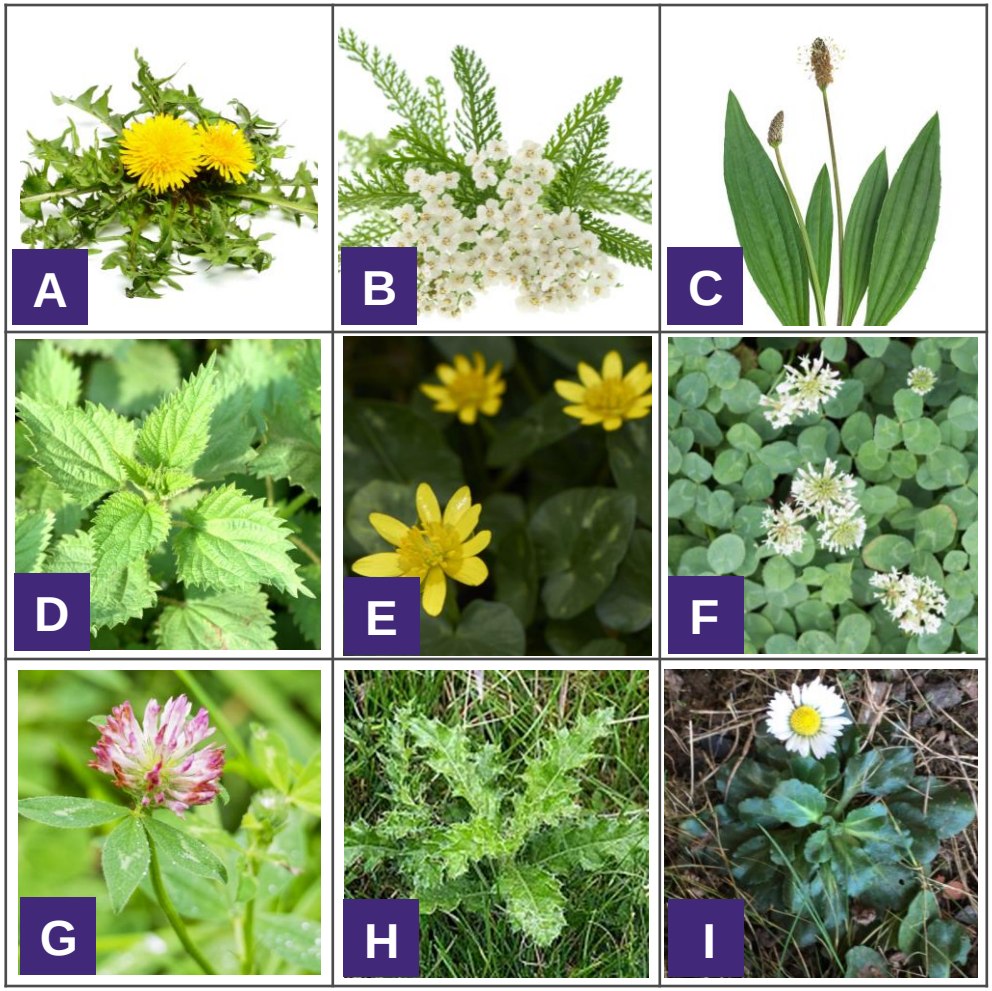
Ideas to improve or modify?

- Different comparisons: light/shade, trampled/untrampled, mown/grazed, tall/short grass, sloping/flat.
- Different plants: yarrow, daisy, clover, thistle, plaintain, lesser celandine, nettle (?) etc. Identification skills.

Task: Identification of playing field plants

Match these plants to the correct letters:

- Lesser Celandine
- Dandelion
- White Clover
- Thistle
- Nettle
- Ribwort Plantain
- Yarrow
- Daisy
- Red Clover.



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Task: Identification of playing field plants

How many did you get?

Other links:

- 3.4.5 Species and taxonomy
- Apparatus and Techniques ‘e’: produce scientific drawing (see Practical Handbook)
- Maths skill MS 0.3 use ratios, fractions and % (inc use scales for measuring = drawing scale lines)

field-studies-council.org/publications/fold-out-charts.aspx#Plants

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Stage 3

3. Lay out the tapes at right angles and place the point quadrat at the first set of co-ordinates.

Ideas to improve or modify?

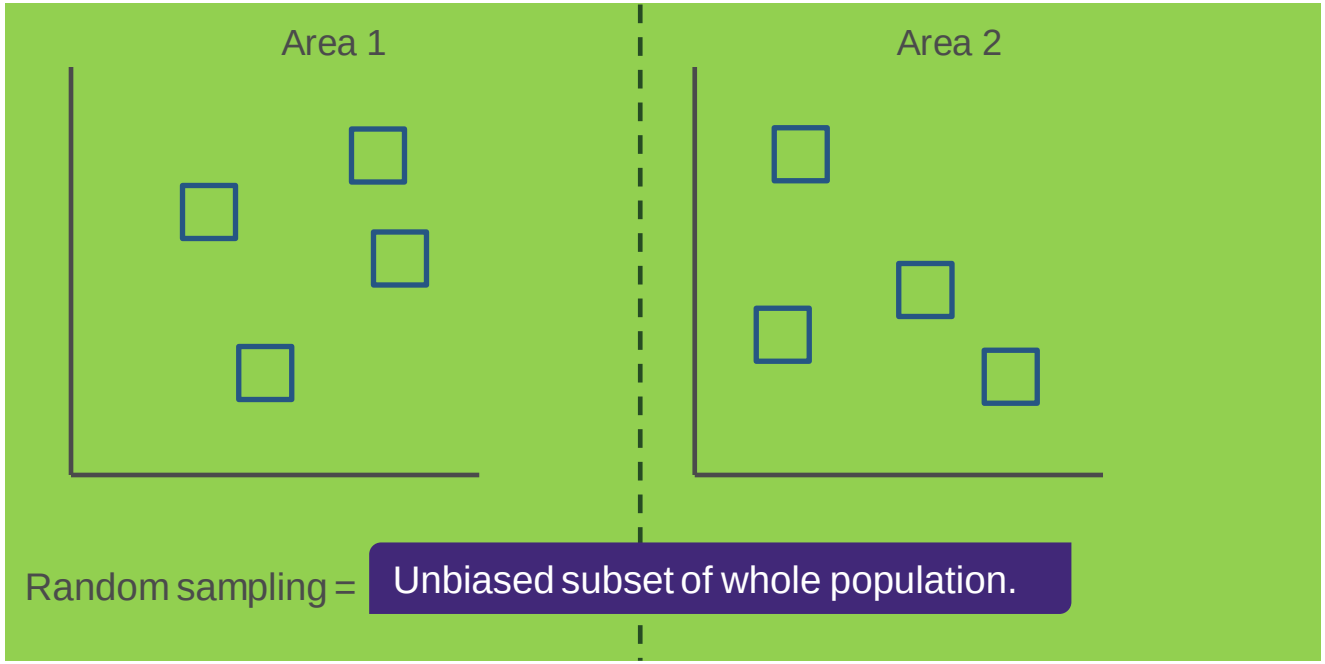
- Use transects – random vs non-random sampling.
- Frame quadrats vs point quadrat (see later).

Question – write a definition for:

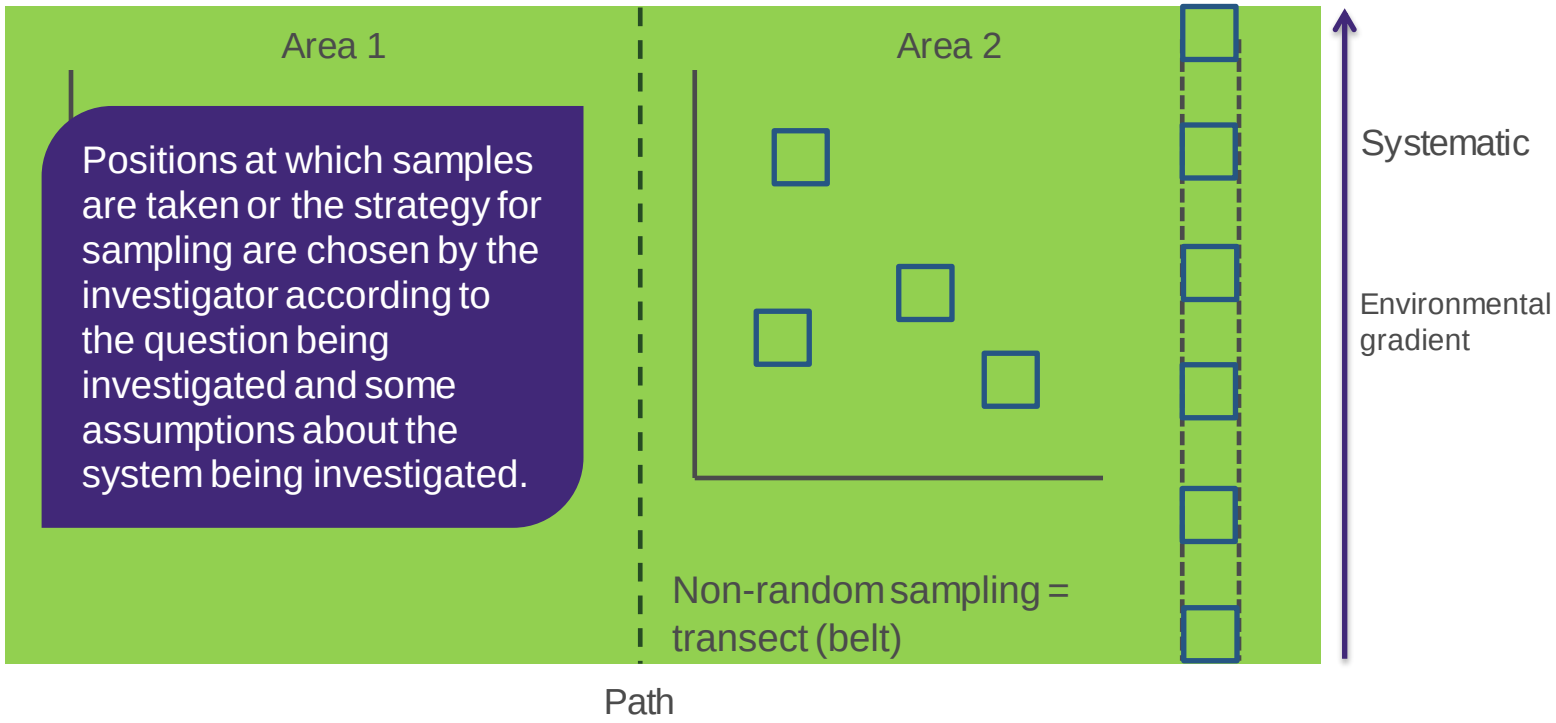
1. random sampling
2. non-random sampling.

Types of sampling

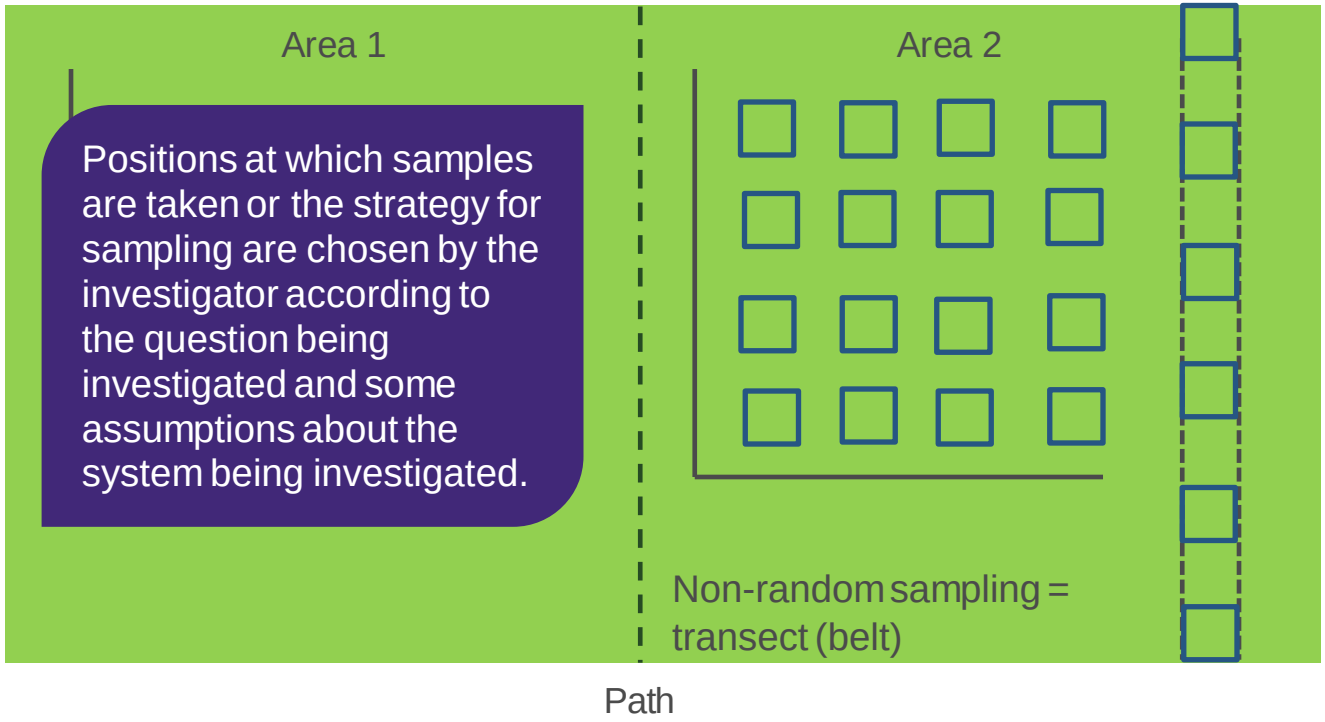
MS 1.5 Understand the principles of sampling as applied to scientific data.



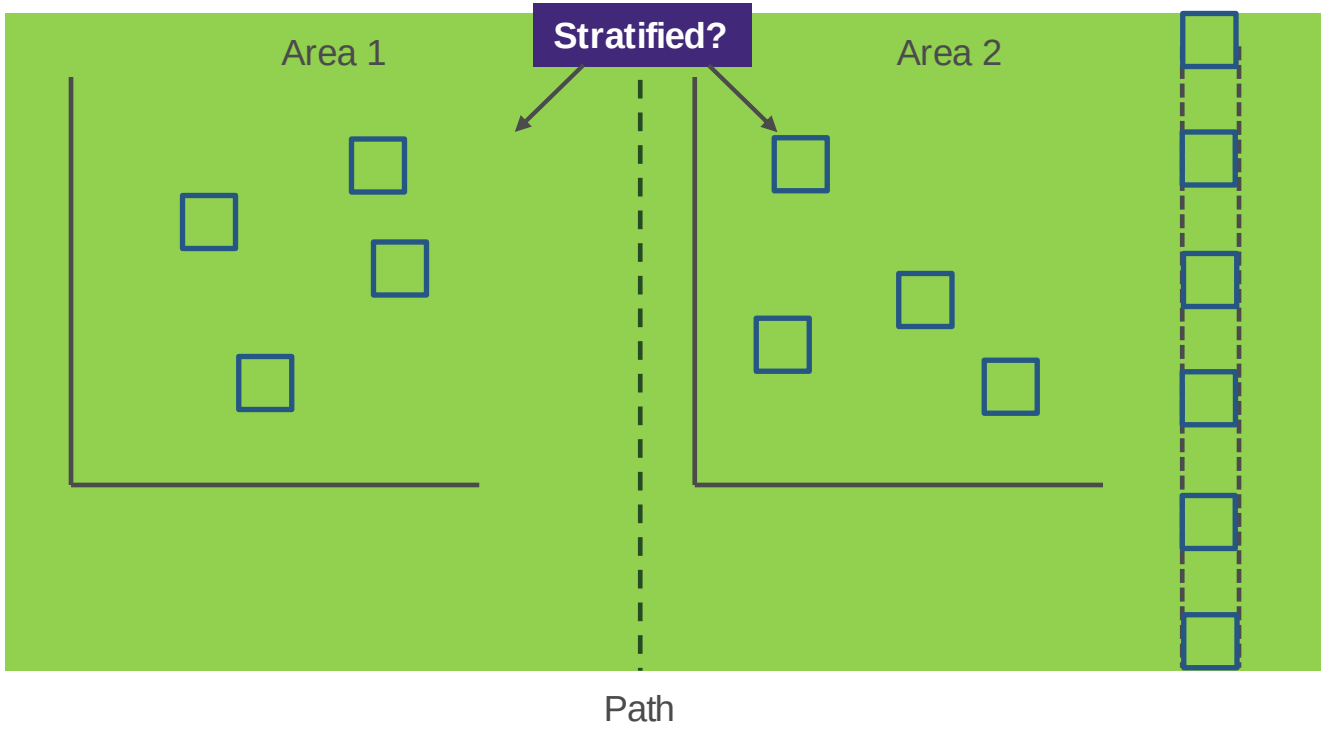
Types of sampling



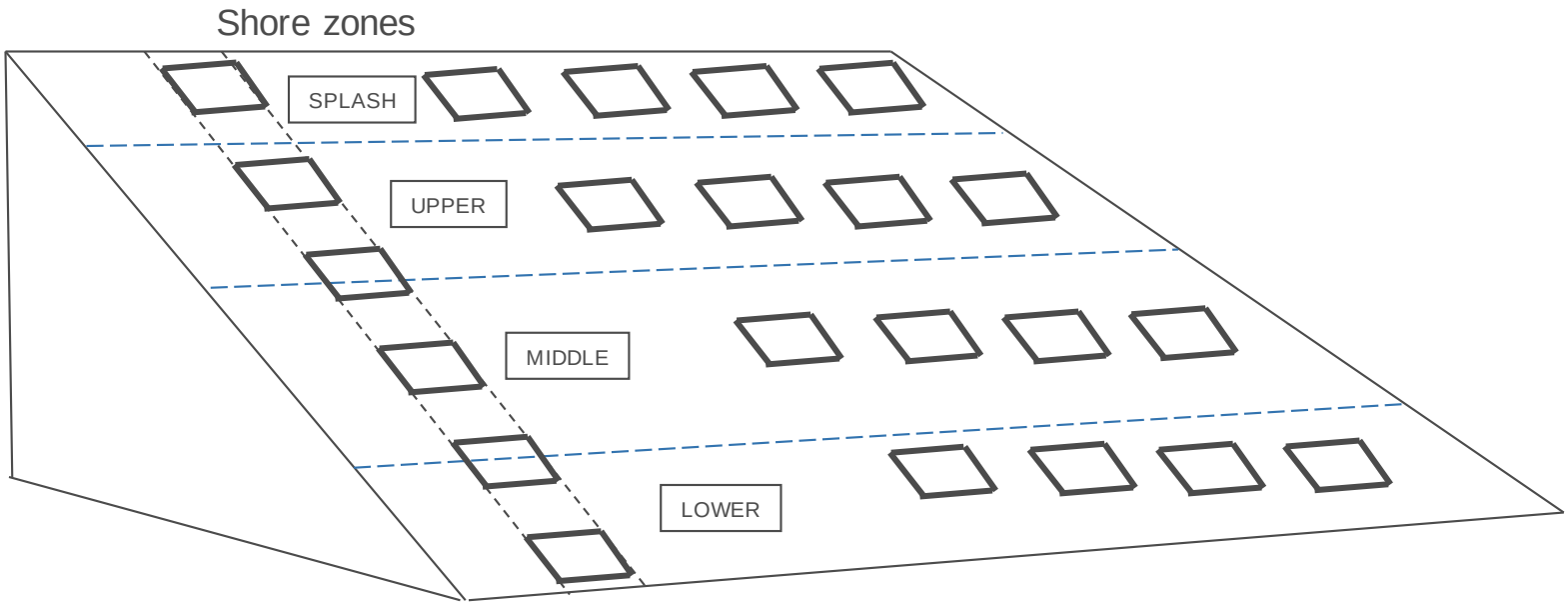
Types of sampling



Types of sampling

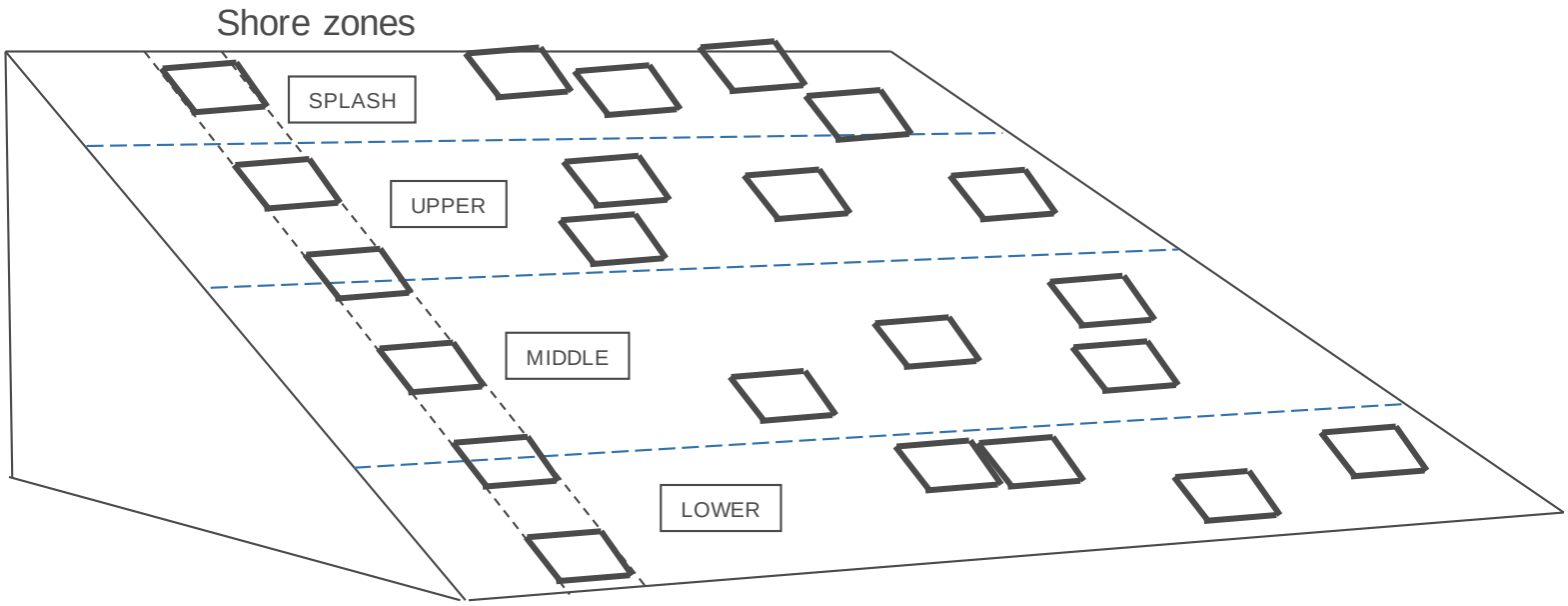


Stratified sampling



Stratified sampling (systematic)

