Biology Summer Work 2023

1) Prepare for your September assessment. This will cover ALL of the AS material. Be prepared for this to be in the first lesson back after the summer break.

2) Complete and self-assess the Biozone pages within this pack

3) Complete the Educake quiz recapping kidneys, brain and thermoregulation

4)

Links to help:

How to Make a Kite Graph Video

https://www.youtube.com/watch?v=_yKtAHhTF50

How to Draw a Kite Diagram

https://slidetodoc.com/kite-diagrams-kite-diagrams-are-a-visual-picture/

Khan Academy Ecological Succession

https://tinyurl.com/s5aett6v

Sand Dunes Succession

https://www.biology-fieldwork.org/a-level/succession/sand-dunes/

Kite Diagrams

A kite diagram can be used to compare the distribution of different species along a transect.

Watch the video linked above. Draw one kite diagram to show the distribution of different species (plants AND animals) along the transect. You will be emailed the data for this separately.

Guidance:

- You must hand-draw your kite diagram using graph paper, a pencil and a ruler
- You must include a table showing the original data used
- You must include a scale showing how many organisms each box represents. If you have a particularly large number of organisms for one species in your data you may need to draw separate kite diagrams with different scales
- Include clear and descriptive titles and axis labels
- Plan your diagrams carefully to ensure your 'kites' will not overlap
- Write a paragraph summarising what your kite diagram shows in terms of species distribution. Link this to the change in the following abiotic factors as you move along the transect – light intensity, salinity, length of time covered by tide.
- Have this ready to hand in first lesson back in year 13 – collect graph paper if needed.

47 Tropisms and Growth Responses

Key Idea: Tropisms are directional growth responses to external stimuli. They may be positive (towards a stimulus) or negative (away from a stimulus).

Tropisms are plant growth responses to external stimuli, in which the stimulus direction determines the direction of the growth response. Tropisms are identified according to the stimulus involved, e.g. photo- (light), geo- (gravity), hydro- (water), and are identified as positive (towards the stimulus) or negative (away from the stimulus). Tropisms act to position the plant in the most favourable available environment.

(a) ....
A positive growth response to a chemical stimulus. *Example: Pollen tubes grow towards a chemical, possibly calcium ions, released by the ovule of the flower.*

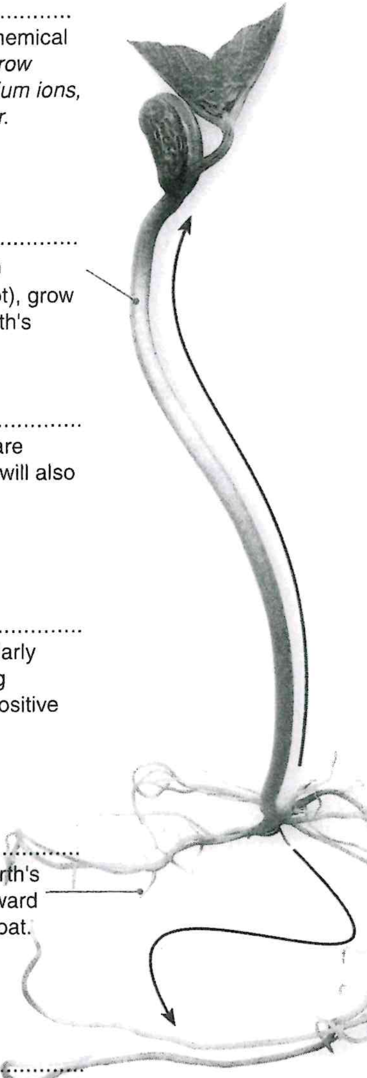
(b) ....
Stems and coleoptiles (the sheath surrounding the young grass shoot), grow away from the direction of the Earth's gravitational pull.

(c) ....
Growth response to water. Roots are influenced primarily by gravity but will also grow towards water.

