Solutions :

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1. venus fly trap; ghost orchid; euglena;
2. dodder (some are photosynthetic); euglena; ghost orchid (some are photosynthetic);
3. dodder – consumer; euglena – consumer; ghost orchid – saprotroph;

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1. observed values:

	Heather Present	Heather Absent	Row Total
Moss Present	57	7	64
Moss Absent	9	27	36
Column Total	66	34	100

2. expected values:

based on the row totals, moss should be present 64% of the time and absent 36% of the time; this should hold in all four cell; based on the column totals, heather should be present 66% of the time and absent 34% of the time;

	Heather Present	Heather Absent	Row Total
Moss Present	$(64 \times 66)/100 = 42.2$	$(64 \times 34)/100 = 21.8$	64
Moss Absent	$(36 \times 66)/100 = 23.8$	$(36 \times 34)/100 = 12.2$	36
Column Total	66	34	100

3. d.f. = 4
4. critical value of 9.49 for 0.05 probability
5. chi-square statistic = 42.1374
6. H_0 = there is no association between the moss and heather; H_1 = there is an association between the moss and the heather; as $X^2 > 9.49$, then $p < 0.05$, therefore we accept H_1;
7. moss collects mineral particles and moisture that favours the growth of the heather;
8. draw a picture, divide into grids and then use a random number generator to sample grids or do a line transect and sample at fixed distances along the line;

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1. insolation decreases with increasing distance from the equator / inverse relationship;
2. **a)** 400 W/m^2

   b) 240-260 W/m^2
3. different levels of cloud cover / variations in the composition of the upper atmosphere that absorbs sunlight;
4. tropical rainforests are near equator so supported; rainforests in areas with high insolation, but not the highest in all areas; some high insolation areas are desert, such as Sahara/Atacama deserts; some tropical rainforests in areas of low insolation, like South East Asia;

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a) respiration rate increases with decreasing temperature below 12°C; temperature changes between 12°C and 33°C have no effect on respiration rate; as temperature climbs above 33°C respiration rate begins to increase (sharply);

b) bird is trying on maintain temperature; homeostasis; respiration generates waste heat; rise in metabolic rate undertaken to preserve core temperature; bird may increase motion as well to preserve core temperature;

c) increase in metabolic rate linked to activities designed to keep cool; such as evaporative cooling through increased ventilation rate; becoming hyperthermic / body temperature higher than normal; faster metabolism / enzyme-catalysed reactions including cell respiration;

d) random/expermental error; variation in surface area of birds effects temperature homeostasis; variation in muscle contractions / some birds more physically active than others;

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1. both are top predators; both occupy more than one trophic level; both can be predator/prey of the other; *belastoma* has higher productivity;
2. *Ranatra* and *Belostama* both can be considered as secondary, tertiary and quartenary consumer;
3. **a)** *Metaphyton* → *Hyalella* → *Telebasis* → *Belostoma;*

   b) telebasis;
4. first rung is sum of metaphyton and epiphyton energy values; first rung labelled as producers or with species name; Second rung is labelled primary consumers; second rung shown 5% as wide as first rung;
5. $\frac{\text{final-initial}}{\text{initial}} \times 100\% = -95.3\%$;
6. same organisms can occupy more than one trophic level at the same time; some organisms can occupy different trophic levels at different points in their life cycle; easier to define trophic level in a food chain rather than a food web;
7. determine the fraction of each organism's diet coming from each specific trophic level;

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1. it is in the spring;
2. **a)** higher in May than in October;

   b) photosynthesis in Northern Hemisphere forests depletes carbon dioxide in summer leading to lower amounts in autumn;
3. **a)** much higher in Northern Hemisphere;

   b) possible explanations: southern hemisphere forests becoming dormant; colder water, so more carbon dioxide dissolves; heavier use of fuel in Northern Hemisphere areas during Northern winter; greater rates of respiration with warmer Northern winters
4. **a)** the Equator;

   b) less fluctuations due to absence of seasons; presence of tropical rainforests to absorb carbon dioxide;

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1. light is on a timer and sharp rises and falls are due to light coming on and off; decline in each period is due to algae growth absorbing light as it grows;
2. six days;
3. **a)** becoming more basic;

   b) in light, pH rises; photosynthesis causes carbon dioxide absorption because $H_2CO_3 \rightarrow HCO_3^- + H^+ \rightarrow H_2O + CO_2$ is driven to the right; which raises pH;
4. when lights go off, photosynthesis stops and carbon dioxide is (net) released which lowers pH; $H_2O + CO_2 \rightarrow HCO_3^- + H^+$

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1. **a)** increasing the temperature increases the release of carbon; the effect is more significant in moist soils than waterlogged soils;

   b) higher temperature means higher rates of chemical reactions, including respiration which releases CO_2;

2. **a)** in both cases, carbon release increases with temperature; an increase in carbon release is much higher in moist rather than water logged soils;

   b) in water-logged soils, more anaerobic respiration in bacteria and fungus; only some have alcoholic fermentation; anaerobic respiration releases less carbon;

3. adding fertilizer impacts carbon release – in moist soils only;

4. water-logging of soils has the highest negative impact on carbon release; temperature has the most significant positive impact;

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1. approximately 210 days of decreasing versus approximately 160 days of increasing;