Stratified sampling



Stratified sampling (random)

Stage 4

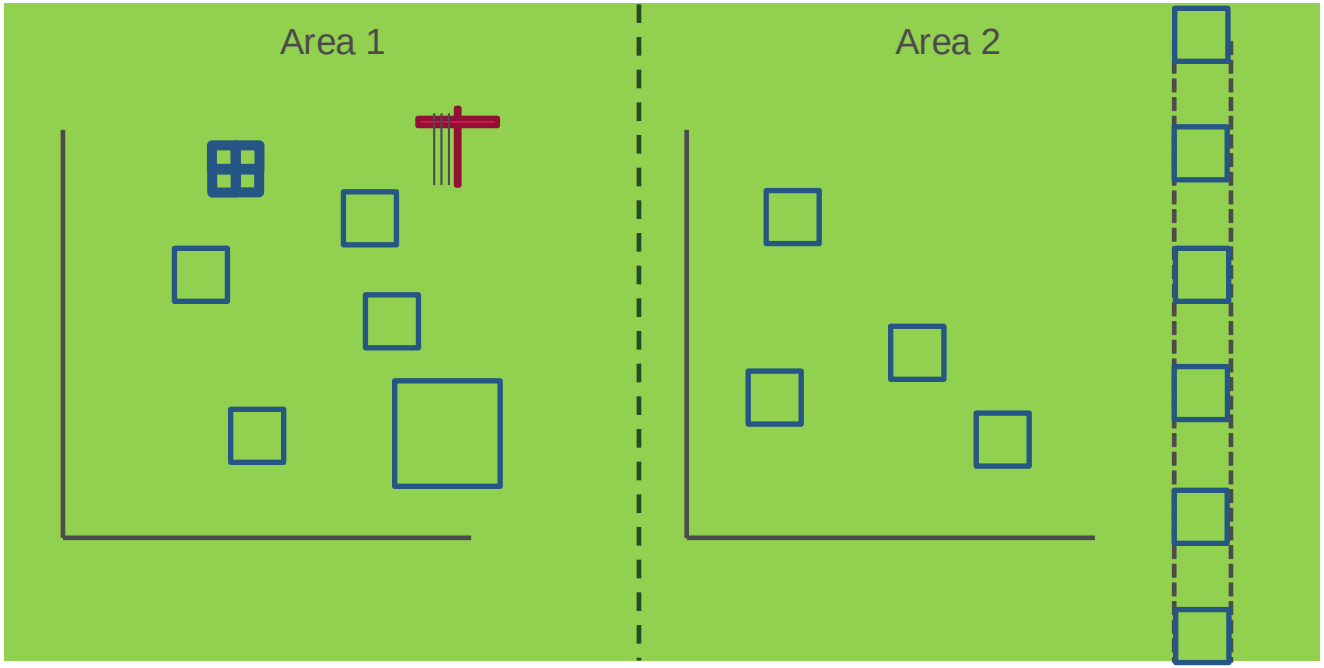
4. Use the pointers in the point frame, record the dandelions at this position.

   Look at the plants hit by the points and attempt to identify them. As each pointer is lowered, you must record any dandelion that is “hit” by the pointer, in the tally chart. Repeat this at the position determined by each set of co-ordinates.

Ideas to improve or modify?

- Frequency or % cover?
- Frame quadrat vs point quadrat.

Choosing quadrat types



Question: what determines 'size' of frame quadrat used?

- Size of organism?
- How common/dispersed/patchy?
- Size of whole sample area?

AQA

Choosing quadrat types

Quadrat sampling game:

Choosing quadrat types

Quadrat sampling game

- Place cardboard shapes randomly on the ground.
- Use different quadrat types in turn to estimate abundance of the cardboard shapes (=plants).
- Complete the results column.
- Consider the advantages and disadvantages of each type of quadrat.

Measurement	Description	Result	Advantages	Disadvantages
Density (open quadrat)	Individuals per unit area (eg count individuals)			
% cover (open quadrat)	Proportion of area covered by a species			
% frequency 1. 100 square gridded frame quadrat 2. Point frame quadrat	Presence/absence of a species at points/in squares	100 square:		
		Point quadrat:		
Relative abundance	Into categories (ACFOR)	Circle... A C F O R		

Choosing quadrat types

List the advantages and disadvantages

Measurement	Description	Result	Advantages	Disadvantages
Density (open quadrat)	Individuals per unit area (eg count individuals)	**7**		
% cover (open quadrat)	Proportion of area covered by a species	**65%**		
% frequency 1. 100 square gridded frame quadrat 2. Point frame quadrat	Presence/absence of a species at points/in squares	100 square: **58**		
		Point quadrat: **38**		
Relative abundance	Into categories (ACFOR)	Circle... A C F O R		

Choosing quadrat types

Calculating area of quadrats

Measurement	Description	Result	Advantages	Disadvantages
Density (open quadrat)	Individuals per unit area (eg count individuals)	**7**	Accurate if all individuals identified.	Difficult to identify 'individual' specimens.
% cover (open quadrat)	Proportion of area covered by a species	**65%**	Quick and easy.	Subjective. Misses underlying vegetation.
% frequency 1. 100 square gridded frame quadrat 2. Point frame quadrat	Presence/absence of a species at points/in squares	100 square: **58**	Objective.	Overestimate (esp. of small species). Time consuming.
		Point quadrat: **38**	Objective: see underlying vegetation.	Time consuming. Pin head small (not representative unless large sample size).
Relative abundance	Into categories (ACFOR)	Circle... A (C) F O R	Quick. Easy comparison of different species/types/ sizes.	Less precise as based on subjective estimates. Can't do stats (semi-quantitative).

AQA

Calculating quadrat areas

MS 0.1 Recognise and make use of appropriate units in calculations

Students may be tested on their ability to convert between units

For example, to calculate area of a 0.5 m by 0.5 m quadrat for ecological analysis:

- could calculate the area of the quadrat in m^2 as $0.5 \times 0.5 = 0.25\ m^2$
- issues can arise if use 1 m = 100 cm to convert this area into centimetres.

Question: What is the area stated as cm^2?

- Misconception can be that if 1 m is 100 cm then $0.25\ m^2$ is $25\ cm^2$.
- **But** 0.5 m = 50 cm so the correct area is $50 \times 50 = 2500\ cm^2$.
- The difference in these answers is a factor of 100 and can lead to massive calculation errors.

Stages 5-6

5. Take 100 pointer samples in each site, ie 10 placements of the point quadrat.
6. Carry out the data collection from the two sites. Then add up the total number of dandelion plants in each of the two sites.

$$\%\ \text{cover of dandelions} = \left(\frac{\text{no. of dandelion plants hit}}{\text{total no. of pointer samples}}\right) \text{x } 100$$

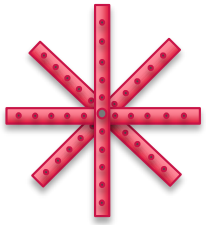
Ideas to improve or modify?

- Sample size? (See earlier).
- How to decide number of samples? (See earlier).
- Type of quadrats (see earlier).

Question: How could we increase sample size without more placements of point quadrat?

10 pins

20 pins



40 pins

AQA

Stages 5-6

5. Take 100 pointer samples in each site, ie 10 placements of the point quadrat.
6. Carry out the data collection from the two sites. Then add up the total number of dandelion plants in each of the two sites.

$$\%\ \text{frequency of dandelions} = \left(\frac{\text{no. of dandelion plants hit}}{\text{total no. of pointer samples}}\right) \text{x } 100$$

Ideas to improve or modify?

- Sample size? (See earlier).
- How to decide number of samples? (See earlier).
- Type of quadrats (see earlier).

Question: Is there a possible error in wording in stage 6?

Summary

We have looked at:

- RP12 method as suggested in the practical handbook activity
- how to adapt it and set in context of developing practical and maths skills.

For the Apparatus and Techniques - AT k (fieldwork sampling):

- investigate the distribution of organisms in a named habitat using randomly placed frame quadrats, or a belt transect
- use both percentage cover and frequency as measures of abundance of a sessile species.

Summary

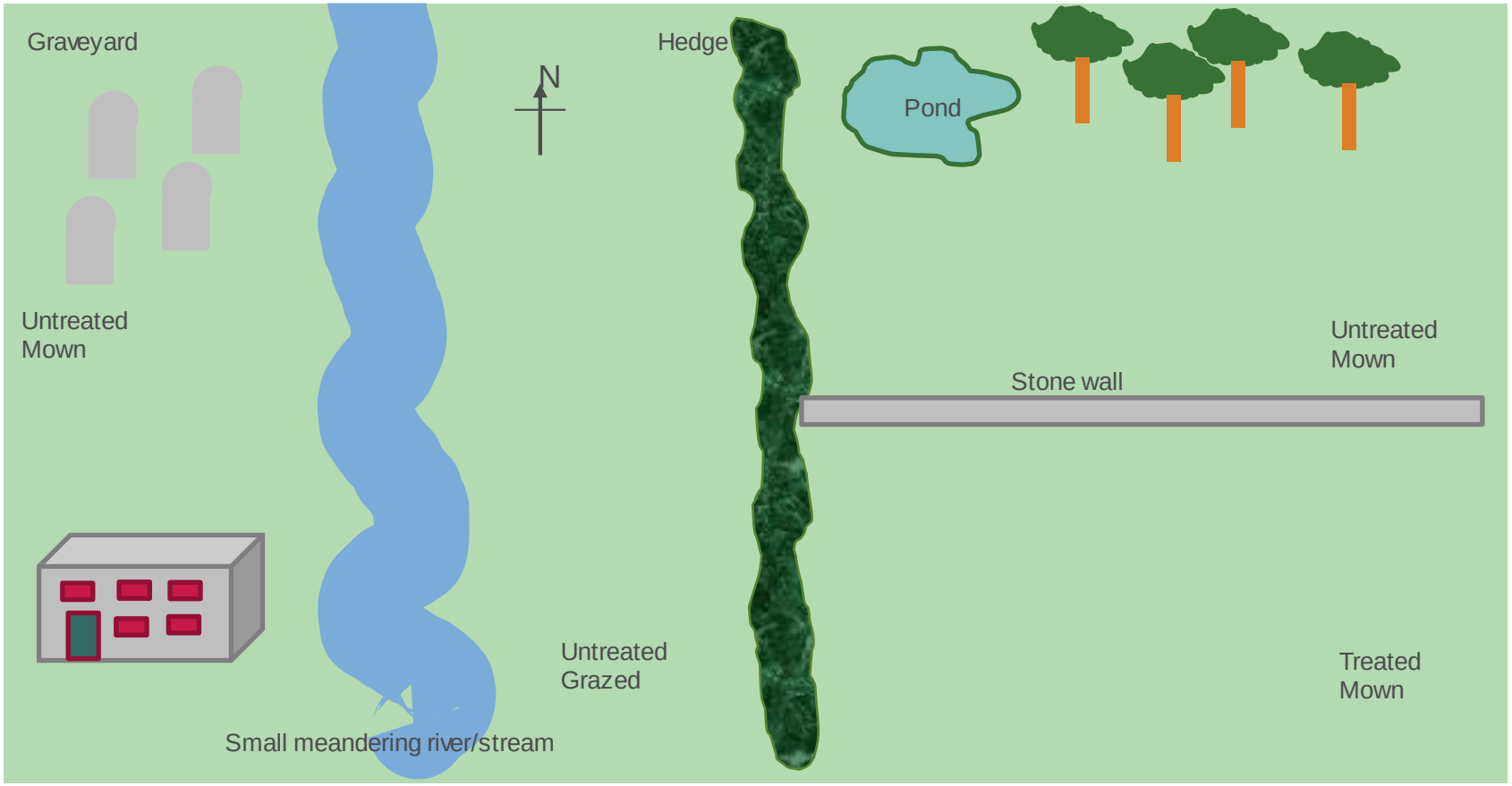
Maths Skills have included aspects of:

- MS 1.5 understand the principles of sampling as applied to scientific data
- MS 0.1 recognise and make use of appropriate units in calculations
- MS 0.3 use ratios, fractions and %
- MS 0.2 (appropriate no. of d.p.s)
- MS 0.4 (estimate results…)
- MS 1.2 (arithmetic means)
- MS 1.3 (construct, interpret graphs).

Required practical 12: developing extended sessions

Task: using the map below of an imaginary field site with a range of habitats, write down a list of other fieldwork investigation titles that would:

1. cover some or all of the apparatus and techniques listed for RP12
2. cover the relevant areas of the specification.



Required practical 12: developing extended sessions

Apparatus and techniques covered (not full statements):

a. use appropriate apparatus to record a range of quantitative measurements

b. use appropriate instrumentation to record quantitative measurements

h. safely and ethically use organisms to measure: plant or animal distribution.

Students could:

use the mark-release-recapture method to investigate the abundance of a motile species.

Required practical 12: developing extended sessions

k. use sampling techniques in fieldwork.

Students could:

- investigate the distribution of organisms in a named habitat using randomly placed frame quadrats, or a belt transect
- use both percentage cover and frequency as measures of abundance of a sessile species.

i. use ICT such as data logger to collect data or use software to process data.

Required practical 12: developing extended sessions

Directly relevant specification content:

3.7 Genetics, populations, evolution and ecosystems (A-level only)

Populations of different species live in communities. Competition occurs within and between these populations for the means of survival. Within a single community, one population is affected by other populations, the biotic factors, in its environment. Populations within communities are also affected by, and in turn affect, the abiotic (physicochemical) factors in an ecosystem.

3.7.4 Populations in ecosystems

Populations. Communities. Abiotic. Biotic. Habitat. Niche. Carrying capacity. Inter/intraspecific competition. Predation. Random sampling. Quadrats. Transects. M-R-R method. Primary succession. Conservation and management of succession.

Required practical 12: developing extended sessions

- Investigation into changes in the abundance of species X between stream/pond, mown/grazed (untreated), treated/untreated (mown).
- Investigation into changes in the abundance of species X with distance from woodland/stream edge/hedge/building.
- Investigation into abundance of species X (eg *Pleurococcus*/moss) on tree trunks/gravestones with changing aspect.
- Investigation into abundance of species X in different areas of a stream (pool v riffle/deep v shallow, with velocity).
  - Collect leaf samples if studying plants/algae to use in RP7: Chromatography.
  - Note: in any of these investigations – could record the size of species X instead or as well as abundance. Size = length, height, leaf area etc..
  - Collect organisms (eg woodlice) to use in RP10: Choice Chambers.

Required practical 12: developing extended sessions

Also…

- M-R-R on snails on wall/woodlice under dead logs/snails in pond.
  - Collect organisms (eg woodlice) to use in RP10: Choice Chambers.

Required practical 12: Lesson plan for fieldwork sessions

Field session one

- Initial activities to explore how to plan sampling (sample size, sampling type, quadrat type).
- Use keys. Biological drawing of plant leaves (in situ) – AT e.
- Decisions about measuring other environmental variables.
- Carry out whole class investigation using method agreed by class (random sampling of plants in two areas).
- Could record all plant species (not just sp. X).
- Could measure leaf/plant size of one species (use calipers?)
- Collect leaf samples for RP7.
- Collect and mark organisms as part of m-r-m investigation. Keep sample for RP10.

Required practical 12: Lesson plan for fieldwork sessions

Classroom follow up:

- analysis of data (maths skills): species diversity, using statistics
- construct and interpreting graphs etc
- evaluation of techniques.

Discussion:

- relevant specification content
- planning for session two.

Required practical 12: Lesson plan for fieldwork sessions

Field session two:

- carry out individual/small group investigations based around RP12 title
- **allows for further higher level CPAC opportunities esp CPAC 2 and CPAC 5.**

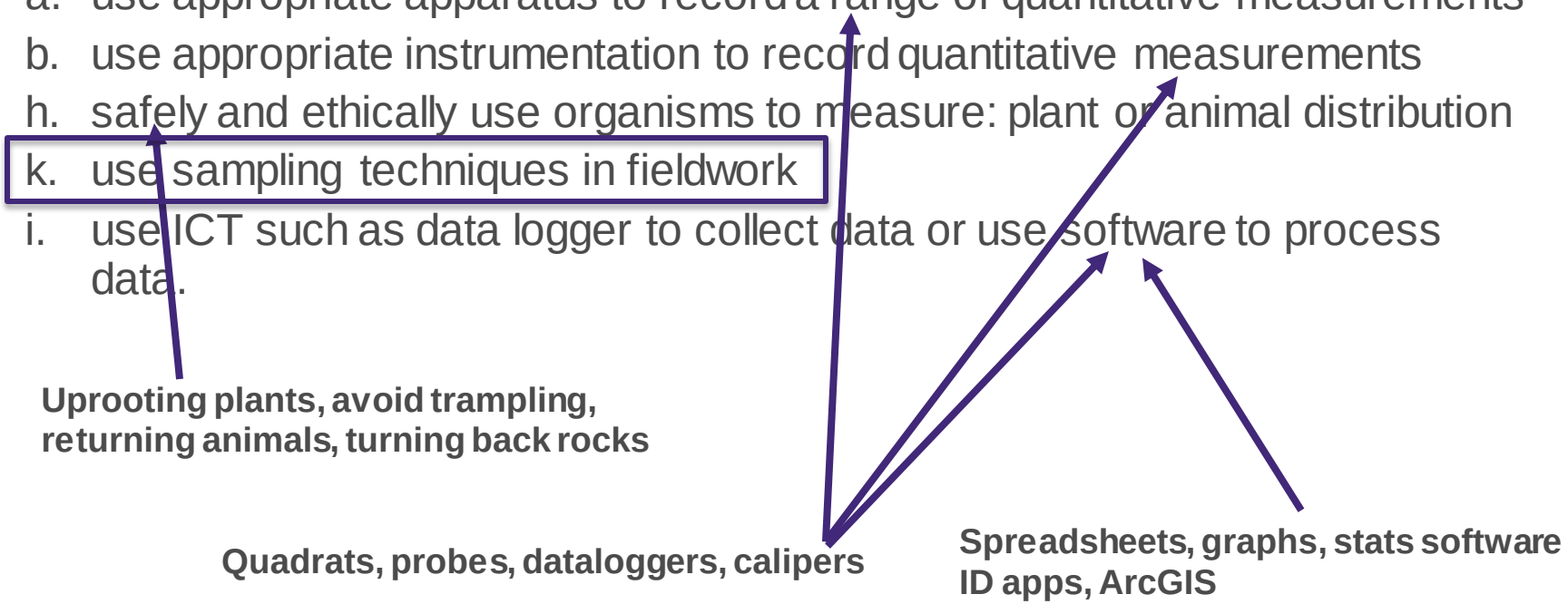
Classroom follow up:

- analysis of data
- evaluation
- poster/presentation.

Required practical 12: developing extended sessions

Are we covering the required apparatus and techniques suggested for RP12?

a. use appropriate apparatus to record a range of quantitative measurements
b. use appropriate instrumentation to record quantitative measurements
h. safely and ethically use organisms to measure: plant or animal distribution
k. use sampling techniques in fieldwork
i. use ICT such as data logger to collect data or use software to process data.



Required practical 12: developing extended sessions

Common practical assessment criteria	
CPAC 1: **Follows written procedures**	(a) Correctly follows instructions to carry out the experimental techniques or procedures.
CPAC 2: **Applies investigative approaches and methods when using instruments and equipment**	a) Correctly uses appropriate instrumentation, apparatus and materials (including ICT) to carry out investigative activities, experimental techniques and procedures with minimal assistance or prompting. (b) Carries out techniques or procedures methodically, in sequence and in combination, identifying practical issues and making adjustments when necessary. (c) Identifies and controls significant quantitative variables where applicable, and plans approaches to take account of variables that cannot readily be controlled. (d) Selects appropriate equipment and measurement strategies in order to ensure suitably accurate results.
CPAC 3: **Safely uses a range of practical equipment and materials**	a) Identifies hazards and assesses risks associated with these hazards, making safety adjustments as necessary, when carrying out experimental techniques and procedures in the lab or field. (b) Uses appropriate safety equipment and approaches to minimise risks with minimal prompting.
CPAC 4: **Makes and records observations**	(a) Makes accurate observations relevant to the experimental or investigative procedure. (b) Obtains accurate, precise and sufficient data for experimental and investigative procedures and records this methodically using appropriate units and conventions.
CPAC 5: **Researches, references and reports**	(a) Uses appropriate software and/or tools to process data, carry out research and report findings. (b) Sources of information are cited demonstrating that research has taken place, supporting planning and conclusions.