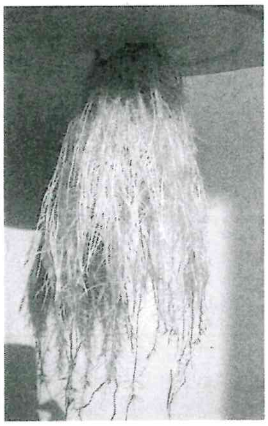
(d) ....
Growth responses to light, particularly directional light. Coleoptiles, young stems, and some leaves show a positive response.

(e) ....
Roots respond positively to the Earth's gravitational pull, and curve downward after emerging through the seed coat.

(f) ....
Growth responses to touch or pressure. Tendrils (modified leaves) have a positive coiling response stimulated by touch.

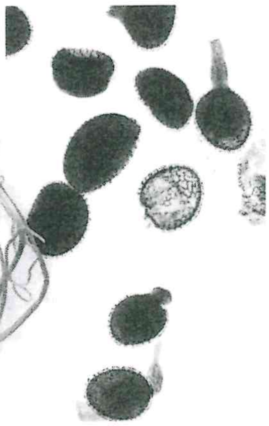


Plant growth responses are adaptive in that they position the plant in a suitable growing environment, within the limits of the position in which it germinated. The responses to stimuli reinforce the appropriate growth behaviour, e.g. roots grow towards gravity and away from the light.

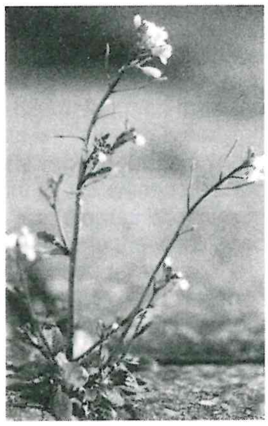


Root mass in a hydroponically grown plant

Sweet pea tendrils



Germinating pollen



Kristian Peters

Thale cress bending to the light

1. Identify each of the plant tropisms described in (a)-(f) above. State whether the response is positive or negative.

2. Describe the adaptive value of the following tropisms:

   (a) Positive geotropism in roots: ______________________________

   (b) Positive phototropism in coleoptiles: ______________________________

   (c) Positive thigmomorphogenesis in weak stemmed plants: ______________________________

   (d) Positive chemotropism in pollen grains: ______________________________

3. Explain the adaptive value of tropisms: ______________________________

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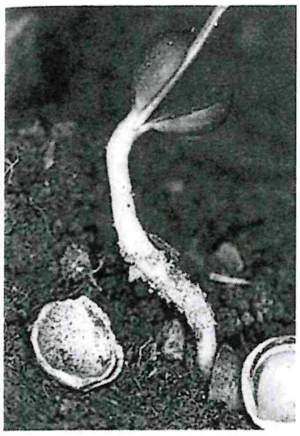
51 Regulating Seasonal and Daily Events

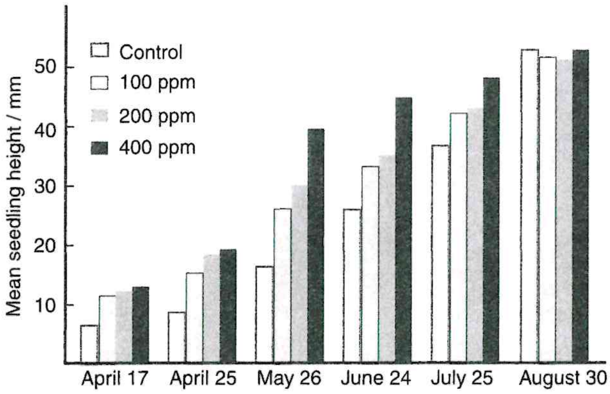
Key Idea: Plant hormones play crucial roles in the timing of activities such as leaf loss, germination, and stomatal closure. Plant hormones (or phytohormones) are chemicals that act as signal molecules to regulate plant growth and responses. Alone or together, plant hormones target specific cells to cause a specific effect. Many have roles in coordinating timing responses in plants including promoting seed germination, leaf loss, and stomatal closure (below).