2. June and July (highest); November and December (lowest);

3. high rates of photosynthesis in summer due to high insolation and warm temperatures leads to high NEP; low rates of photosynthesis with cellular respiration

4. net flux is into forest as although there are fewer days, there are much higher NEP rates in the summer;

5. because they could capture CO_2 and store it;

greater fraction of incident light energy lost in desert; deserts are less productive/less vegetation to fix energy;

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1. during the years that both data sets are overlapping, they support the same conclusion; the ice core data extends over a greater time period;

2. both appear to rise exponentially from 1970/80; rise in carbon dioxide appears to precede rise in temperature;

3. $0.22 - (-0.19) = > 2000 - 1900 = 0.41$ C $\quad 0.41 - (-0.21) = > 2005 - 1905 = 0.62$ C

4. **a)** some possible explanations:
   natural variability / solar variability / variations in fossil fuel use; local conditions at monitoring stations vary; feedback systems from the earth triggered by warming;

   b) they suggest that CO_2 is not the only variable influencing temperature; strong correlation both in figure 5 and in the figure 6 + 7;

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1. **a)** 1990;

   b) 1970;

2. **a)** the higher the temperature, the earlier the opening of the chestnut leaves;

   b) over the final 10 year period, highest average temperatures occurred; pervious pattern appeared to be cyclical; supports claim of global worming;

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1. greater affluence in the US leading to more transportation; more use of air conditioning in the US; no winter so no heating use in Brazil; greater industrial activity in the US;
2. warm year; increased use of air conditioning; fossil fuel use in oil production;
3. forest fires; to clear land for farming; combustion releases carbon dioxide;
4. farming activities releasing methane;

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1. AIFI;
2. minimum 1.1 °C; maximum 5.9 °C;
3. 1.8 °C;
4. 2.1 °C in the Arctic versus 1.8 °C global average; Arctic temperature rise is higher than global average;
5. whether positive feedback cycles will exacerbate the problem; such as melting of polar ice caps; or permafrost melting; or increase in cloud cover;
6. depends on whether data used by centres is the same or independently gathered; more centres means more validity; similar logic applies to positive impact of sample size on certainty in IA experiments;
7. according to precautionary principle strong action called for because consequences of inaction are potentially catastrophic; costs of mitigation should be borne equally; developing nations need assess to carbon production to achieve higher standard of living; will require greater reductions in developed world;
8. forces acting in support of avoiding economic risk are more powerful; some shifts in economic activity possible; local versus global economies; shift to greater degree of subsistence activities; fossil fuel shortage may aid shift.

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1.

	Espèces A présentes	Espèces A absentes	Total des rangés
Espèces B présentes	**57**	**7**	**64**
Espèces B absentes	**9**	**27**	**36**
Total des colonnes	**66**	**34**	**100**

2.

$$ex : \ Fréquence\ prévue\ pour\ espèces\ A\ et\ B\ présentes = \frac{66 \times 64}{100} = 42{,}24$$

3. Calculer le degré de liberté en utilisant formule suivante où «m» et «n» sont le nombre de rangés et de colonnes dans le tableau croisé.

$$degré\ de\ liberté = (2-1)(2-1) = 1$$

4. La valeur critique du test du chi-carré selon un tableau de valeur en utilisant le degré de liberté de 1 et le niveau «p» de probabilité (signification) de 5% est 3,84.

5. Calculer la valeur du chi-carré en utilisant l'équation : $\sum \frac{(f_o - f_p)^2}{f_p}$

   Où : f_o est la valeur observée, f_p est la valeur prévue et Σ est la somme

Combinaisons	**Observés (O)**	**Prévus (P)**	$\frac{(O-P)^2}{P}$
A et B présentes	57	42,24	5,16
A présentes et B absentes	9	23,76	9,17
A absentes et B présentes	7	21,76	10,01
A et B absentes	27	12,24	17,80
Total	**100**	**100**	**42,14**

6. Comparer la valeur du chi-carré avec la valeur critique du tableau.

   - La valeur calculée est supérieure à 3,84, il y a une évidence d'association entre les deux espèces et l'hypothèse nulle (H_0) est rejetée.

7. La méthode des quadrats et le chi-carré pour la distribution des ☺ et des ☻.
    a. les 20 coordonnées utilisées sont les suivantes
    b. (4, 10) ; (11, 1); (13, 4) : (4, 9) : (3, 1) : (15, 2) : (2, 6) : (1, 10) : (15, 8) : (14, 7) : (3, 11) : (9, 8) : (12, 9) : (15, 10) : (15, 1) : (7, 10) : (8, 4) : (5, 11) : (8, 9) : (2, 10)

	☻ présents.	☻ absents.	Total des rangés
☺ présents	**8**	**7**	**15**
☺ absents	**1**	**4**	**5**
Total des colonnes	**9**	**11**	**20**

Combinaisons	**Observés (O)**	**Prévus (P)**	$\frac{(O-P)^2}{P}$
☺ et ☻ présentes	8	6,75	0,231
☺ présentes et ☻ absentes	7	8,25	0,189
☺ absentes et ☻ présentes	1	2,25	0,694
☺ et ☻ absentes	4	2,75	0,568
Total	**20**	**20**	**1,682**

- La valeur calculée est inférieure à 3,84, il n'y a aucun évidence d'association entre les deux espèces et l'hypothèse nulle (H_0) est acceptée.