Required practical 12: maths skills

Using the AQA suggested practical we can cover:

- MS 1.5 Understand the principles of sampling as applied to scientific data.
- MS 0.1 Recognise and make use of appropriate units in calculations.
- MS 0.3 Use ratios, fractions and %.
- MS 0.2 (appropriate no. of d.p.s).
- MS 0.4 (estimate results…).
- MS 1.2 (arithmetic means).
- MS 1.3 Construct, interpret graphs.

Required practical 12: maths skills

If we expand fieldwork sessions we can also cover:

- MS 1.6 Understand the terms, mean, median and mode.
- MS 1.7 Use a scatter diagram to identify a correlation between two variables.
- MS 1.9 Select and use a statistical test.
- MS 1.10 Understand measures of dispersion, inc standard deviation and range.
- MS 1.3 Construct, interpret bar charts and histograms (inc SE bars).
- MS 1.11 Identify uncertainties in measurements.
- MS 2.3 Substitute numerical values into algebraic equations (eg Simpson's Index of Diversity.

Simpson's Index of Diversity

Species richness (R) =

Measure of **number** of species in a particular area or habitat.

Simpson's Index of Diversity

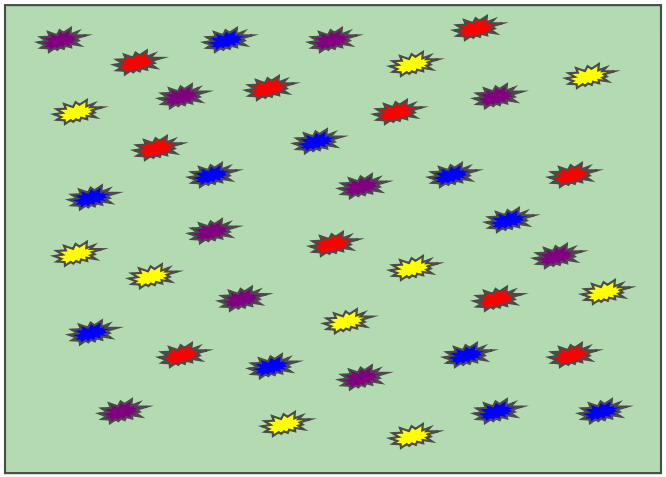
Species richness (R) =

Measure of number of species in a particular area or habitat.

Species diversity (D) =

Measure of number and relative abundance of species in a particular area or habitat.

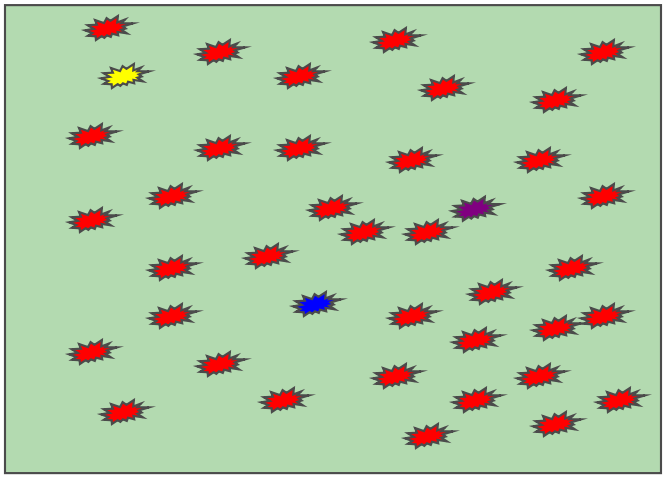
Simpson's Index of Diversity



Area one

Species Richness (R) = **4**

Higher Diversity
= ecological equilibrium



Area two

Species Richness (R) = **4**

Lower Diversity
= ecological stress

Simpson's Index of Diversity

$$D = 1 - (\Sigma\ (n/N)^2)$$

n = number of individuals of a species

N = Total number of individuals of all species

Σ = sum of

Maximum D = 1. Minimum D = 0.
More diverse an area, D value closer to 1.

Simpson's Index of Diversity

Example....

Species	Abundance
A	32
B	78
C	86

N = Total No. of individuals

N = 32 + 78 + 86 = **196**

$D = 1 - (\Sigma (n/N)^2)$

Simpson's Index of Diversity

Example....

Species	Abundance
A	32
B	78
C	86

N = Total No. of individuals

N = 32 + 78 + 86 = **196**

$D = 1 - (\Sigma (n/N)^2)$

Next Step.... **$(n/N)^2$** for each species:

$\frac{32}{196} = 0.1632653^2 =$ **0.0266555**

$\frac{78}{196} = 0.3979592^2 =$ **0.1583715**

$\frac{86}{196} = 0.4387755^2 =$ **0.1925394**

$\Sigma (n/N)^2 = 0.3775664$

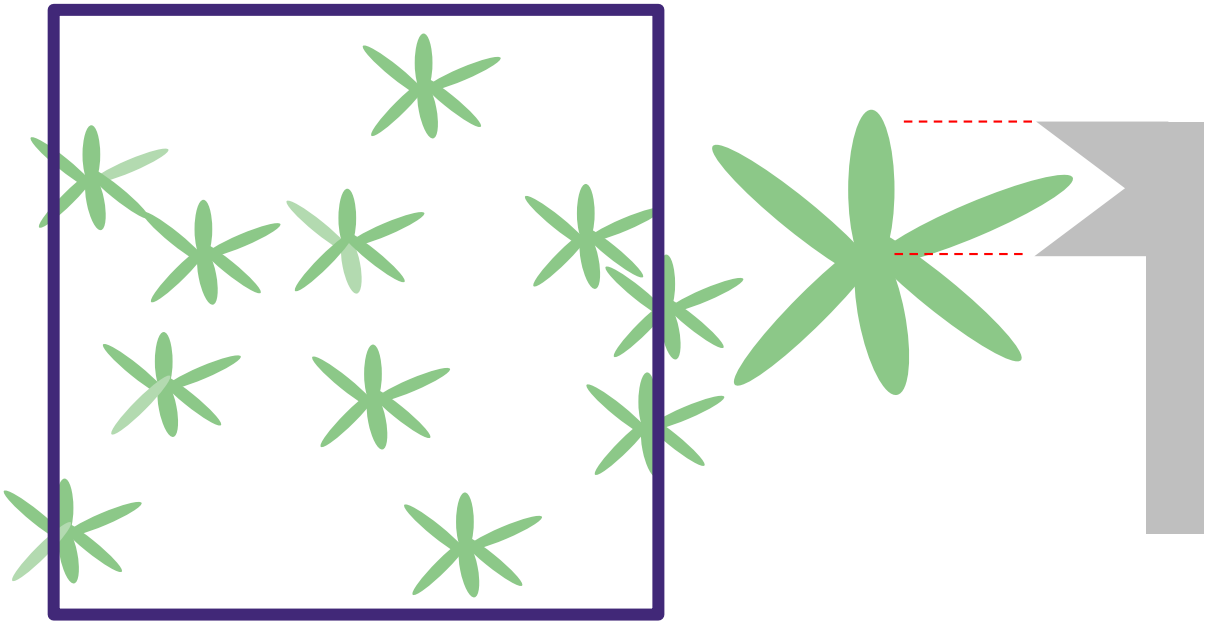
Finally... **$1 - (\Sigma (n/N)^2)$** $= 1 - 0.3775664 = 0.6224336$

= 0.62

MS 0.2 Recognise and use expressions in decimal and standard form.

Leaf size investigation

Investigation into mean leaf length of ribwort plantain in two contrasting areas of grassland.



MS 1.11 Identify uncertainties in measurements and use simple techniques to determine uncertainty when data are combined.

Leaf size investigation

Sample data

Leaf length (mm) of *Plantago lanceolata* in two contrasting areas of grassland.

Area 1: mown	Area 2: unmown
30.55	60.00
41.60	104.60
40.00	48.15
27.55	30.90
27.80	49.15
43.50	57.80
41.25	101.45
35.10	29.95
25.90	49.90
44.75	39.85

What maths skills can be tested here?

- M0.2 Recognise and use expressions in decimal and standard form.
- M1.1 Use an appropriate number of significant figures.
- M1.2 Find arithmetic means.
- M1.3 Construct and interpret frequency tables and diagrams, bar charts and histograms.
- M1.6 Understand the terms mean, median and mode.
- M1.10 Understand measures of dispersion, including standard deviation and range.
- M.1.9 Select and use a statistical test.
- M1.11 Identify uncertainties in measurements and use simple techniques to determine uncertainty when data are combined.

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Mean		

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	44.75	39.85
Mean	**35.800**	**57.175**

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	44.75	39.85
Mean	**35.800**	**57.175**

What maths skills can be tested here?

M0.2 Recognise and use expressions in decimal and standard form.

Decimal places and significant figures
Students are expected to record raw data to the same number of decimal places (rather than the same number of significant figures).

For example, in this table all values are to 2 decimal places **but** they do not have the same number of significant figures.

Note: in exams may be asked to record answer(s) to a particular number of decimal places or to a particular number of significant figures.

Leaf size investigation

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	35.10	29.95
	25.90	49.90
	44.75	39.85
Mean	**35.800**	**57.175**

What maths skills can be tested here?

M0.2 Recognise and use expressions in decimal and standard form.

Processed data can be recorded to up to one decimal place more than the raw data.

For example, calculated mean for this example could be recorded as 57.175 mm or 57.18 mm.

Leaf size investigation

Sample data

Leaf length (mm) of *Plantago lanceolata* in two contrasting areas of grassland.

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- **M.1.9 Select and use a statistical test.**
- **M1.10 Understand measures of dispersion, including standard deviation and range.**
- M1.11 Identify uncertainties in measurements and use simple techniques to determine uncertainty when data are combined.

MS 1.9 Select and use a statistical test

Stats – why bother?

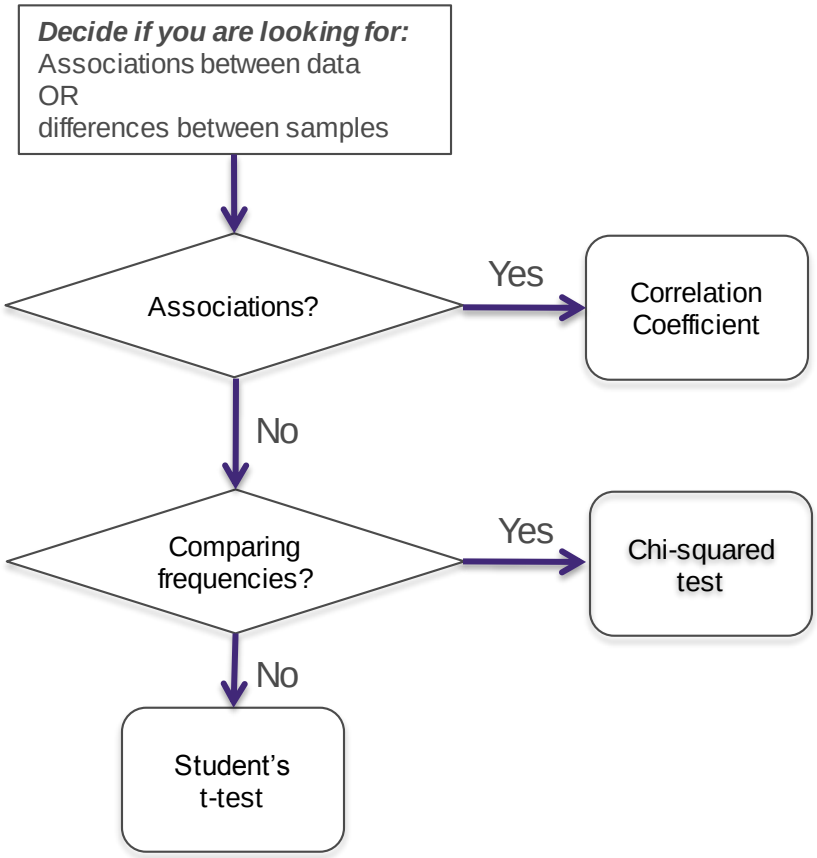
- to test whether sample data is significant = good
- …or could values have arisen by chance?
- …how much confidence do you have in your data?

- Especially if samples are small.

- Especially if any patterns or trends in data are unclear (is something going on or not?)

- Stats means prizes (can come up in exams).

MS 1.9 Select and use a statistical test



Statistics – flowchart

- Formulae that you can put **sample** data into to test its **significance**.
- Different tests for different types of sample data.
- Learners must be able to choose correct test for their data.

Leaf size investigation

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Leaf length (mm) of *Plantago lanceolata* in two contrasting areas of grassland.

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Mean	**35.80**	**57.18**

Which stats test will be used here?

- Student's t-test (MS 1.9).
- Also need standard deviation (MS 1.10).
- Also draw histograms (MS 1.3).

MS 1.9 Select and use a statistical test

Teaching stats: handy hints

- Don't 'over-teach'.
- Ensure differentiation for range of maths ability.
- Peer teaching?
- Calculators vs manual vs spreadsheets?
- Don't get bogged down in 'number crunching'.
- Don't lose sight of 'why'.
- Teach Spearman's first? Easier?

Relevant specification content for RP12

3.7 Genetics, populations, evolution and ecosystems (A-level only)

Populations of different species live in communities. Competition occurs within and between these populations for the means of survival. Within a single community, one population is affected by other populations, the biotic factors, in its environment. Populations within communities are also affected by, and in turn affect, the abiotic (physicochemical) factors in an ecosystem.

3.7.4 Populations in ecosystems

Populations. Communities. Abiotic. Biotic. Habitat. Niche. Carrying capacity. Inter/intraspecific competition. Predation. Random sampling. Quadrats. Transects. M-R-R method. Primary succession. Conservation and management of succession.

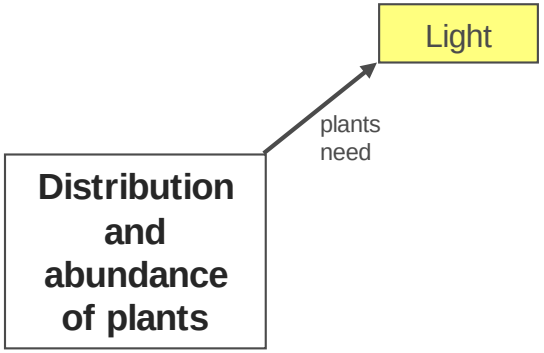
Also… 3.4.5 Species and taxonomy

How do we make wider synoptic links?

Plants – Synoptic Links

Distribution and abundance of plants

Plants – Synoptic Links



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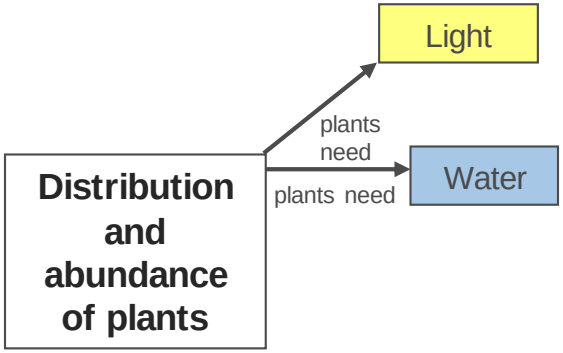

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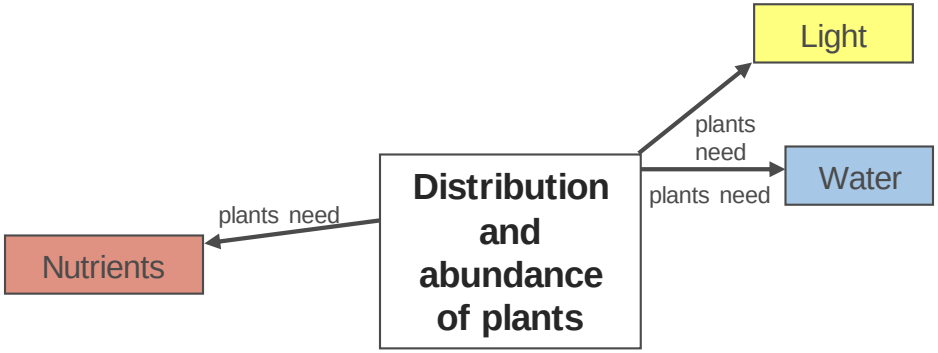

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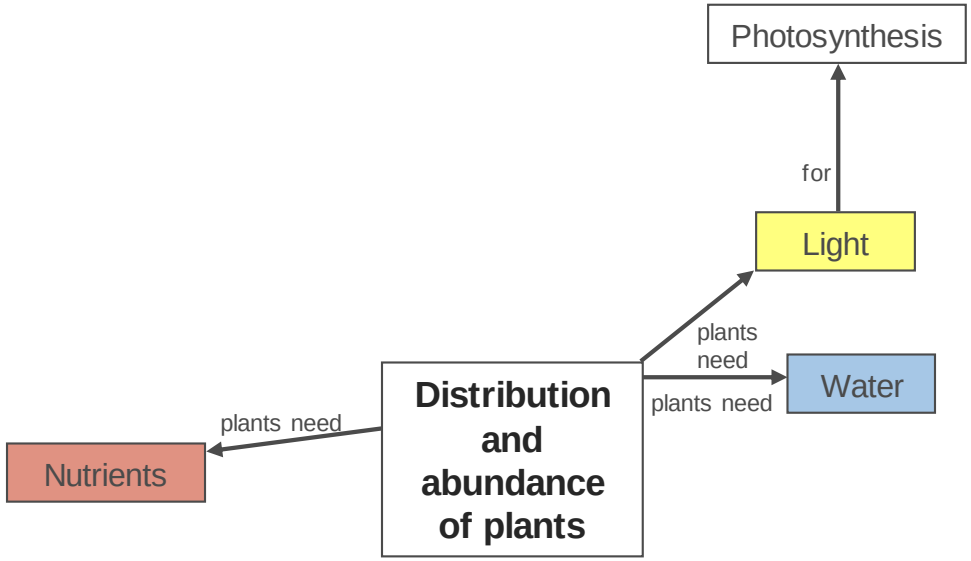

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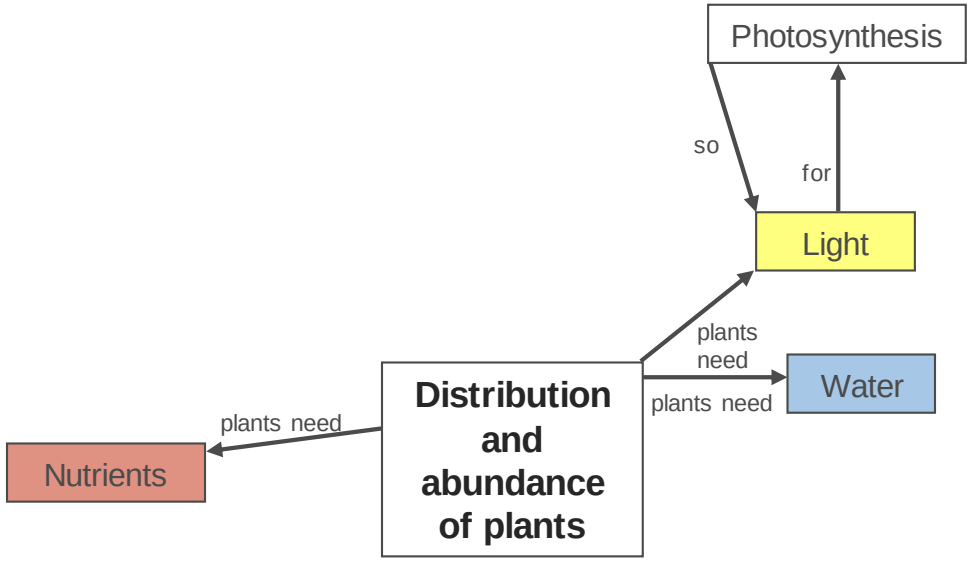

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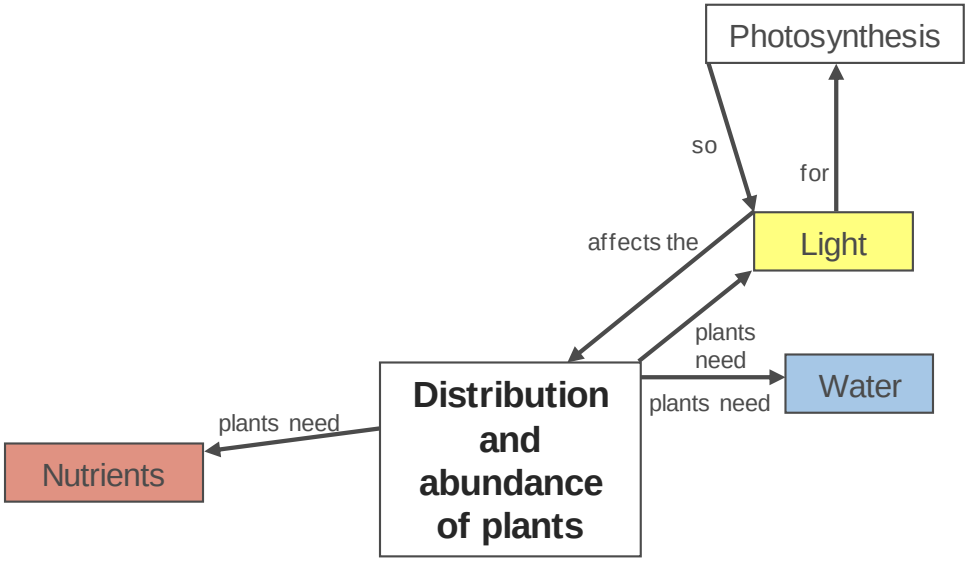