Seed germination



In plants, germination refers to when a seed begins to sprout (left) and develop into a seedling. This process is controlled by a group of hormones called **gibberellins** (GA). When conditions are favourable for growth (e.g. moist, warm soil temperature) gibberellins break seed dormancy and promote the growth of the seed. Cell division and cell elongation are stimulated, allowing the root to penetrate the seed coat.

The effect of gibberellic acid on the growth of rhododendron seedlings



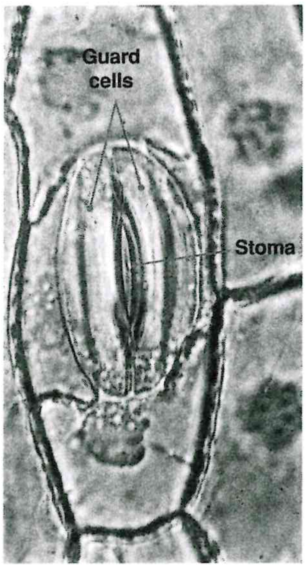
Adapted from Ticknor, R. *Journal American Rhododendron Society*. Volume 12(2) April 1958

The effect of gibberellic acid (a type of gibberellin) on germination in rhododendron seedlings is shown above. Seeds were initially germinated on sphagnum moss and transferred into soil when two leaves formed. Gibberellic acid of varying concentrations (100, 200, or 400 ppm) was sprayed on the seedlings when they reached 5 mm in height. The controls received no gibberellic acid. The height of the seedlings was measured at varying time intervals (above). Each bar represents the mean height of 15 seedlings.

Leaf loss in deciduous plants

Deciduous plants shed their leaves every autumn in a process called **abscission**. The plant hormones **auxin** and **ethylene** work together to cause leaf loss. As the leaf ages, auxin levels within the leaf drop. The plant becomes more sensitive to the effects of ethylene, and gene expression of enzymes involved in cell wall degradation (e.g. cellulase) increases. These enzymes begin to break down the cell wall in localised regions (the separation layer) at the base of the leaf stalk (petiole). As a result the leaf and its stalk fall away.

Stomatal closure



Gas exchange and water loss from plants occur via stomata (pores on the surfaces of leaves). Turgor changes in the guard cells flanking the stomata open and close the pore (the pore opens when the guard cells are swollen tight and closes when they are flaccid). This regulates the rate of gas exchange and water loss. The hormone abscisic acid (ABA) is involved in regulating stomatal closure. In times of drought or high salinity, ABA levels increase, causing K^+ and Cl^- to leave the guard cells. Water follows by osmosis and the stomata close, reducing water loss via transpiration and conserving water.

1. Describe the results for the graph above and determine if gibberellic acid has any effect on seedling growth: ______________________________

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2. Describe the role of auxin and ethylene in leaf loss: ______________________________

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3. Why is ABA important in the survival of plants during times of drought? ______________________________

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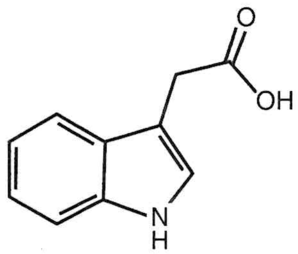
53 The Role of Auxins in Apical Dominance

Key Idea: Auxin promotes apical growth in plants and inhibits the growth of lateral (side) buds.

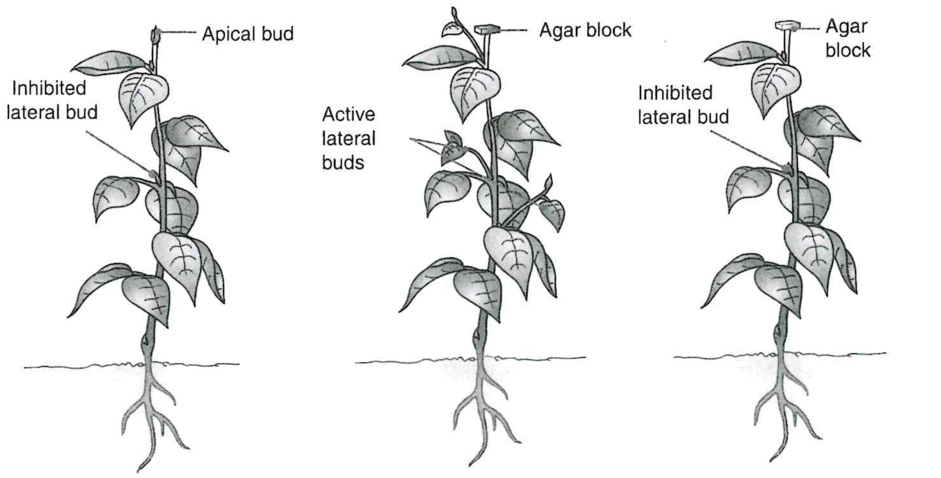
Auxins are responsible for apical dominance in shoots. Auxin is produced in the shoot tip and diffuses down to inhibit the development of the lateral (side) buds. The effect of auxin on preventing the development of lateral buds can be demonstrated by removing the source of the auxin and examining the outcome (below).