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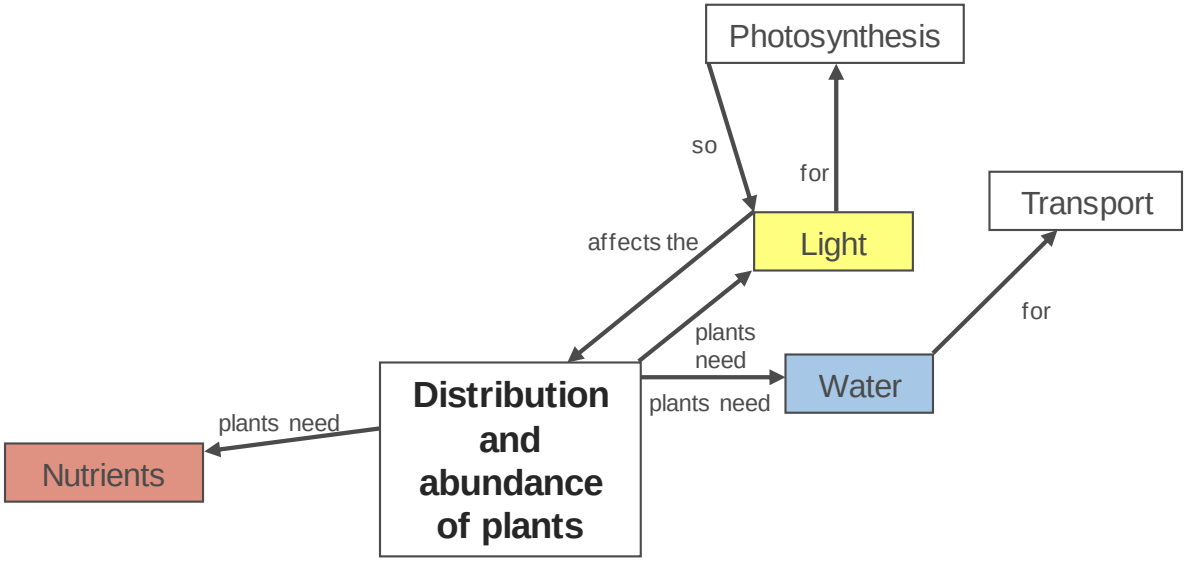

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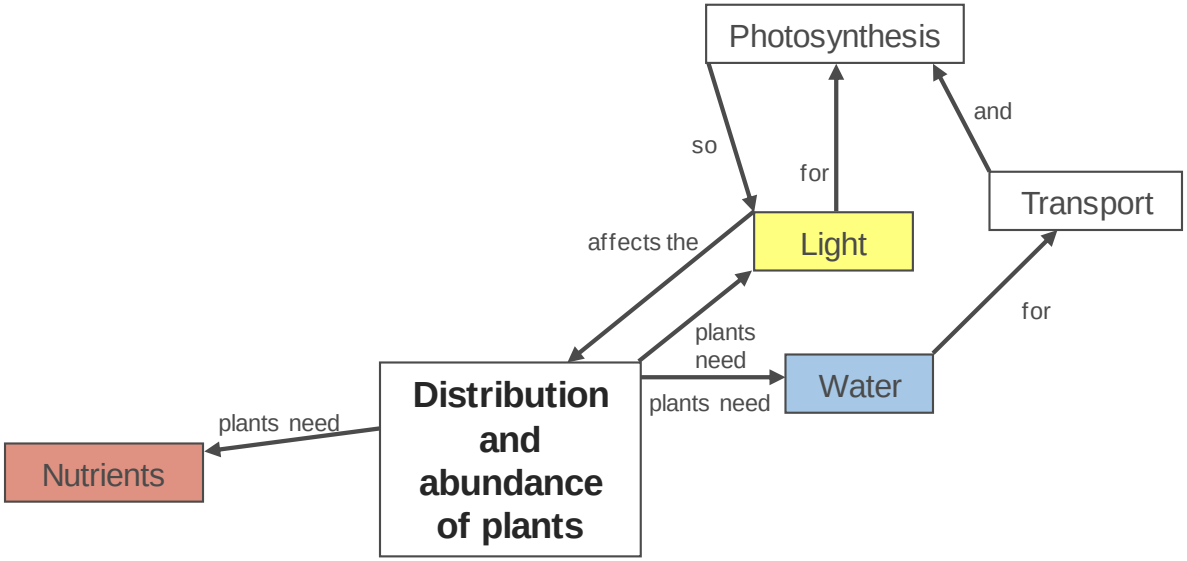

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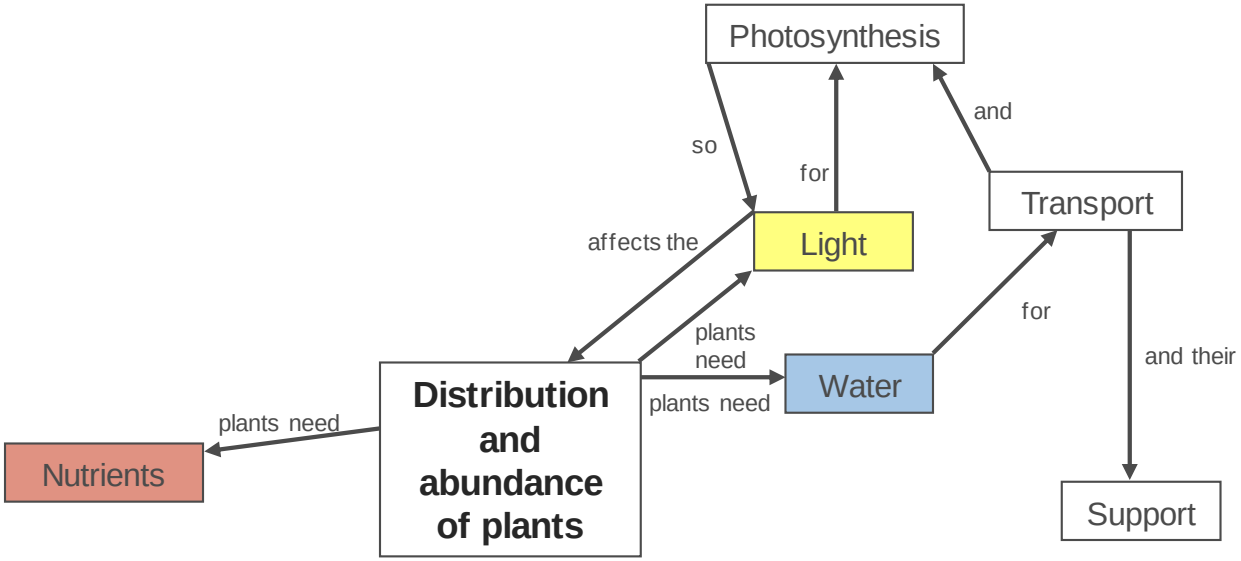

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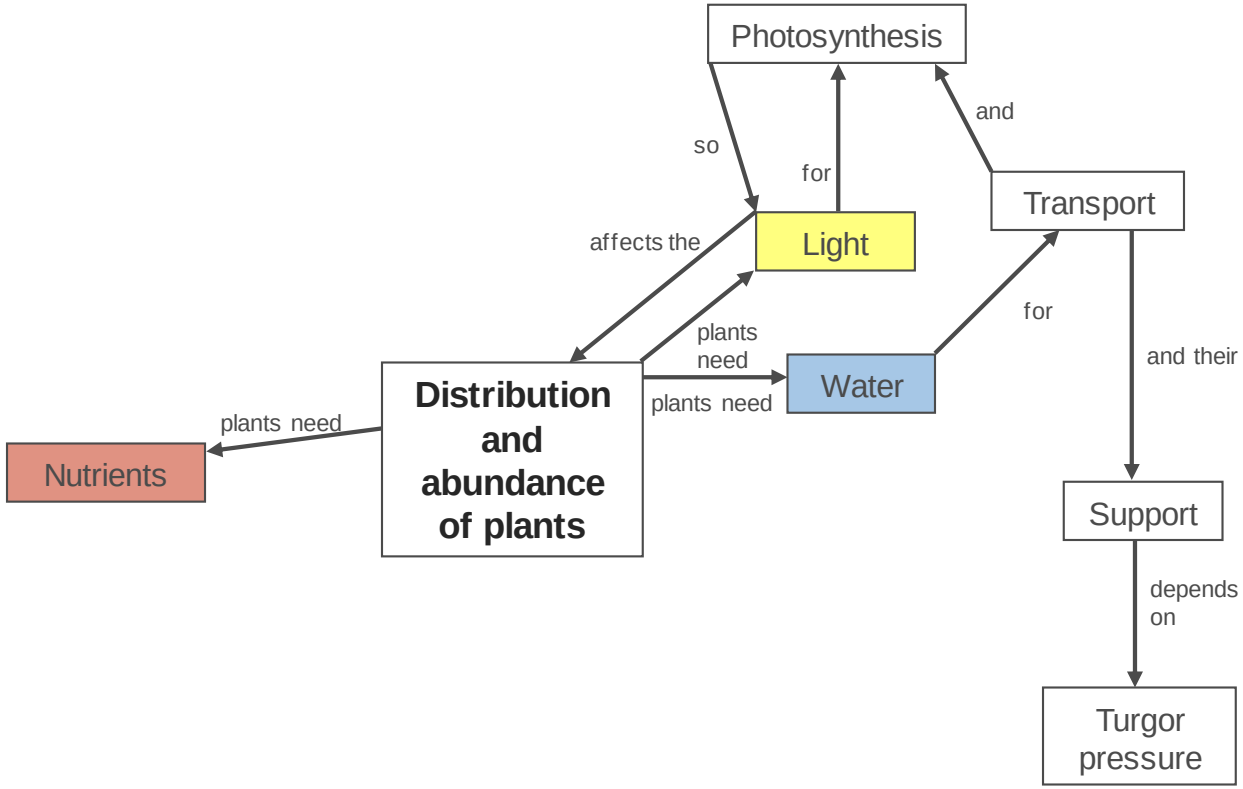

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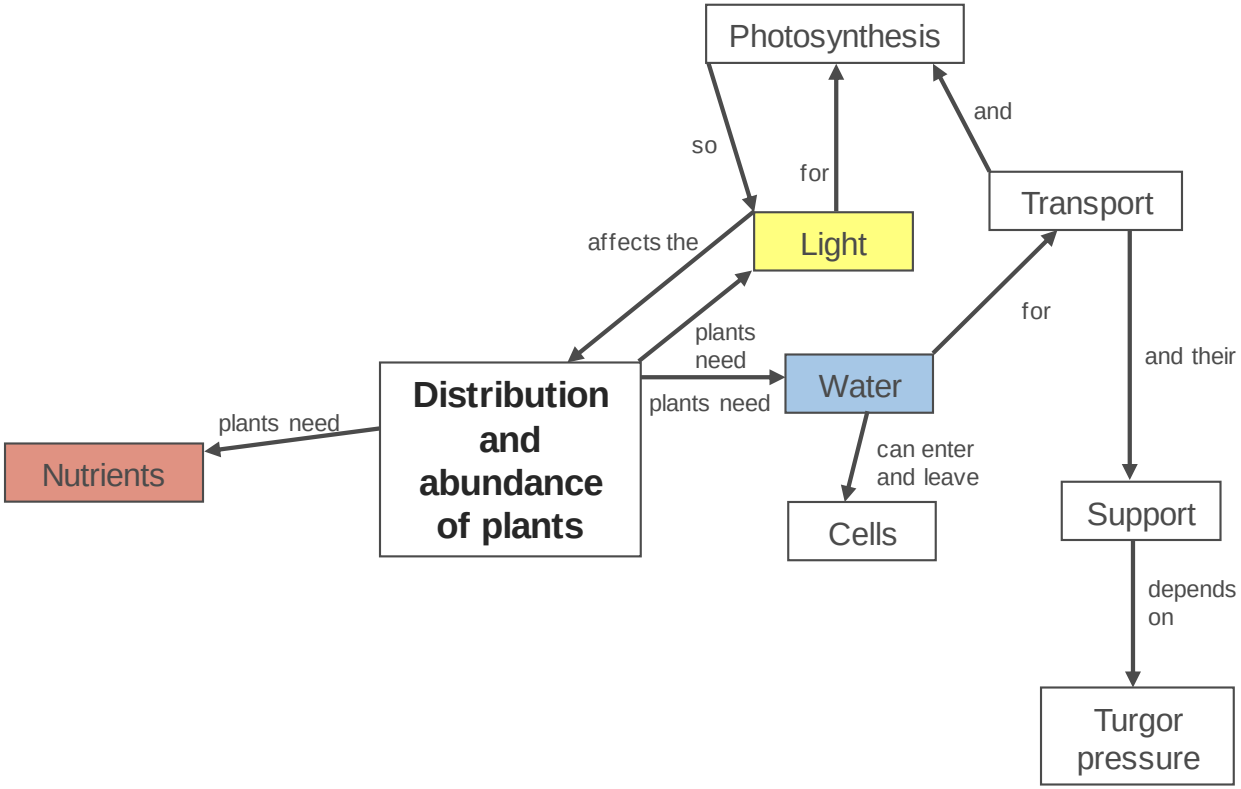

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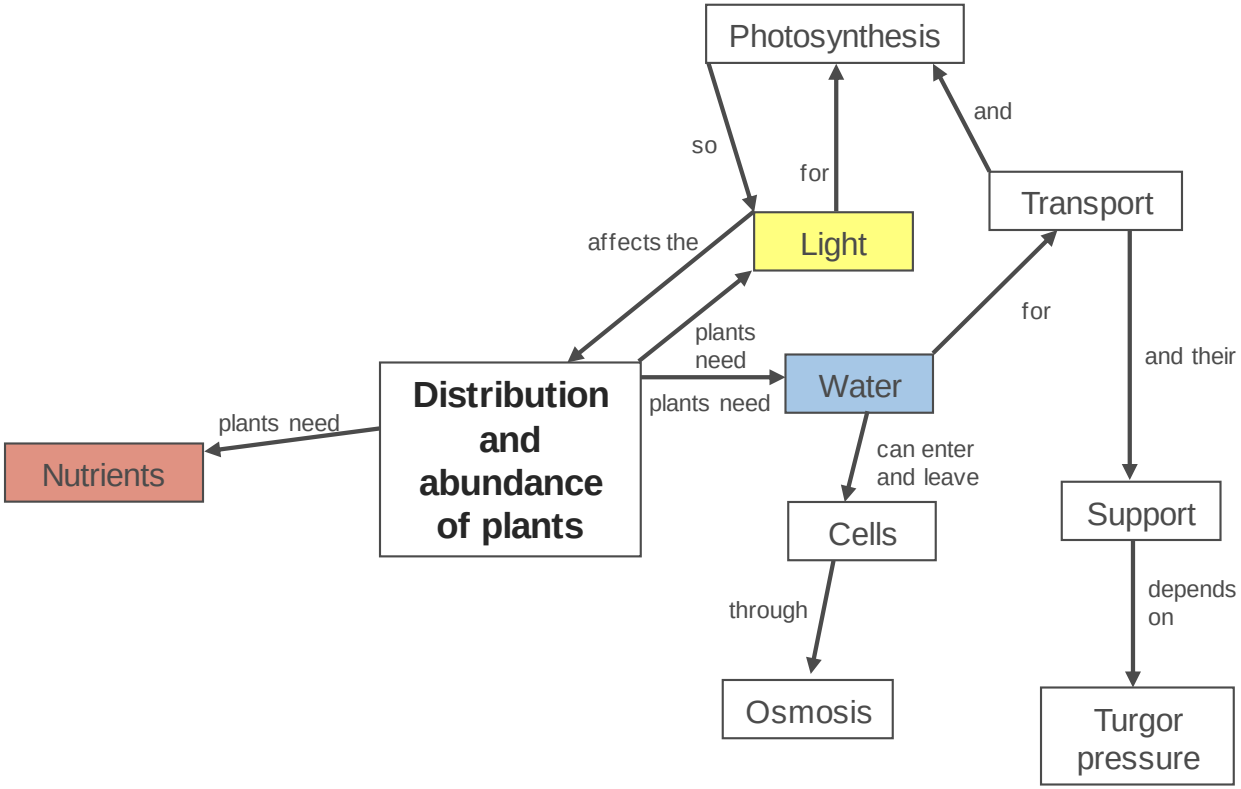

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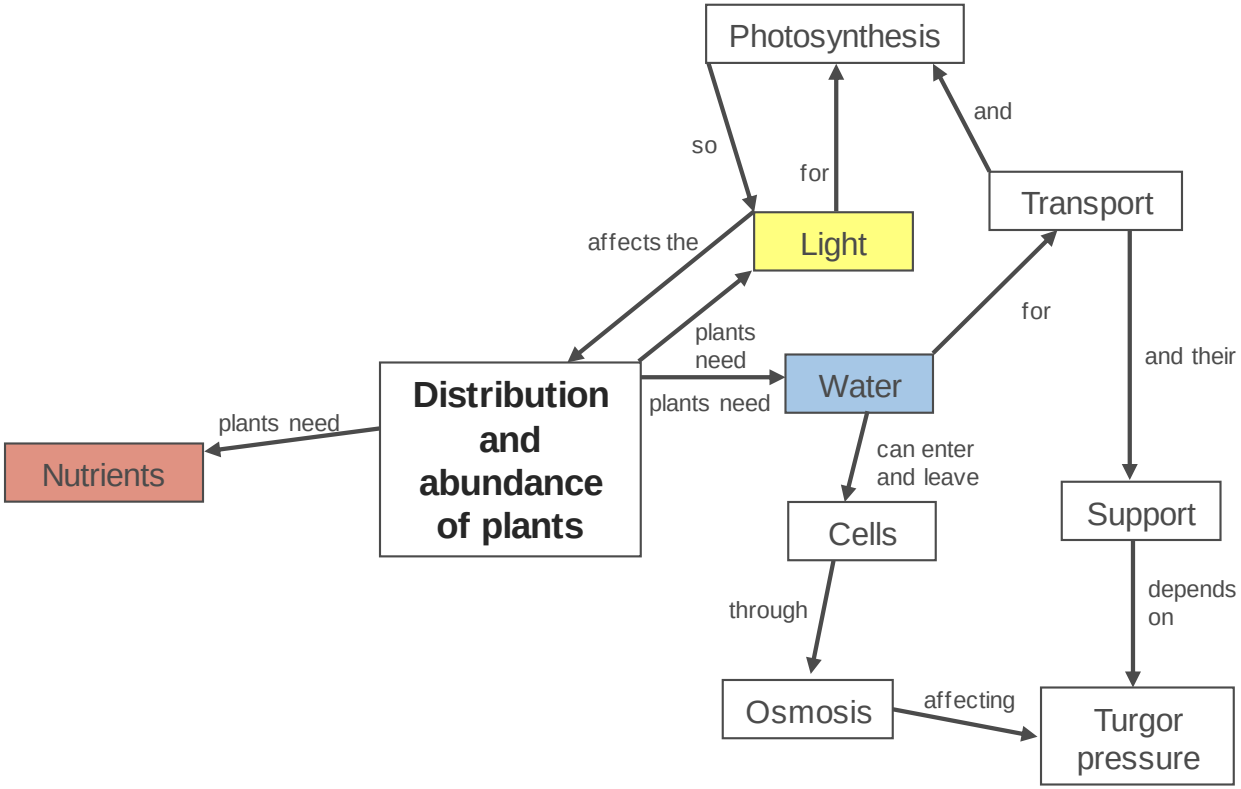