Auxin was the first substance to be identified as a plant hormone. Charles Darwin and his son Francis were first to recognise its role in stimulating cell elongation. Frits W. Went isolated this growth-regulating substance, which he called auxin, in 1926. Auxin promotes **apical dominance**, where the shoot tip or apical bud inhibits the formation of lateral (side) buds. As a result, plants tend to grow a single main stem upwards, which dominates over lateral branches.



Indole-acetic acid (above) is the only known naturally occurring auxin. It is produced in the apical shoot and young leaves.

No treatment	Treatment one	Treatment two
Apical bud is left intact.	Apical bud is removed; no auxin is applied.	Apical bud is removed; auxin is applied.



In an intact plant, the plant stem elongates and the lateral buds remain inactive. No side growth occurs.	The apical bud is removed and an agar block without auxin is placed on the cut surface. The seedling begins to develop lateral buds.	The apical bud is removed and an agar block containing auxin is placed on the cut surface. Lateral bud development is inhibited.

Two conclusions can be drawn from this experiment.

(1) The apical bud contains a hormone that inhibits lateral growth because its removal promoted lateral growth.

(2) The presence of auxin in the apical bud inhibits lateral growth because auxin applied to a cut stem tip could inhibit lateral growth and mimic the effect of an intact apical bud.

1. Describe the role of auxins in apical dominance: ______________________________

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____

2. Outline the experimental evidence supporting the role of auxins in apical dominance: ______________________________

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3. Study the photo (right) and then answer the following questions:

(a) Label the apical bud. (b) Label the lateral bud(s).

(c) Which buds are the largest? ______________________________

(d) Why would this be important? ______________________________

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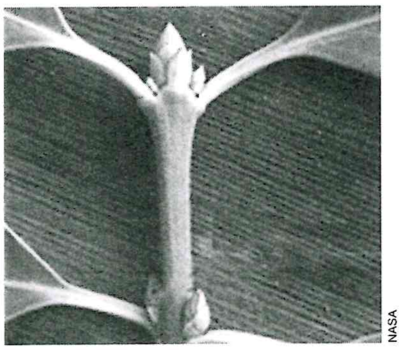

4. If you were a gardener, how would you make your plants bushier? ______________________________

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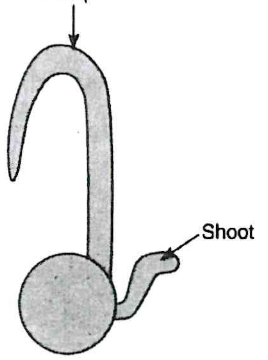
50. Investigation of Geotropism in Roots (page 66)

1. (a) Down (towards the ground).
   (b) The root began to curve towards the ground.
   (c) The direction of the pull of gravity relative to the root had changed and so the root curved to compensate for the change of direction and continue to grow down.
   (d)



2. (a) Up (away from the ground)
   (b) The shoot continued to grow away from the ground.
   (c) The shoot reorientated itself to grow away from the ground, as this is the direction in which it is most likely to find light.

51. Regulating Seasonal and Daily Events (page 67)

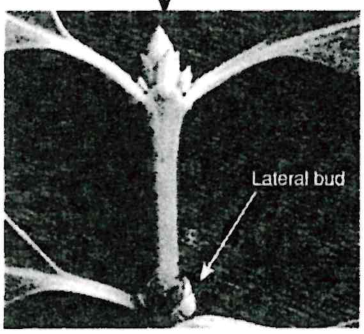
1. Gibberellic acid (GA) increased the height of the seedlings for the first four months of the experiment, with the mean height of seedlings treated with GA being greater than for the control (no GA). Increase in seedling height corresponded to GA concentration, with the greatest mean seedling height occurring at the highest GA concentration. After five months there was little to no difference between the height of seedlings with and without GA.
2. As the leaf ages, auxin levels drop making it more sensitive to ethylene. Ethylene is involved in the production of enzymes (e.g. cellulase) that break down the cell wall at the bases of the petiole, causing the leaf to fall.
3. ABA regulates stomatal closure. During drought, ABA levels increase, causing K^+ and Cl^- (and then water by osmosis) to leave the guard cell, closing the stomata.

52. Transport and Effects of Auxin (page 68)

1. Positive phototropism
2. In an experiment in which a cut stem with an auxin-infused agar block is uppermost and an agar block without auxin is at the base, auxin moves down the stem. However, if the system is inverted, no auxin is found in the stem, indicating that the auxin in the agar was not transported or diffused through the stem - it only travels one way.
3. Auxin causes cell elongation.

53. The Role of Auxins in the Apical Dominance (page 69)

1. Auxins in the growing leaves of the apical bud are synthesised in concentrations high enough to suppress the growth of the buds below. Consequently, the main shoot grows more vigorously than the lateral shoots.
2. Auxin is produced in the growth regions of young plants (e.g. apical tip). If the apical tip of a young seedling remains intact, no lateral growth occurs. If the apical tip is removed, there is lateral growth. Conclusion: the presence of auxin in the apical tip of young seedlings inhibits lateral growth.
3. (a) and (b)



   (c) The apical buds.
   (d) Their production of auxin inhibits the lateral buds so that the plant keeps growing upwards (towards light).
4. By nipping off the apical buds and encouraging lateral growth.

54. How Gibberellins Affect Growth (page 70)

1. and 2.

Table 1 Height of control / cm

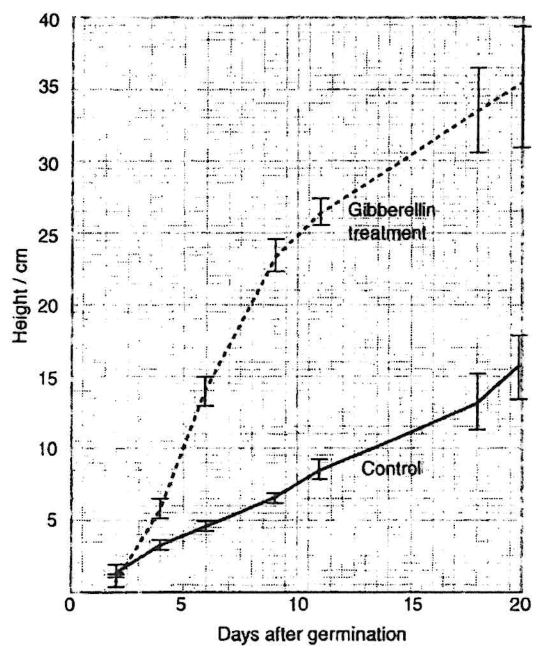
	2	4	6	9	11	18	20
Mean	1.2	3.3	4.7	6.6	8.5	13.2	15.8
SD	0.5	0.3	0.4	0.4	0.8	2.0	2.6

Table 2 Height gibberellin treatment / cm

	2	4	6	9	11	18	20
Mean	0.8	5.8	14.0	23.4	26.6	33.5	35.2
SD	0.3	0.7	1.0	1.2	0.9	3.3	4.2

3 (a)

Effect of gibberellin on plant growth



(b) Gibberellin increases the height of the plant.
(c) Yes
(d) The difference is significant as the error bars do not overlap between treatment and control.
(e) A Student's t - test could be used as there are two