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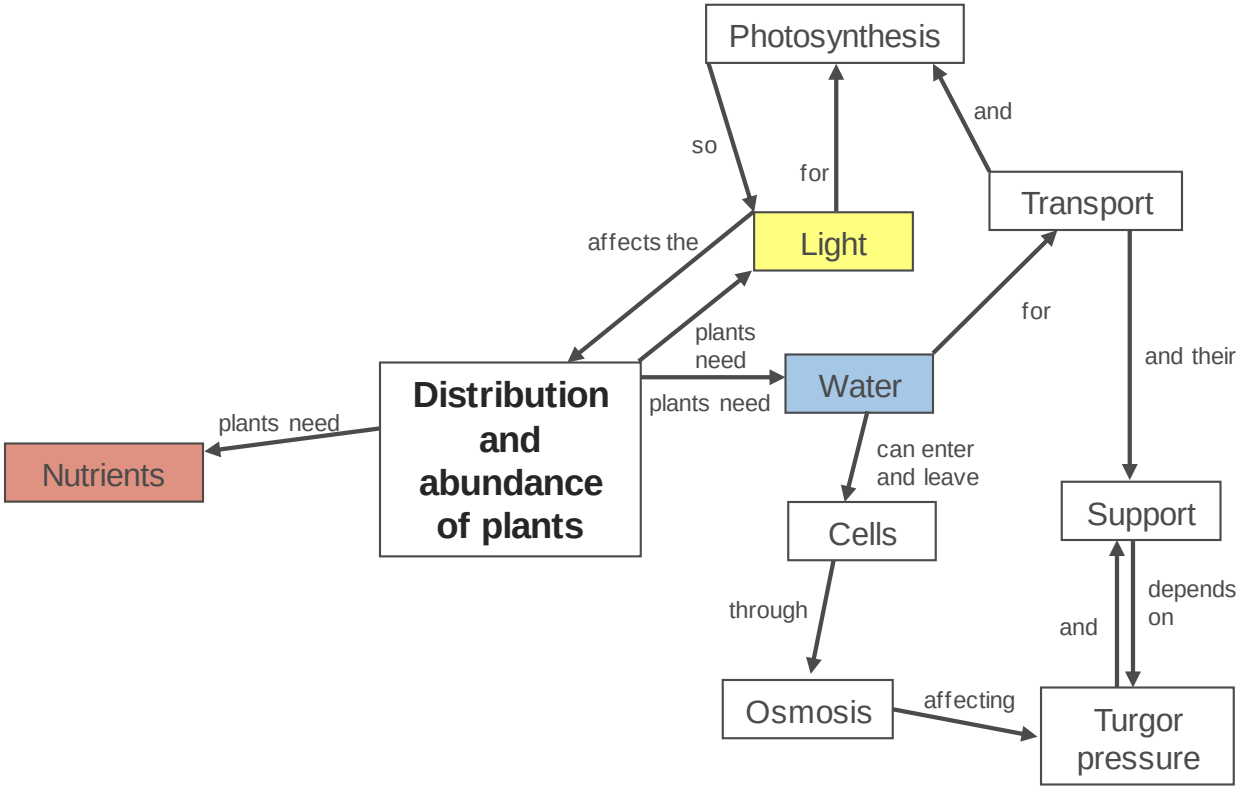

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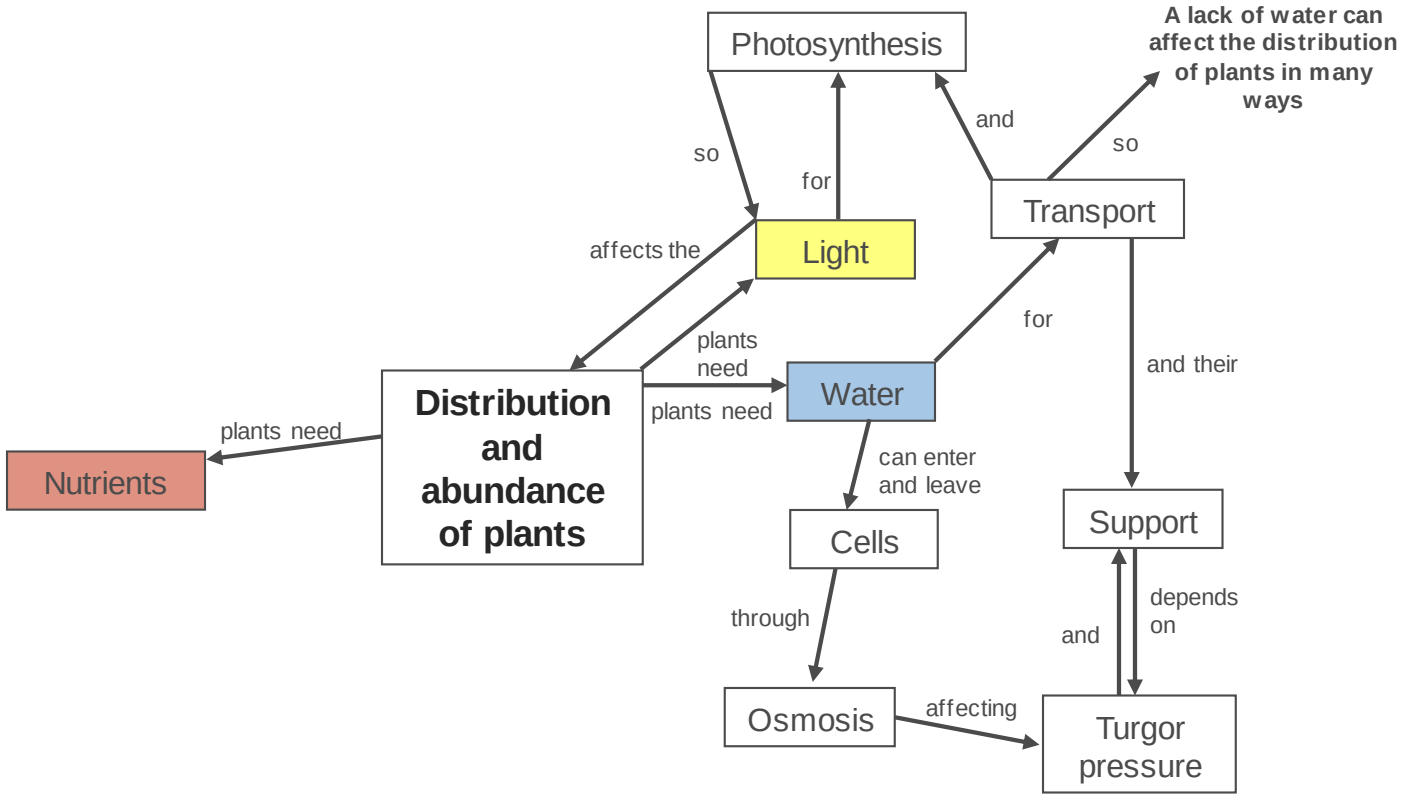

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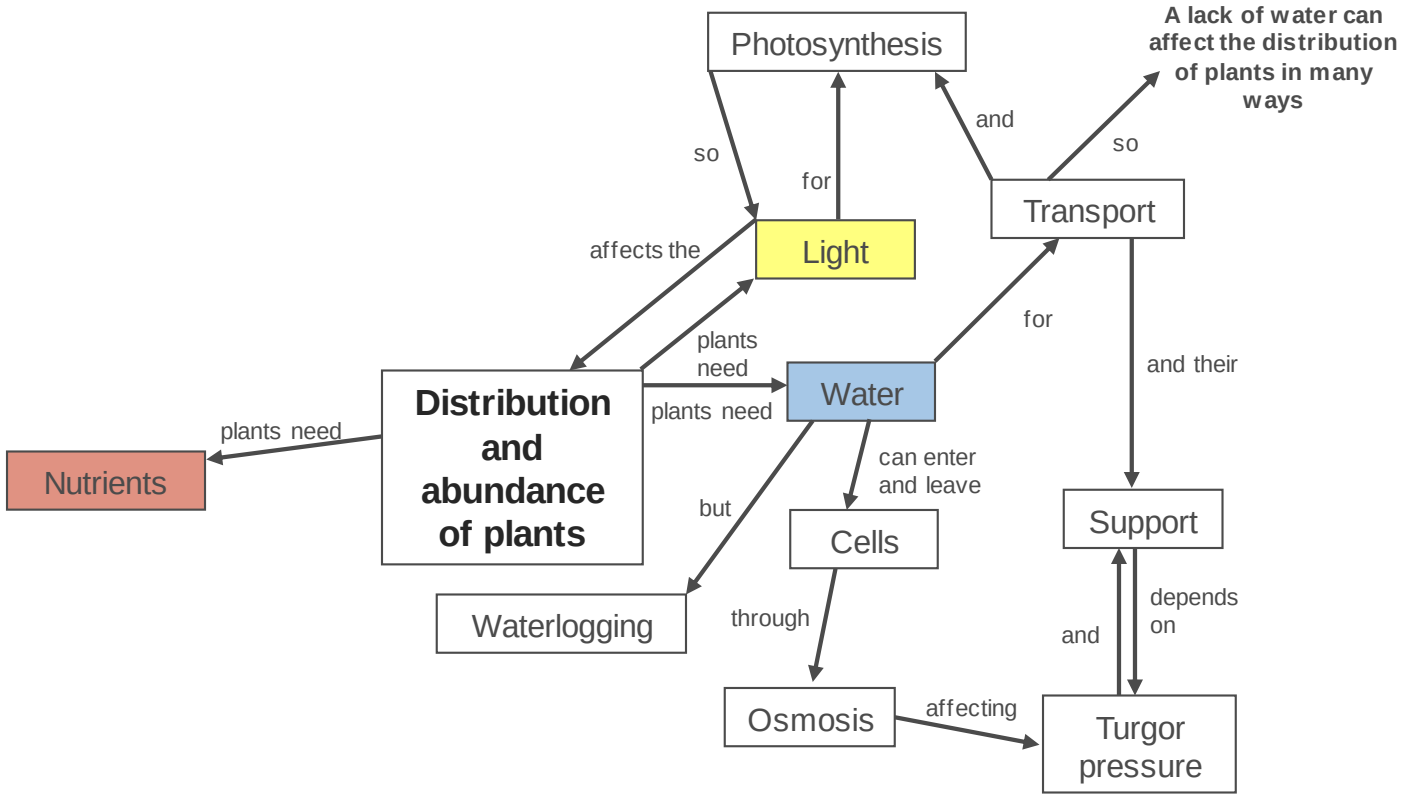

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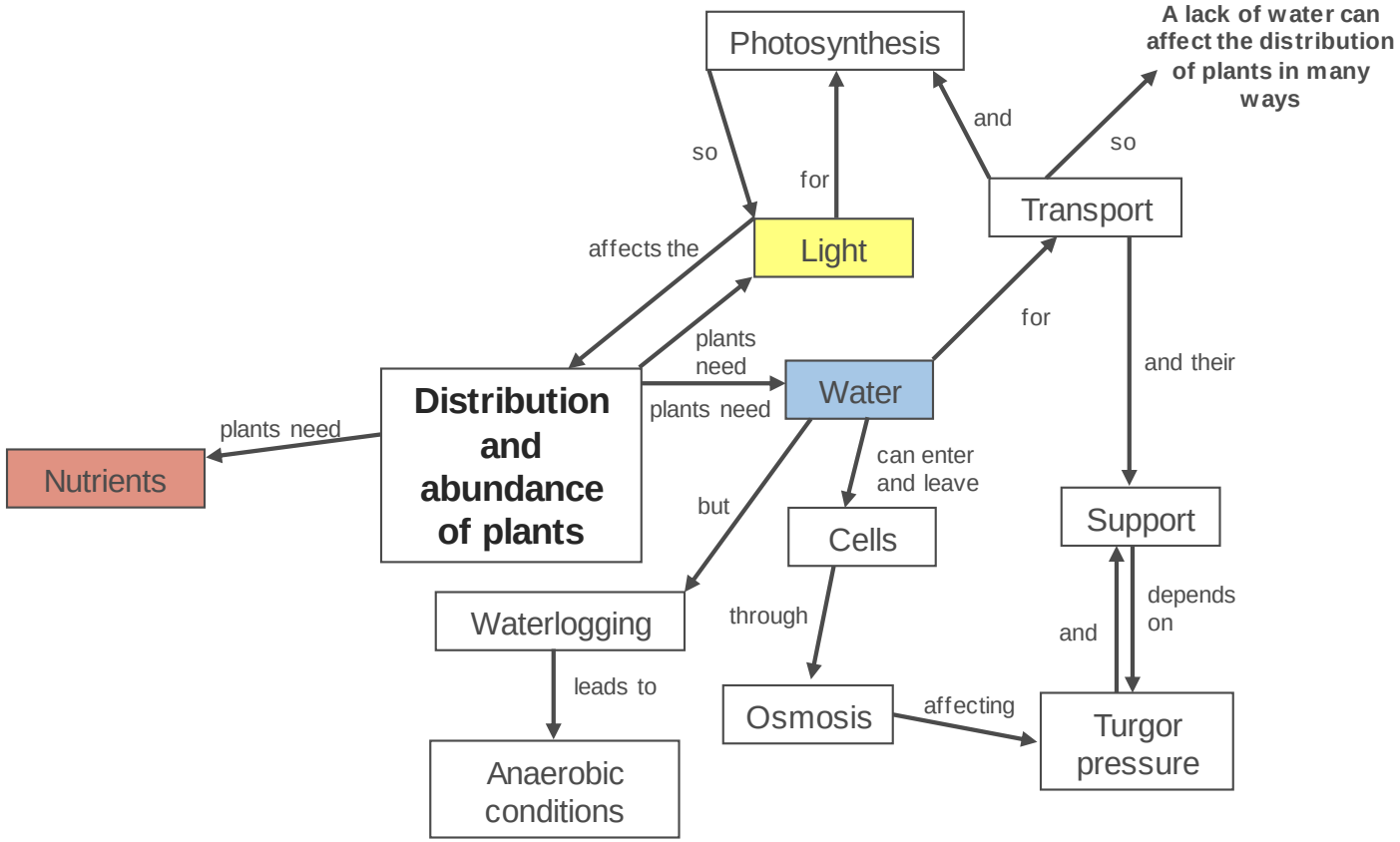

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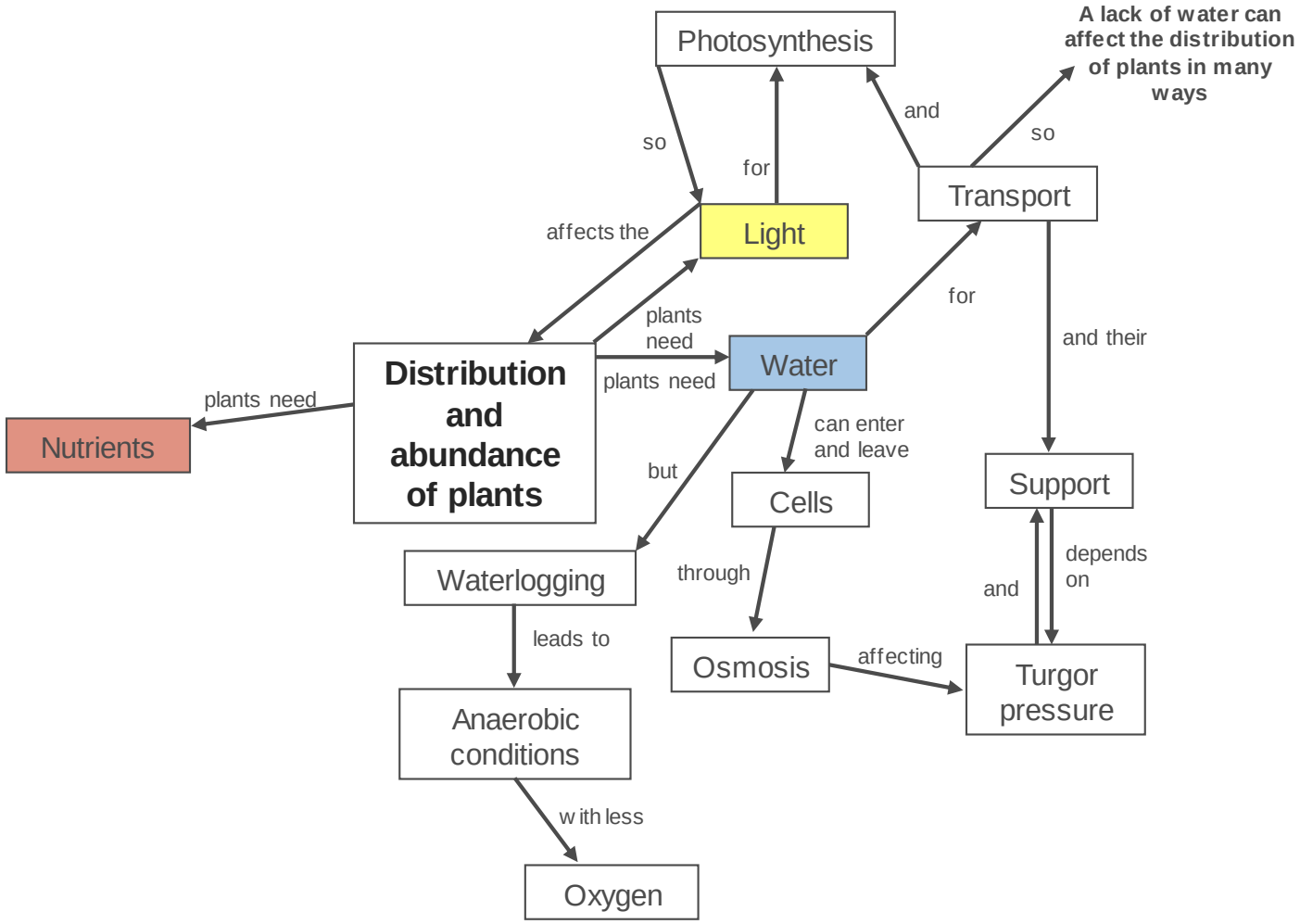

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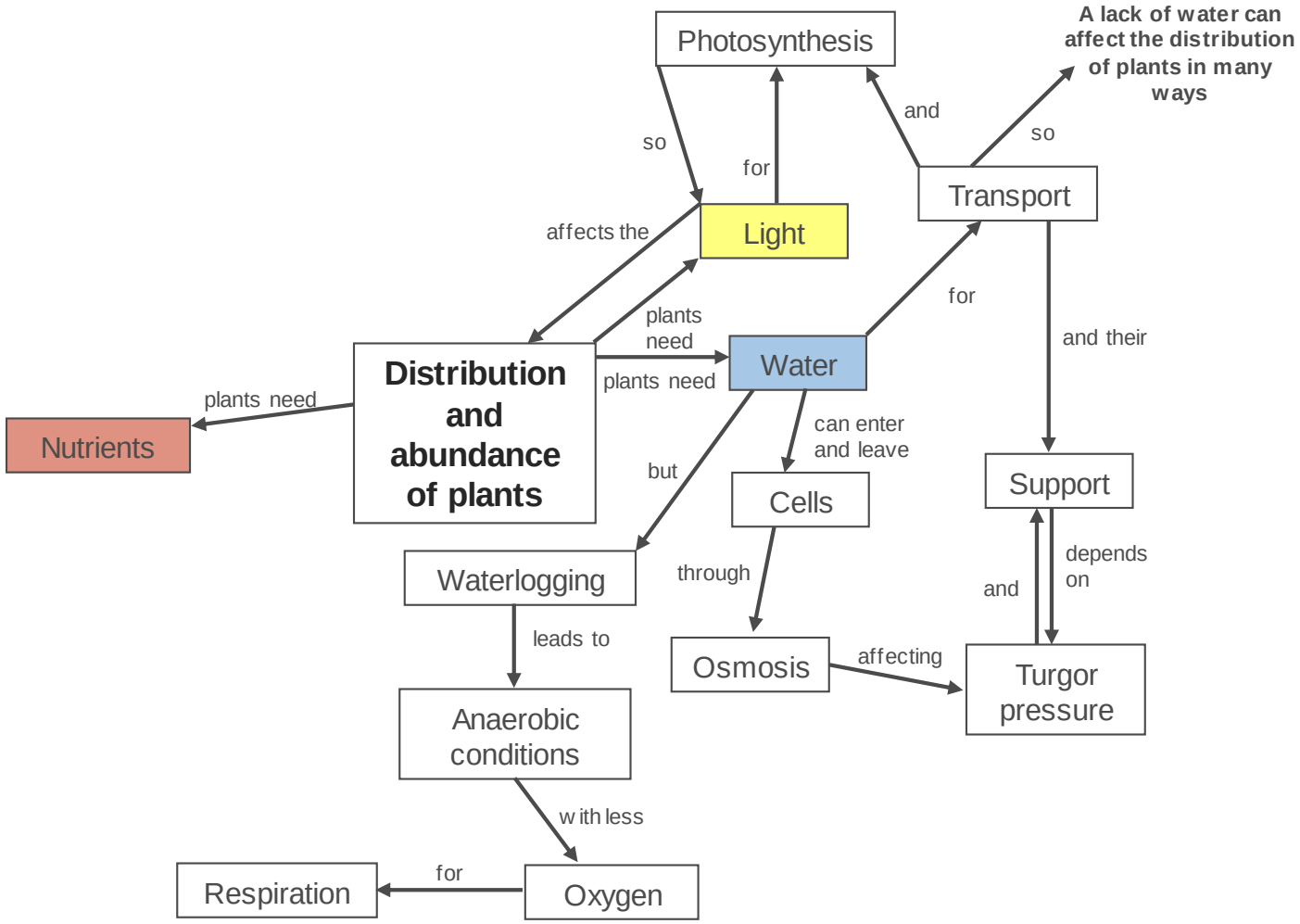