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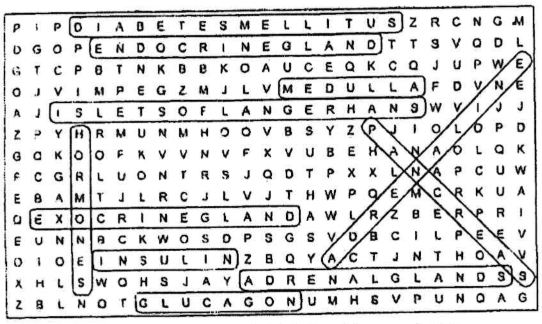
(b) Potentially, the cells would be susceptible to the auroimmune destruction that destroyed the patient's original β cells.

43. Chapter Review (page 58)

No model answer. Summary is the student's own.

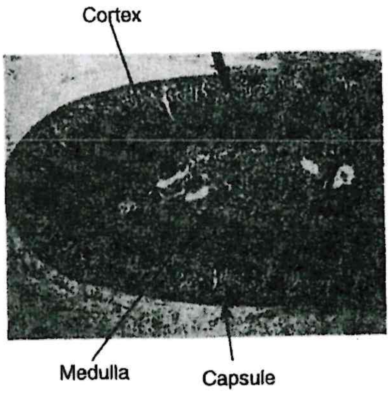
44. KEY TERMS: Did You Get it? (page 59)

1



(a) Hormones
(b) Endocrine gland
(c) Insulin
(d) Pancreas
(e) Adrenaline
(f) Glucagon
(g) Islets of Langerhans
(h) Exocrine gland
(i) Diabetes mellitus
(j) Adrenal glands
(k) Medulla

2.



3. (a) Regulate blood glucose levels.
   (b) Negative feedback
   (c) The pancreas
4. (a) Glycogenesis is the production of glycogen from glucose. Glycogenolysis is the breakdown of glycogen to glucose.
   (b) The liver.

45. Plant Responses to Abiotic Stress and Herbivory (page 61)

1. (a) Plants must be able to adapt to changes in the physical environment as they are not able to move when the changes occur.
   (b) Examples include: opening and closing of stomata in response to water loss. Opening and closing of flowers in response to temperature.
2. Chemical means of protection include producing tannins and alkaloids which affect the taste of the leaf or may be toxic. Plants may use chemical signals to enlist the help of animals for protection (e.g. ants).

   Physical means of protection include thorns, spines, and silica in the leaves.

46. Nastic Responses (page 62)

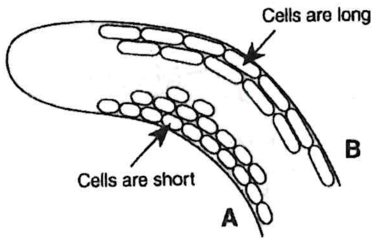
1. Nastic responses are independent of stimulus direction and are often quite rapid (compared with growth responses).
2. (a) Thermonasty (b) Photonasty
3. Disturbance causes a change in membrane potential to the cells at base of each leaflet. The cells lose tugor, causing them to collapse.

47. Tropisms and Growth Responses (page 63)

1. (a) Positive chemotropism
   (b) Negative geotropism
   (c) Positive hydrotropism
   (d) Positive phototropism
   (e) Positive geotropism
   (f) Positive thigmomorphogenesis (*alt.* thigmotropism)
2. (a) Enables roots to turn and grow down into the soil (where they obtain moisture and nutrients).
   (b) Enables coleoptiles to turn up and grow towards the sunlight (necessary for food manufacture).
   (c) Enables the plant to clamber upwards and grow toward the light instead of possibly becoming smothered by more upright plants.
   (d) Enables pollen tube to locate the micropyle of the embryo sac, and sperm nuclei to fertilise the egg.
3. Tropisms show adaptive value because they help position a plant to achieve the most favourable conditions. For example, positive phototropism orientates seedlings to grow towards the sunlight, and helps them obtain enough light for photosynthesis.