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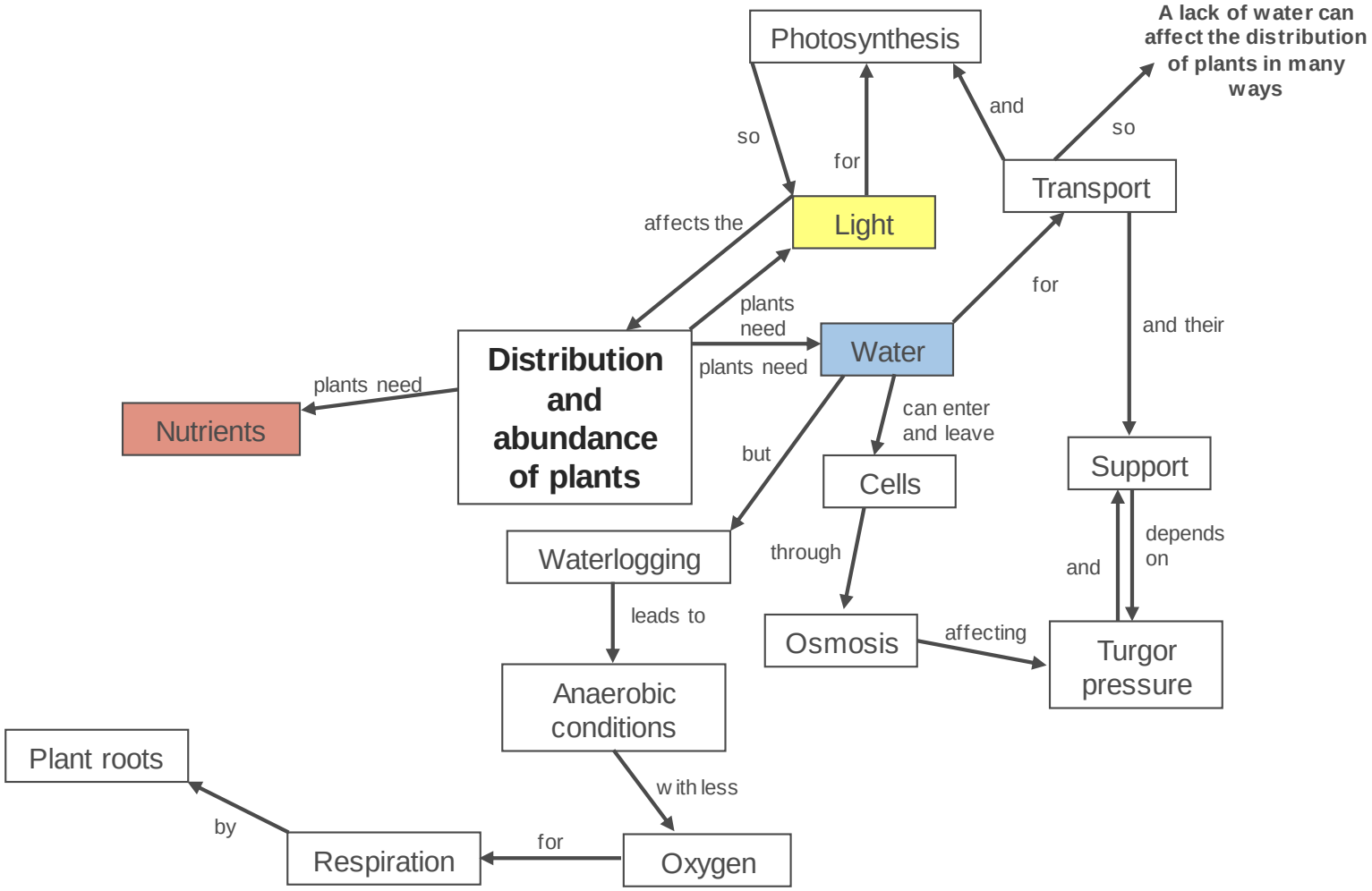

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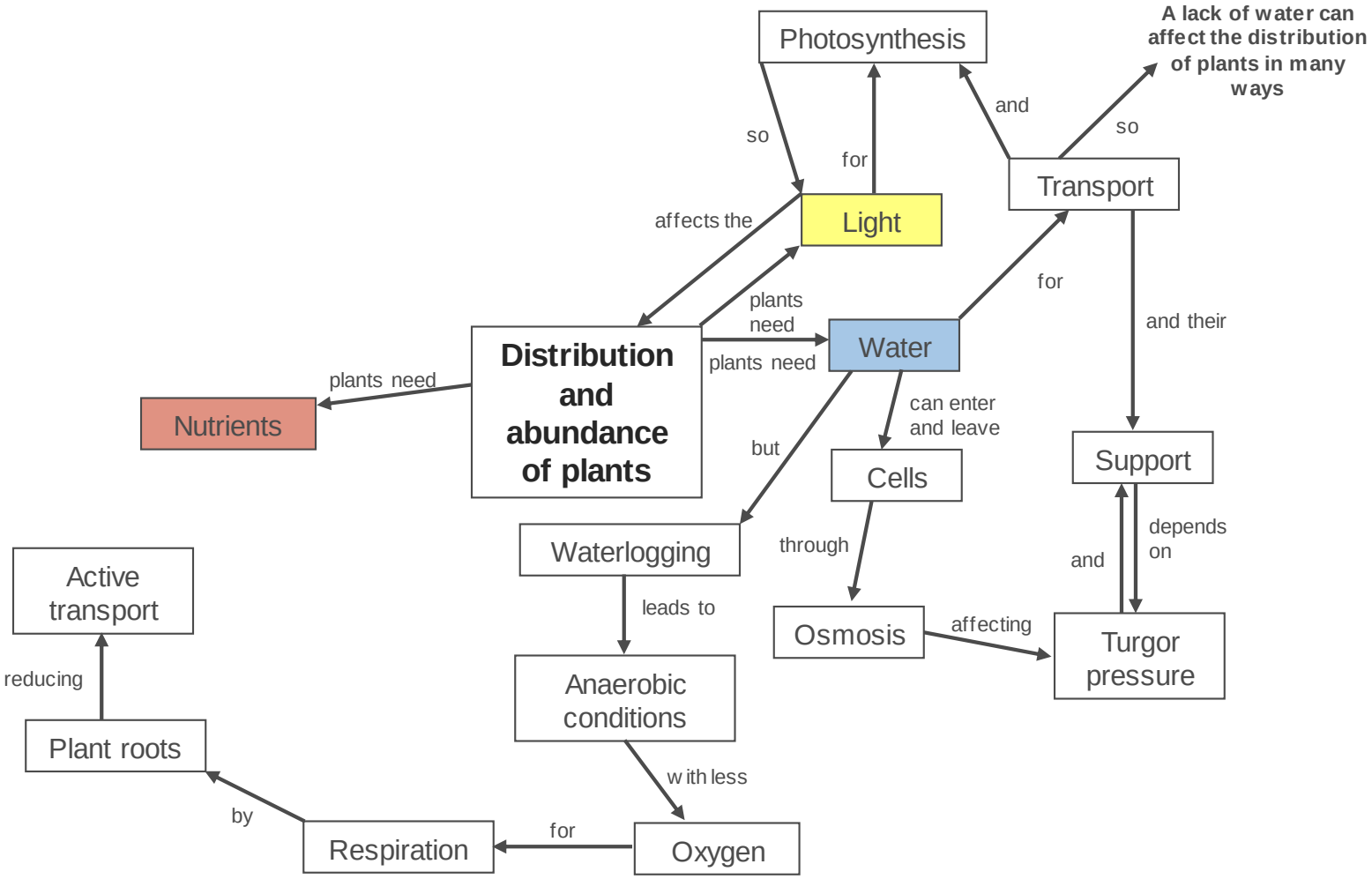

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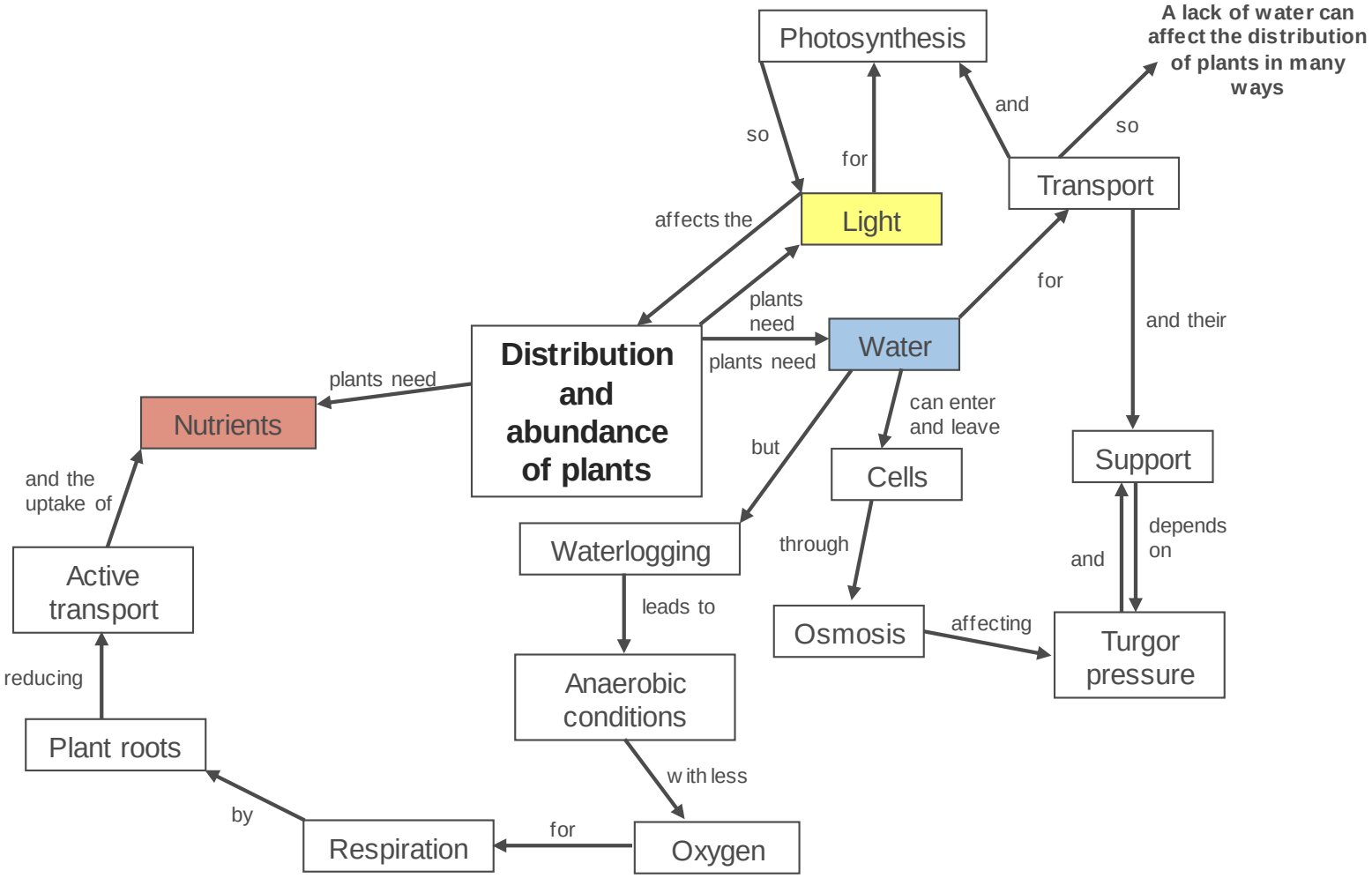

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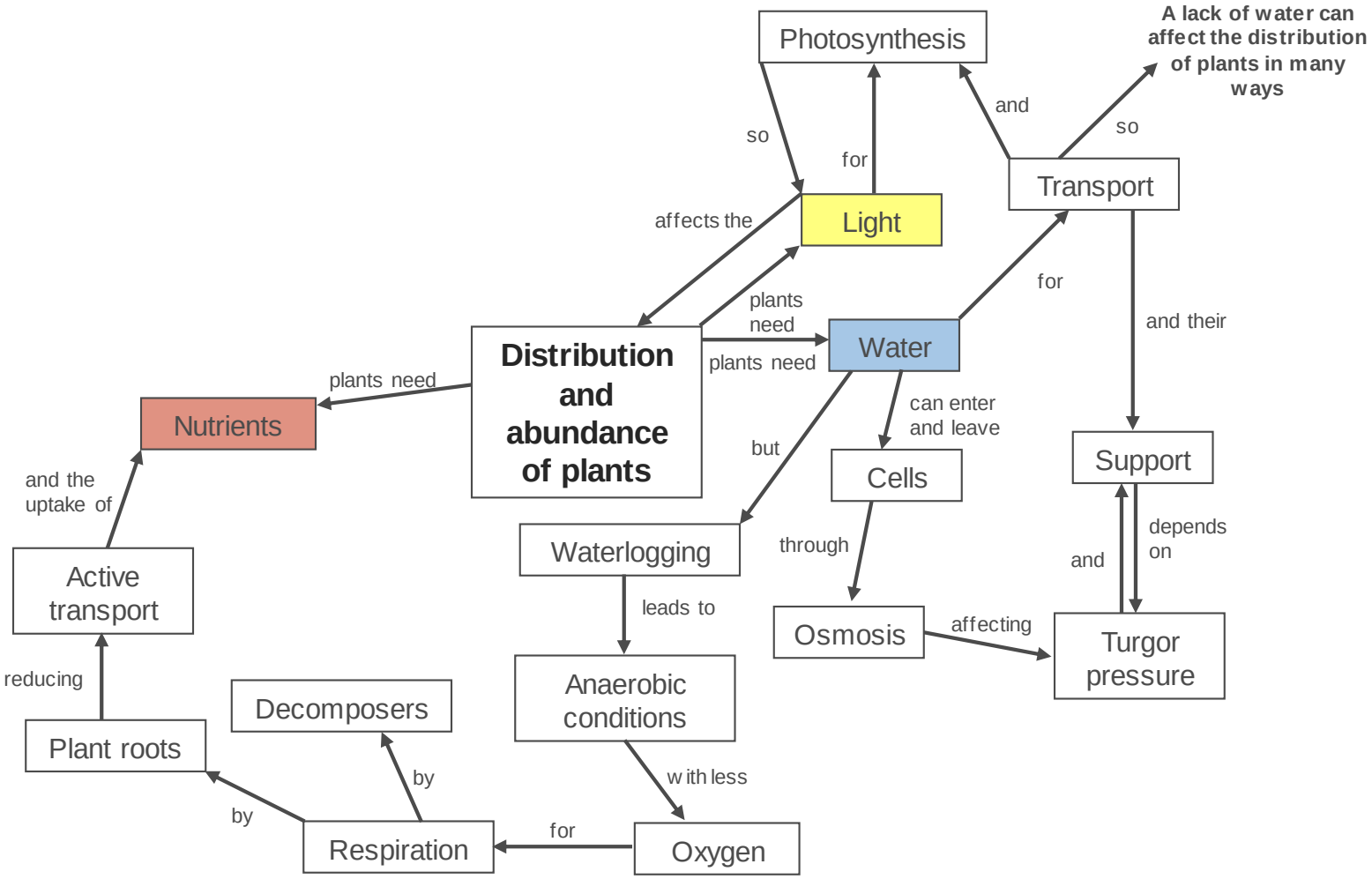

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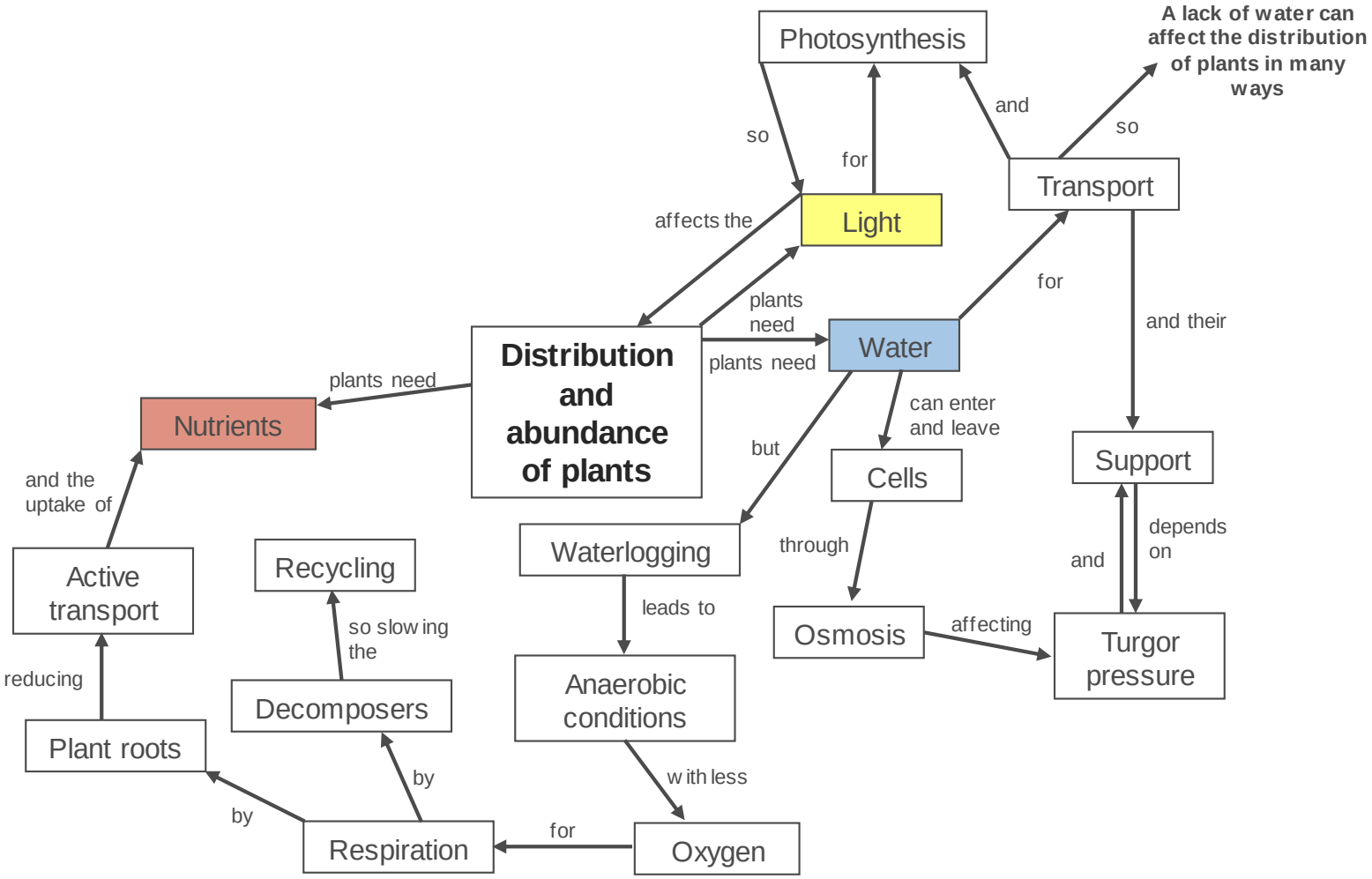
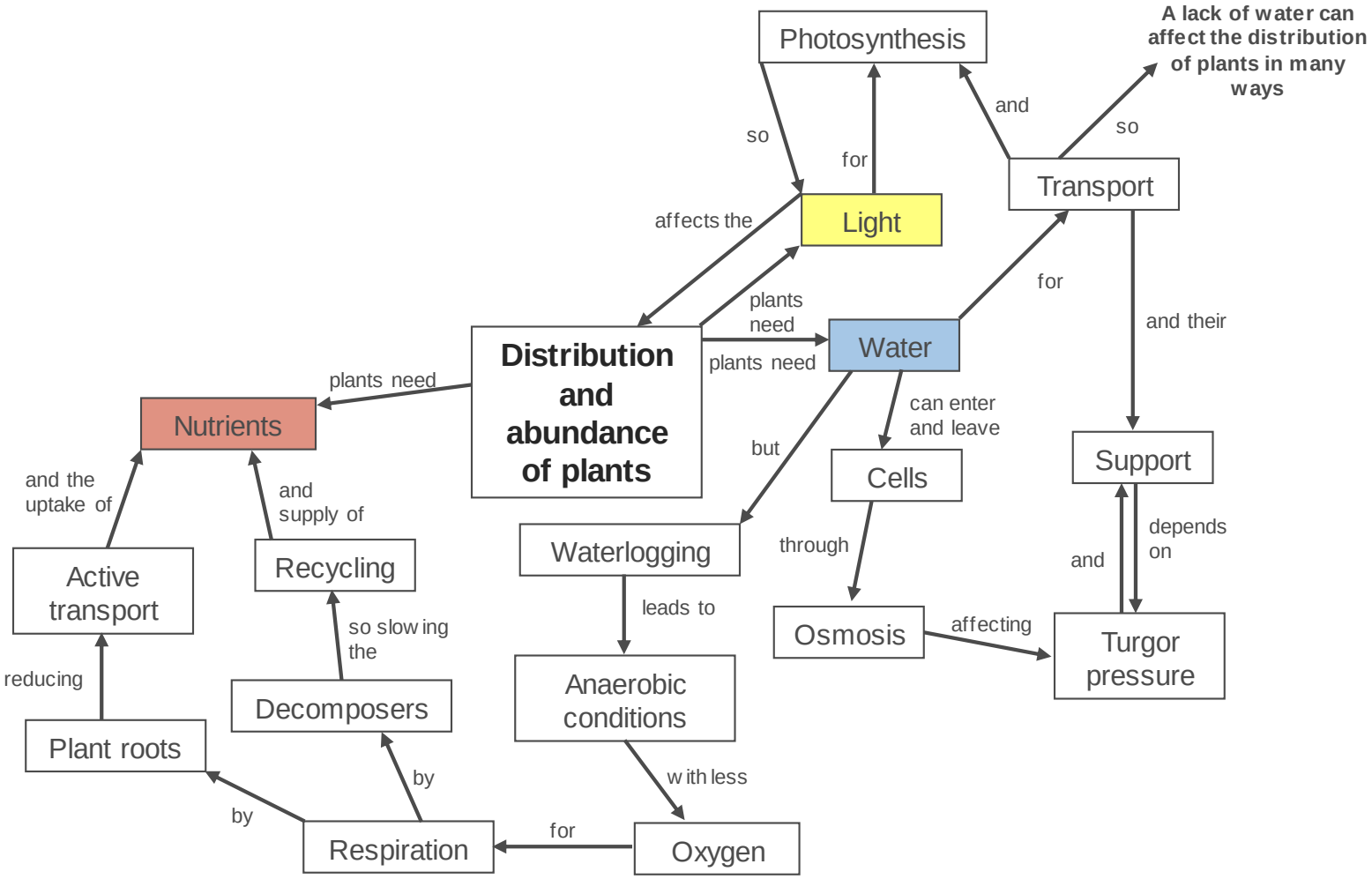


Plants – Synoptic Links



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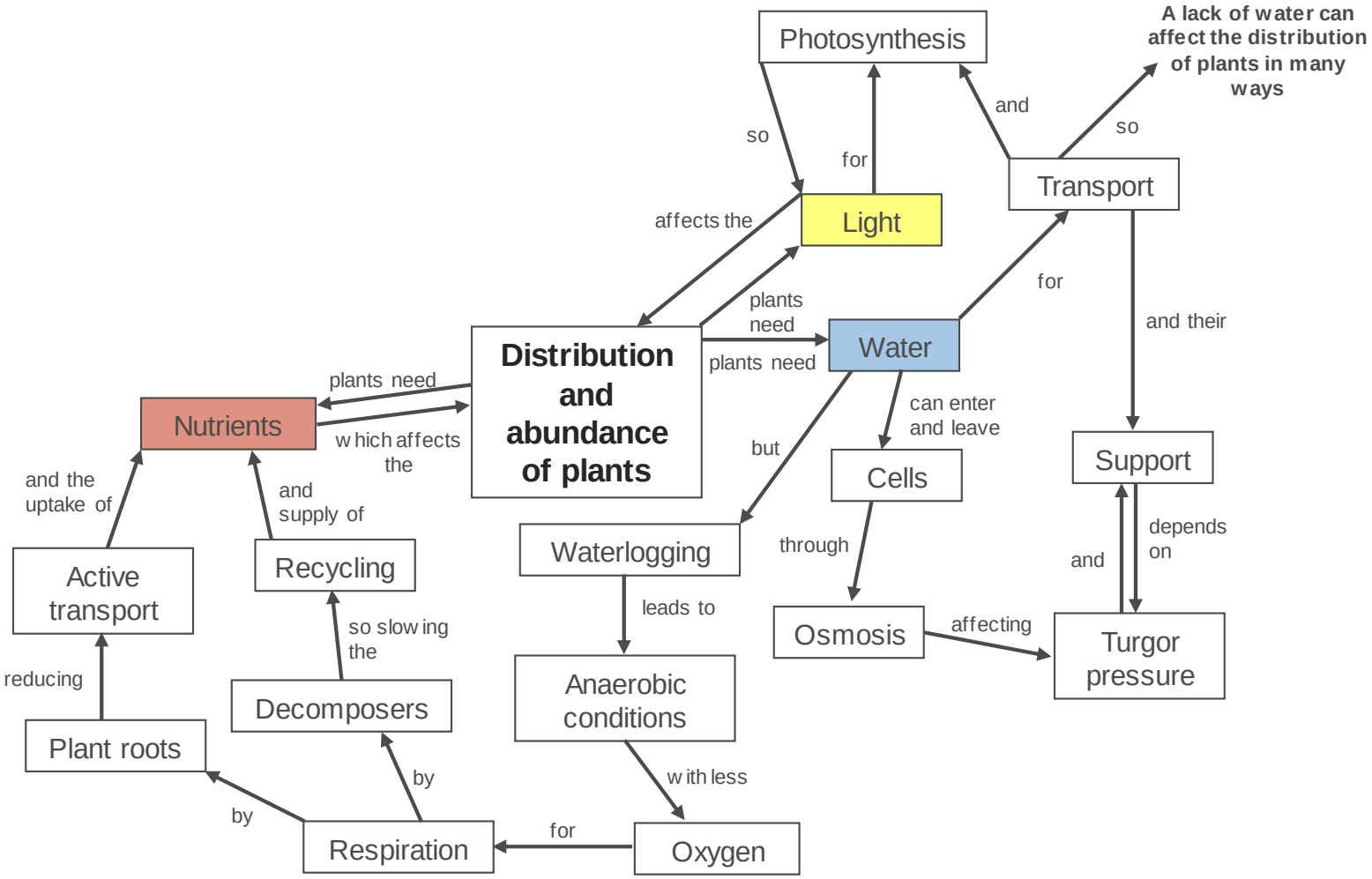
Plants – Synoptic Links



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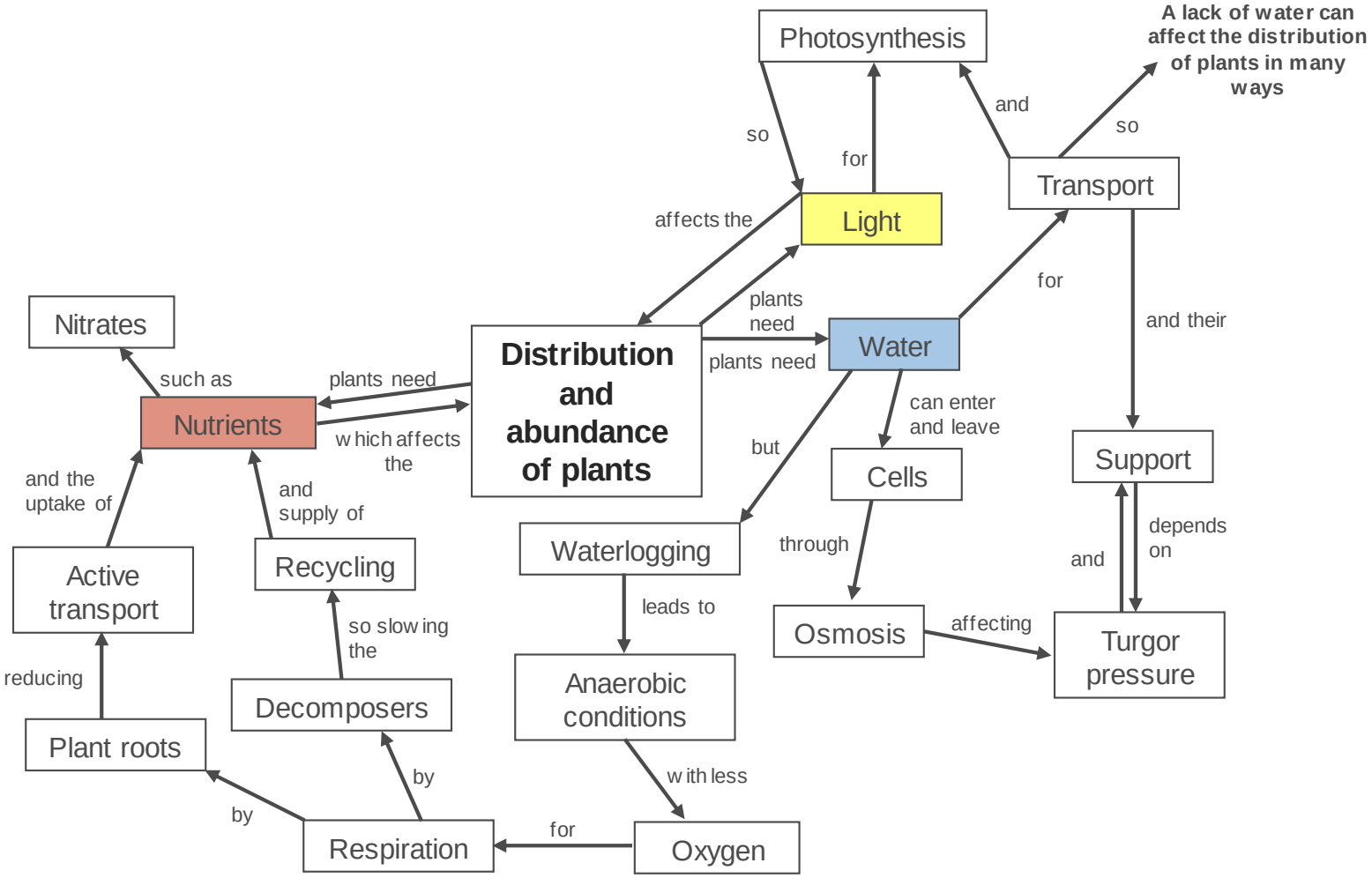

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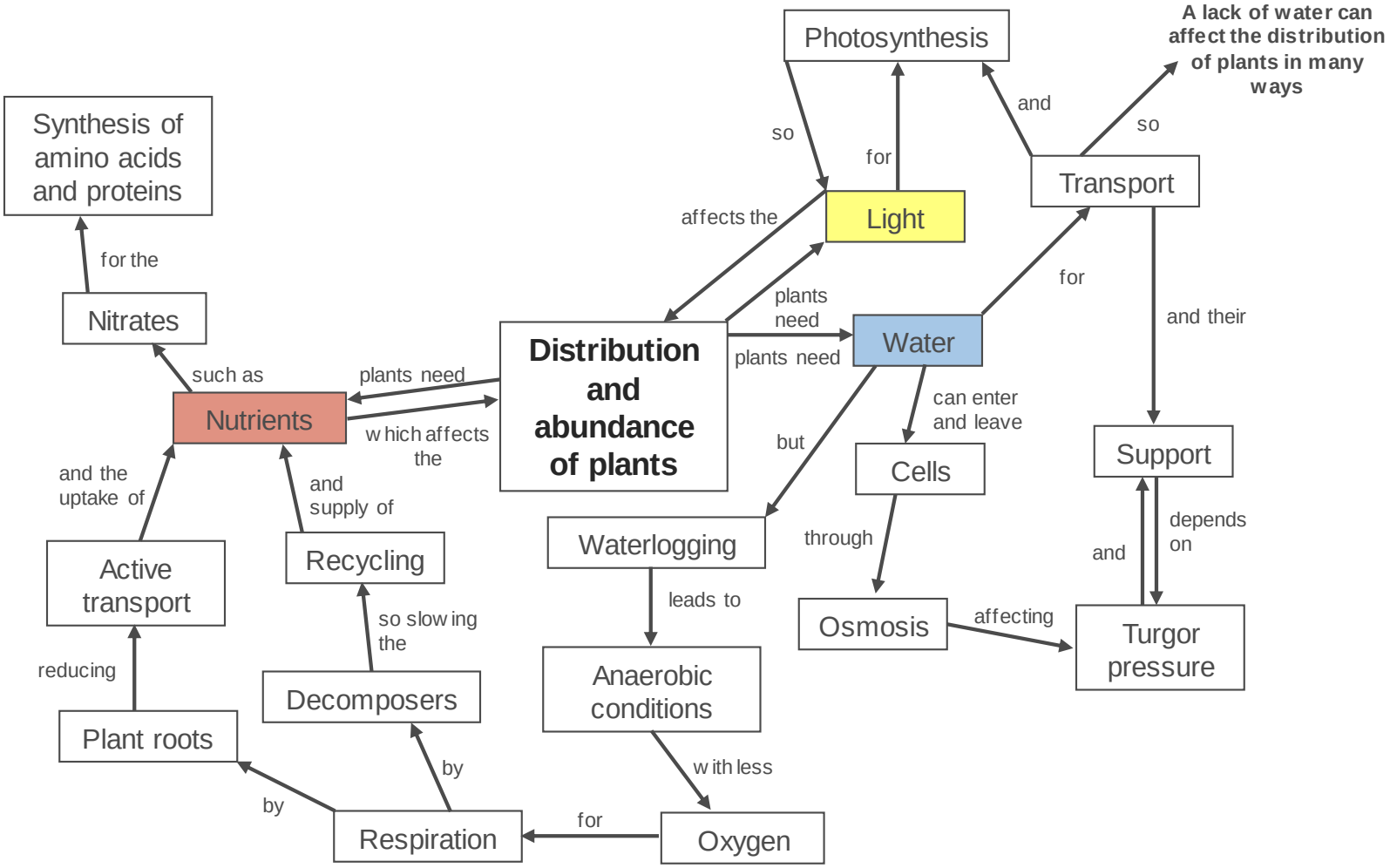

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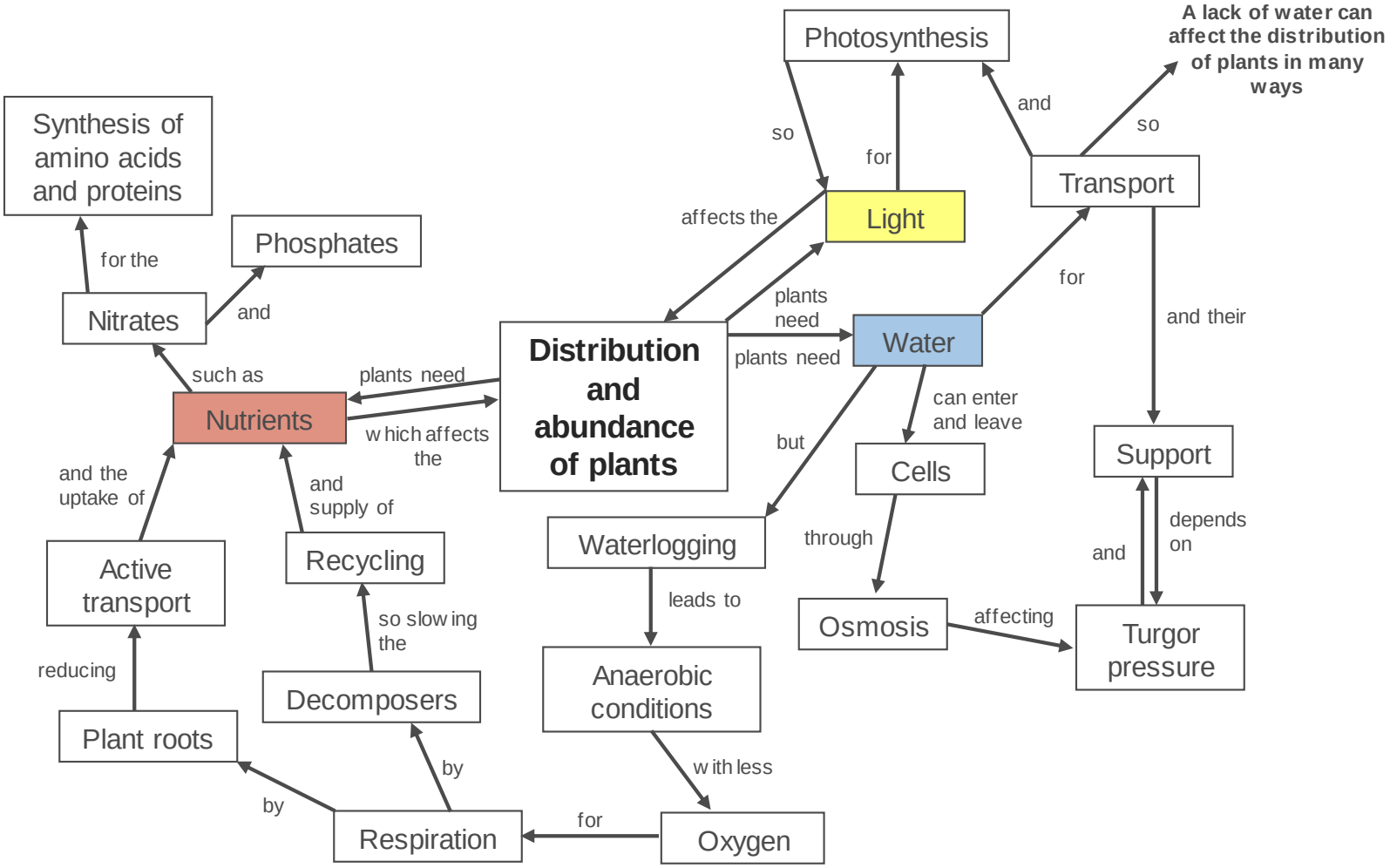

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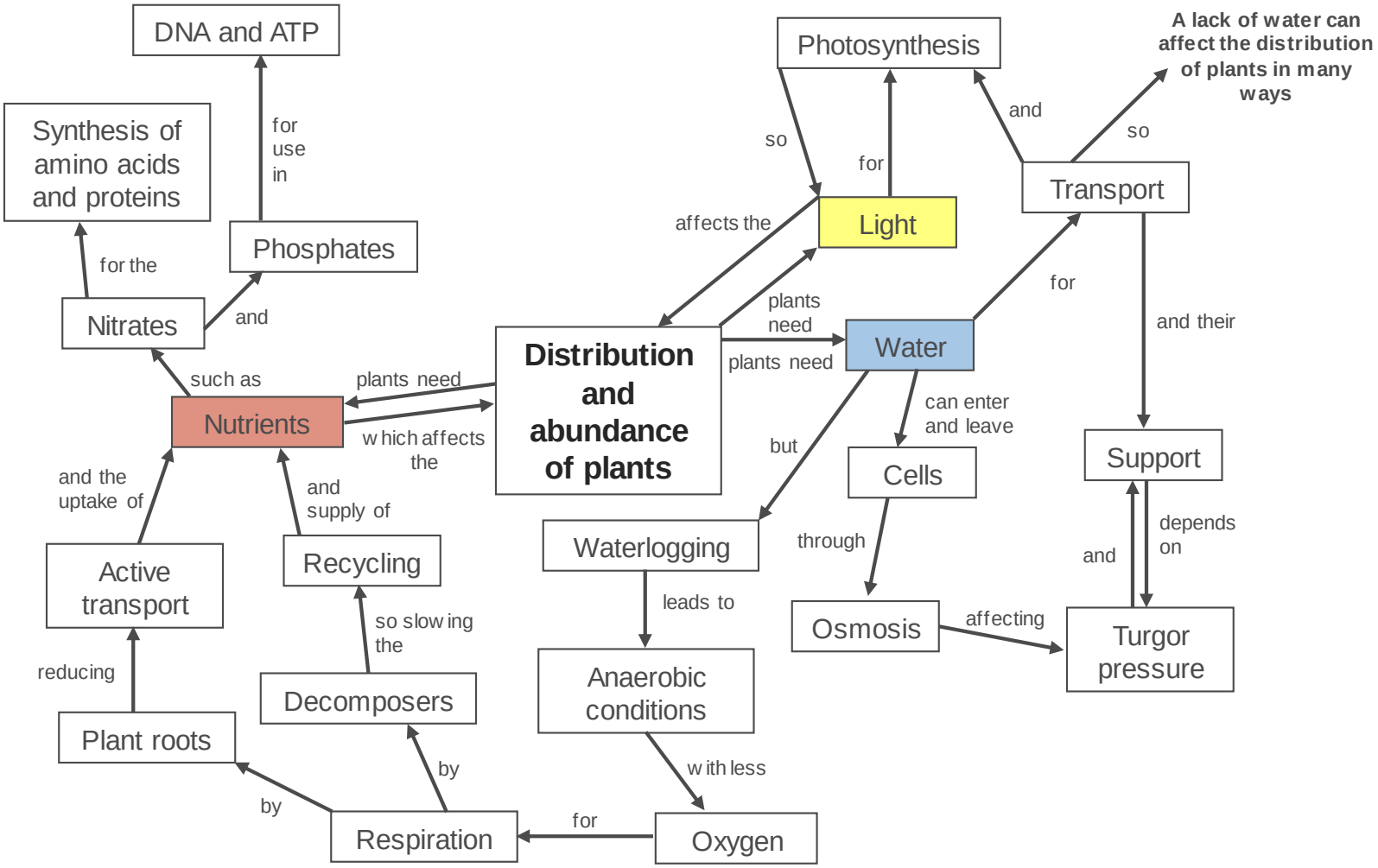

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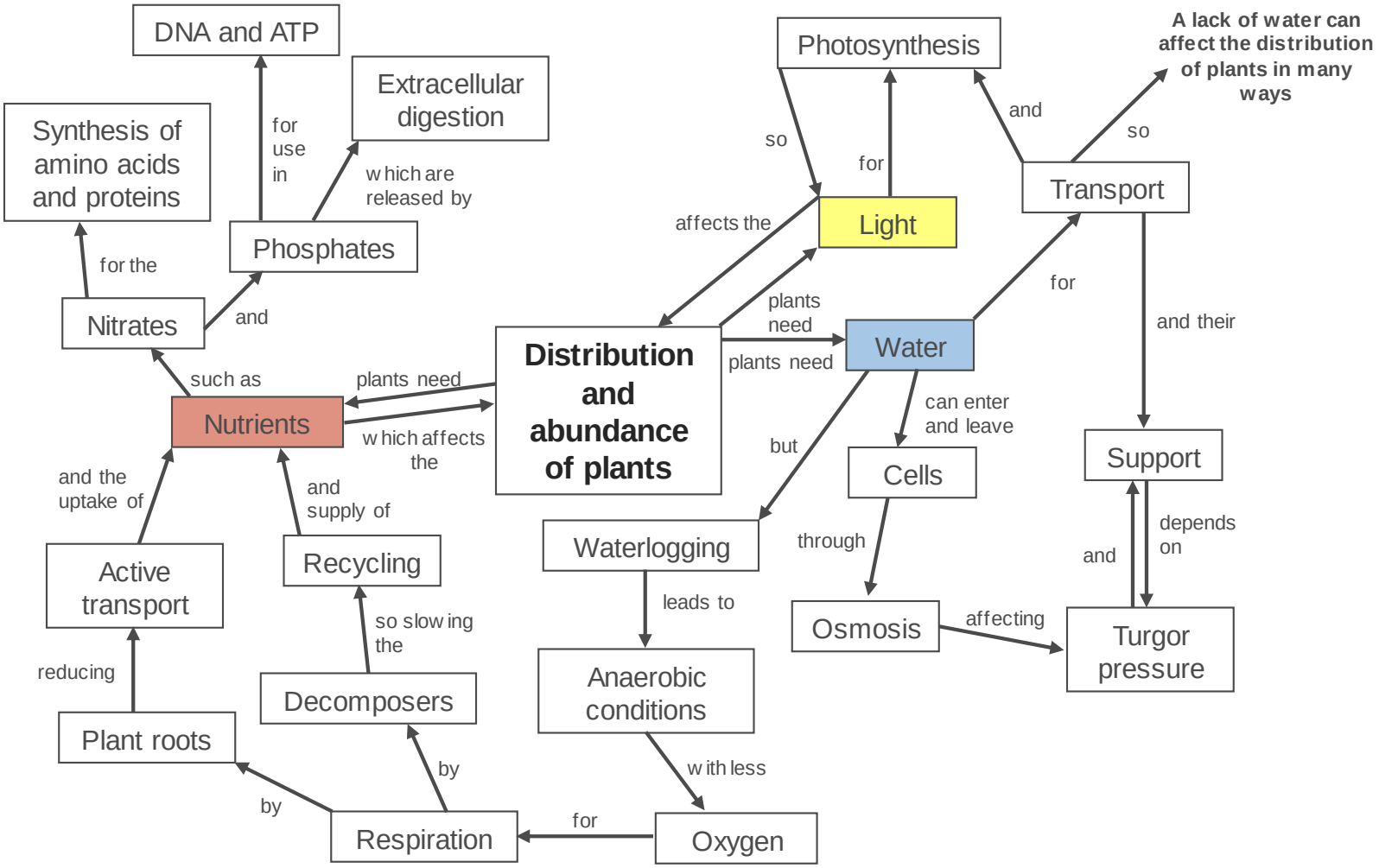

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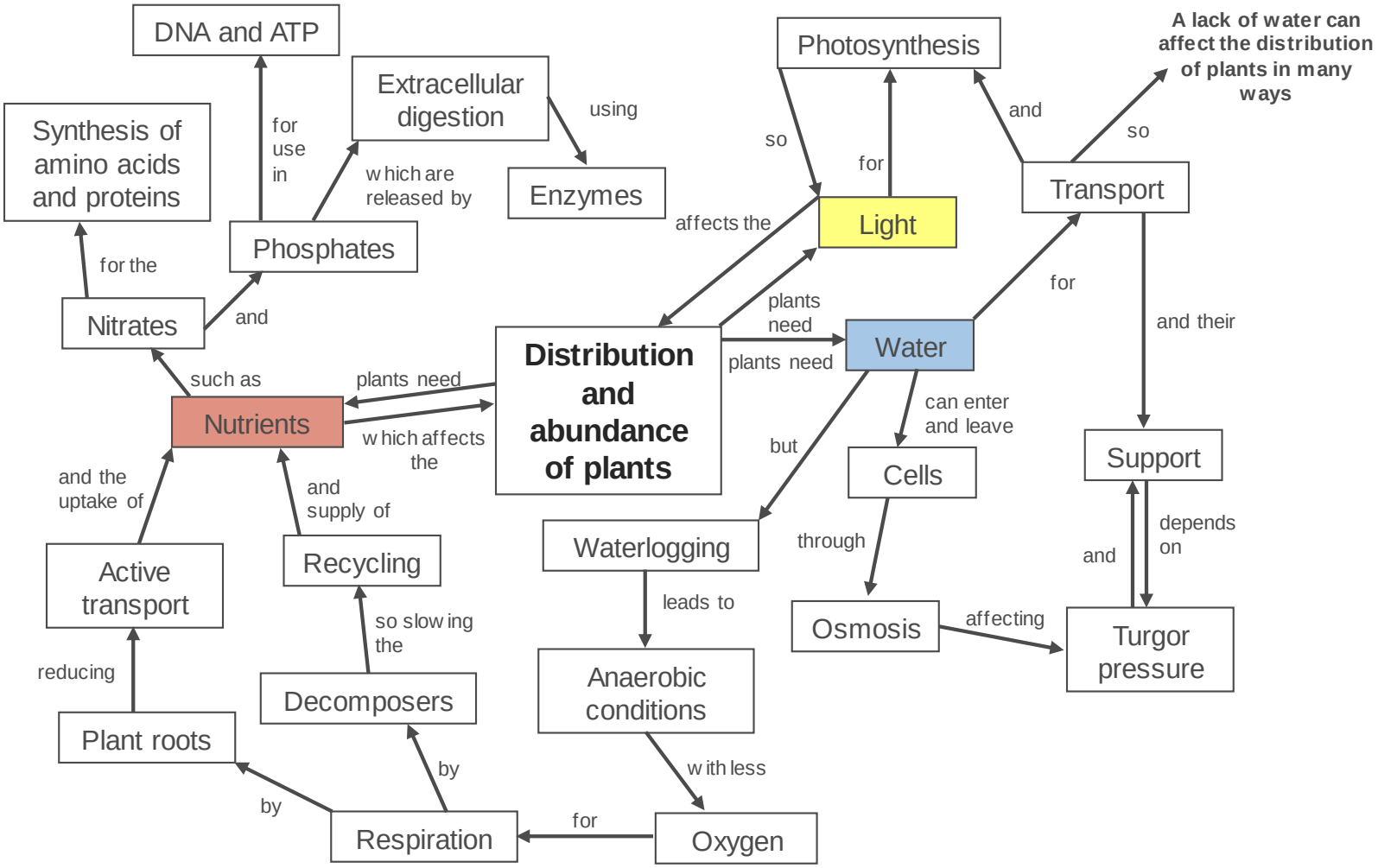

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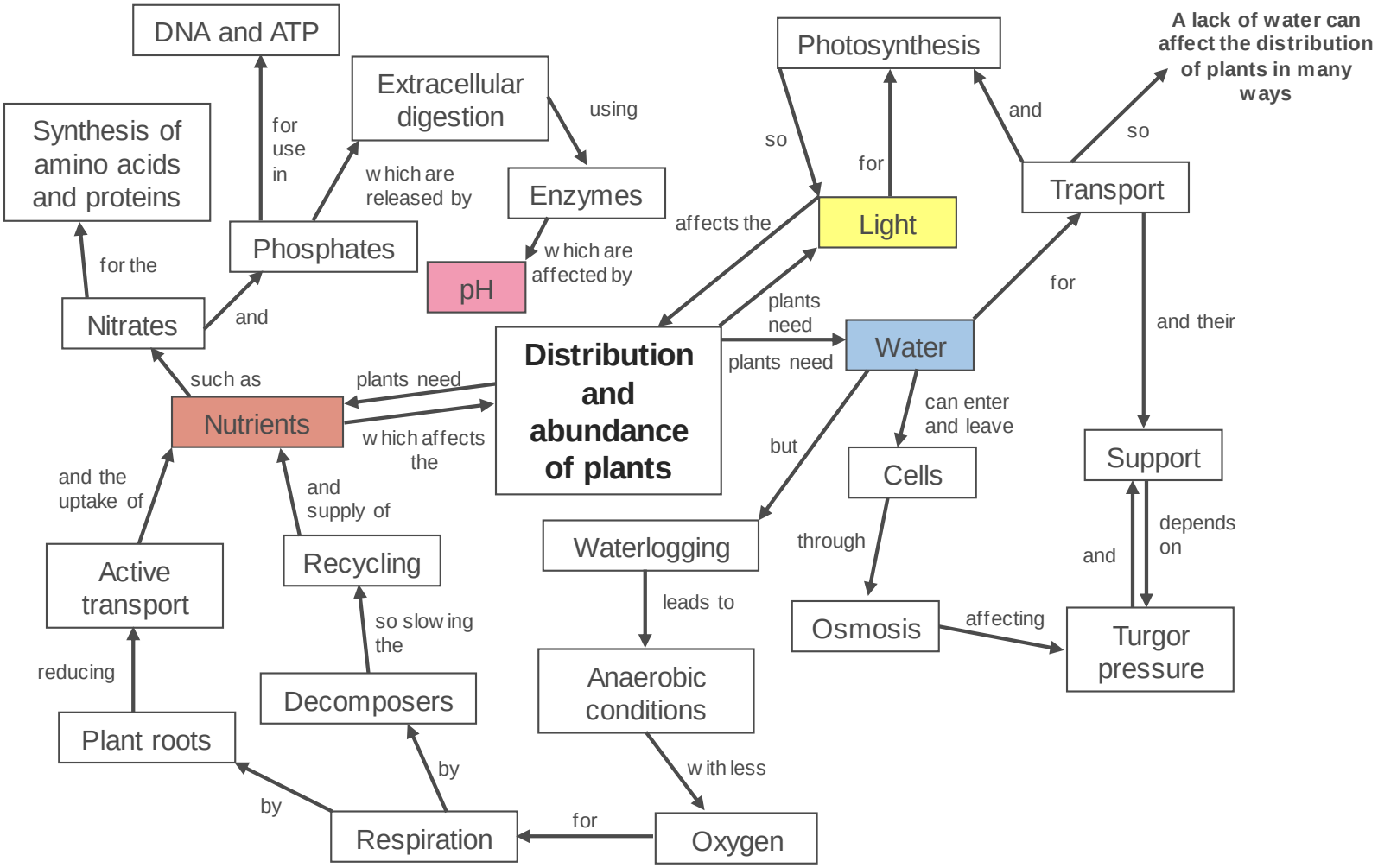

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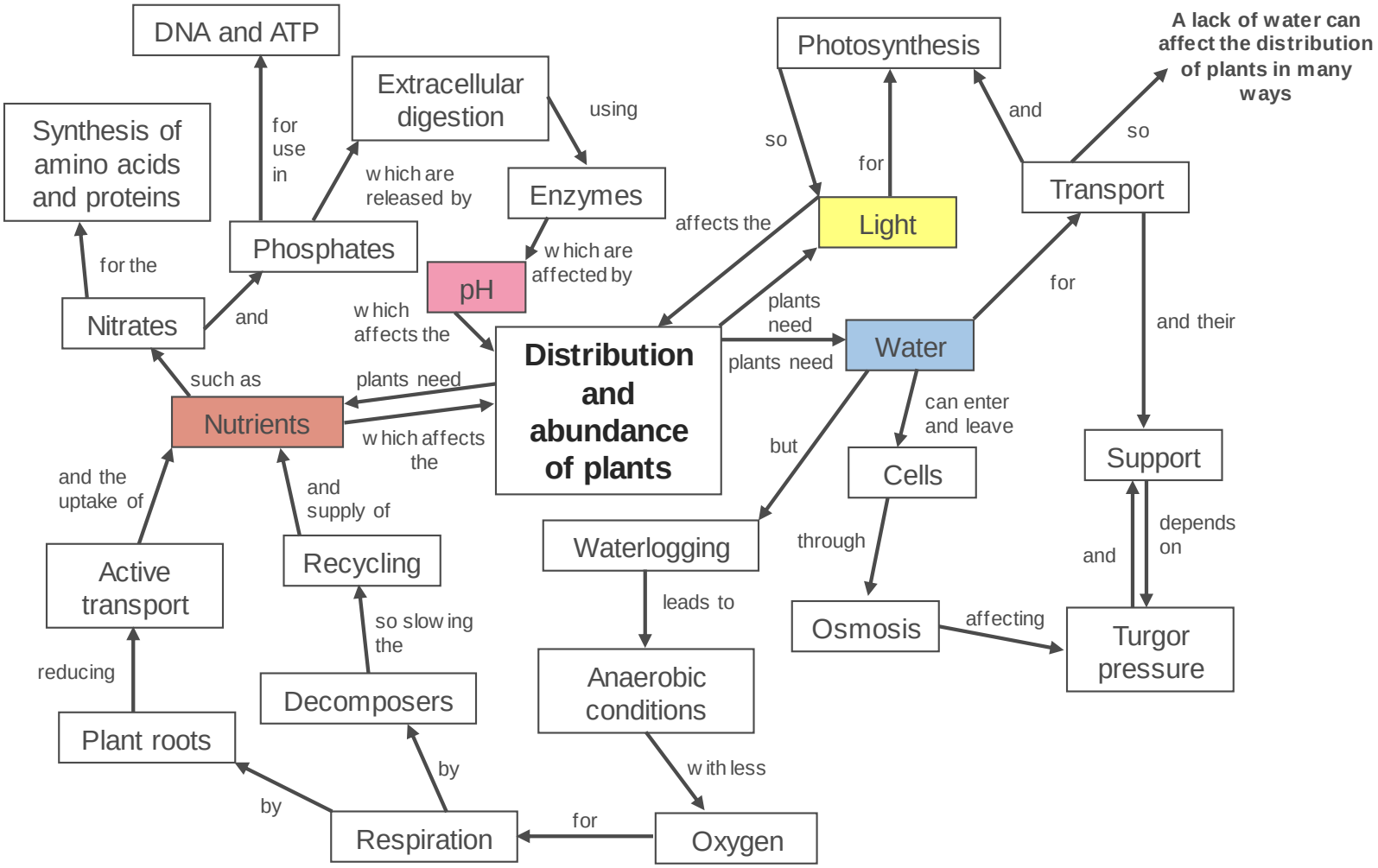

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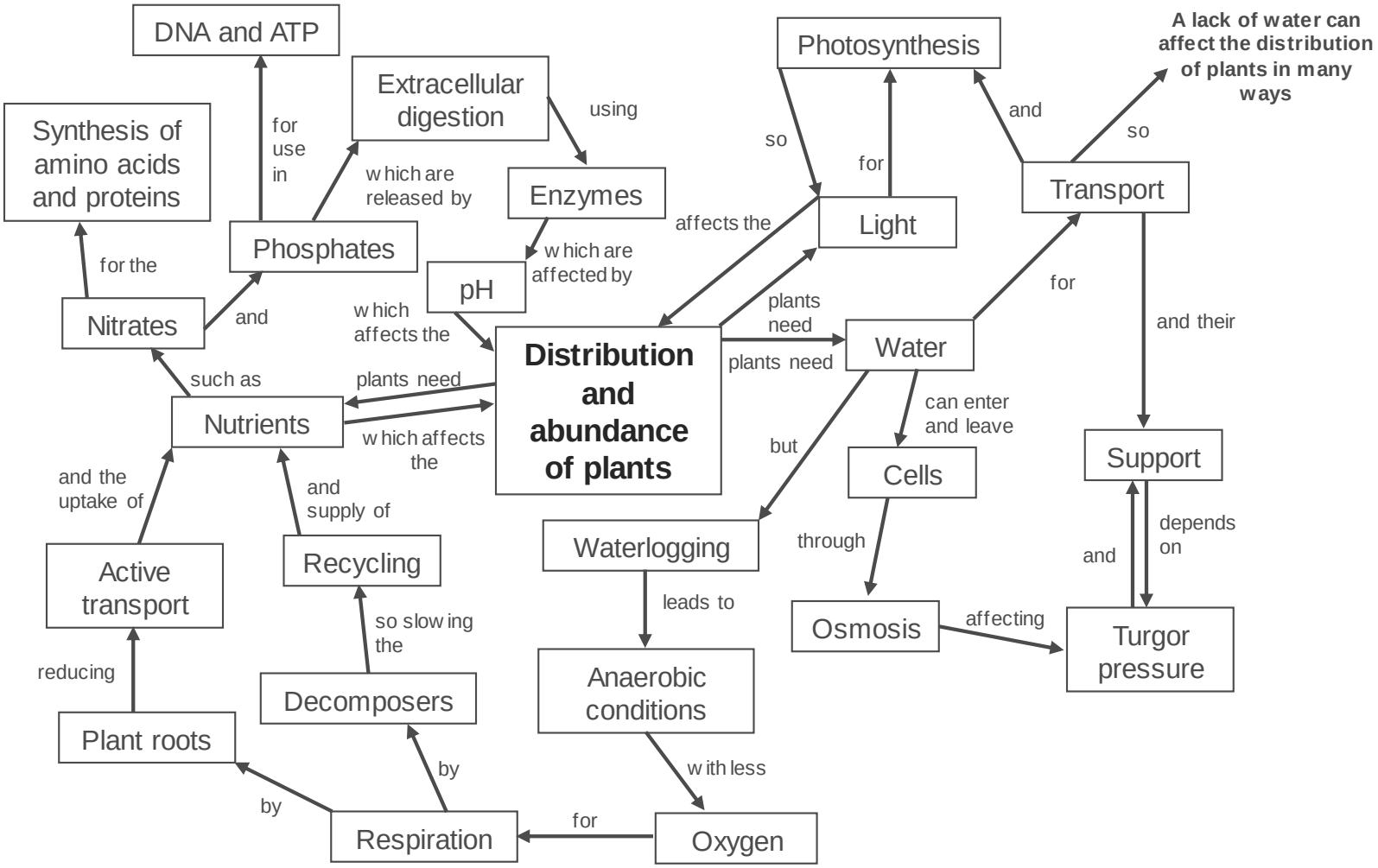
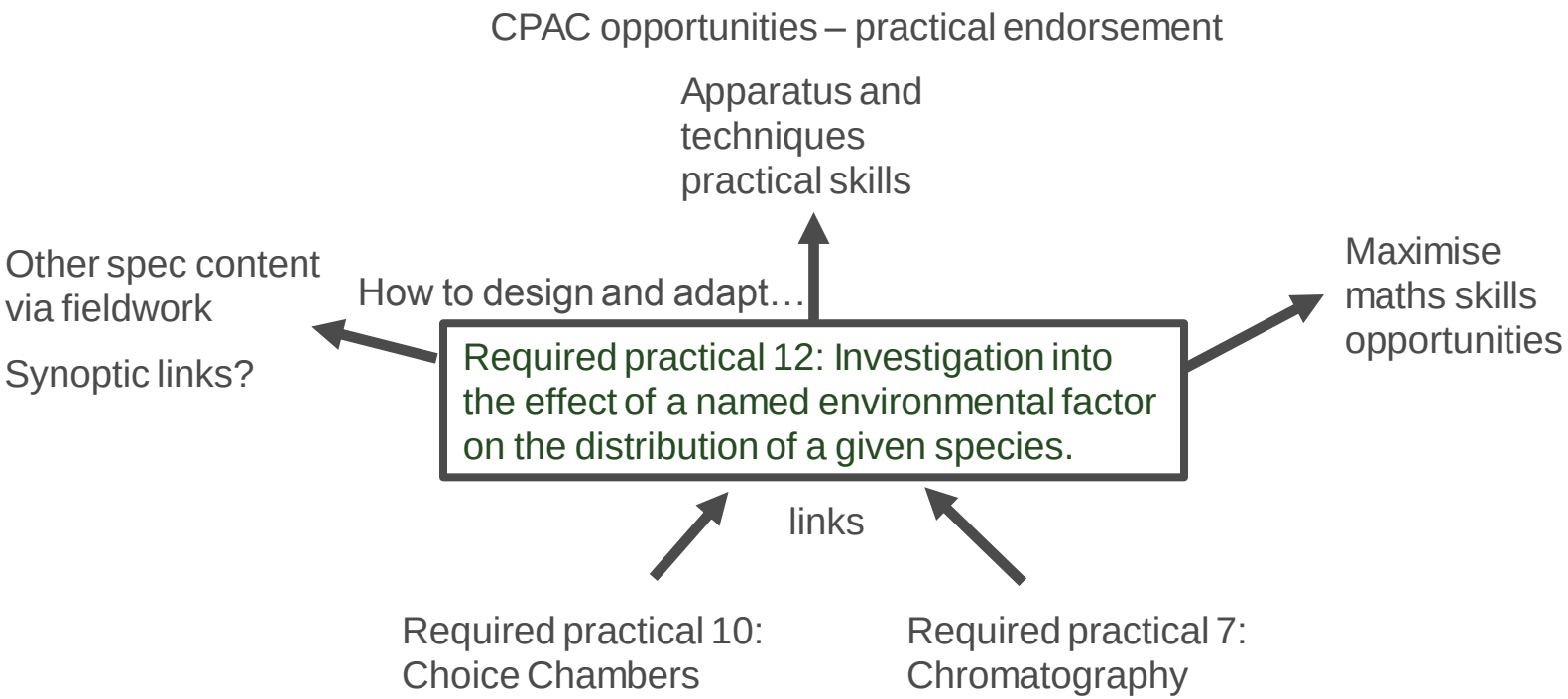


AQA

Review of aims



Also Field Studies Council aspirations…

Environmental awareness
Benefits of outdoor learning
'Real science'?

My challenge:

Use RP 12 as an example to show you how you can design a rich, synoptic learning experience (even using limited habitats at or near your school).

AQA

How can the Field Studies Council help?

FSC website age
field-studies-council.org

FSC Biology Fieldwork
http://www.biology-fieldwork.org/

- Residential or day field courses (taught)
- Teacher and professional training
- FSC publications

Other Projects:

- OPAL and outdoor learning – new CPD training
- BES/FSC summer science camp

Visit the FSC/OPAL stall.

How did we do?

- Please rate this session on the **Sched Conference app**.

- Using the post-its provided, please write:
  - one thing you enjoyed about our session or will take away for your teaching
  - one thing you feel could be improved.
- Stick these on the feedback poster as you leave.

Get in touch

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Thank you

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BRINGING ENVIRONMENTAL UNDERSTANDING TO ALL