48. Investigating Phototropism (page 64)

1. (a) Auxin.
   (b) Positive phototropism.
   (c) **Point A:** Cells stay short.
   Point B: Cells elongate.
   (d) Side B
   (e)



2. The hormone is produced in the shoot tip. The light initiates the response.
3. **Plant A:** The plant will exhibit phototropism and bend towards the sun.
   Plant B: The plant will exhibit no phototropic behaviour and will not bend.

49. Investigating Geotropism (page 65)

1. (a) In shoots, more auxin accumulates on the lower side of the shoot. In response to higher auxin levels here, the cells on the lower side of the stem elongate and the shoot tip turns up.
   (b) In roots, the accumulation of auxin on the lower side inhibits elongation (since this is the response of roots to high auxin). The cells on the upper side therefore elongate more than those on the lower side and the root tip turns down.
2. (a) Approx. 10–3 mg L^{-1} (b) Stem growth is promoted.
3. (a) A negative geotropic response ensures shoots turn up towards the light (important when light may be absent as when buried deeply in soil).
   (b) Positive geotropism ensures roots turn down into the soil so that they can begin obtaining the water and minerals required for continued growth.

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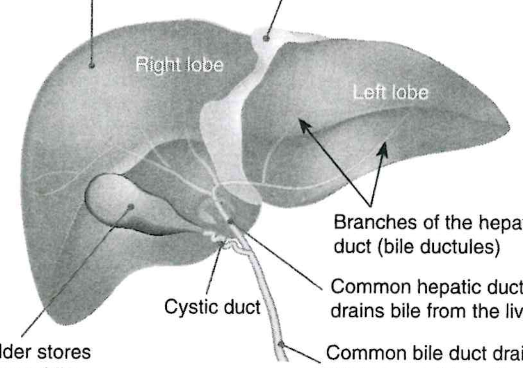
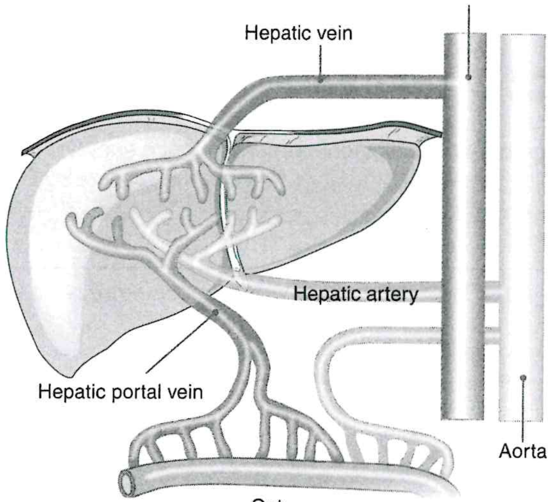
12 The Structure and Role of the Liver

Key Idea: The liver has both homeostatic and digestive functions. It receives a double blood supply and has a simple internal structure, made up of repeating units called lobules.

The liver the largest homeostatic organ. It is located just below the diaphragm and makes up 3-5% of body weight. It performs a vast number of functions including production of bile, storage and processing of nutrients, and detoxification of poisons and metabolic wastes. The liver receives a dual blood supply from the hepatic portal vein and hepatic arteries, and up to 20% of the total blood volume flows through it at any one time. This rich vascularisation makes it the central organ for regulating activities associated with the blood and circulatory system. In spite of its many functions, the liver tissue and the hepatocytes (liver cells) themselves are structurally relatively simple. Features of liver structure and function are outlined below.

The gross structure of the liver

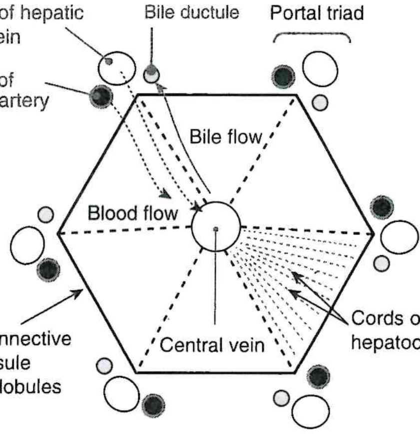




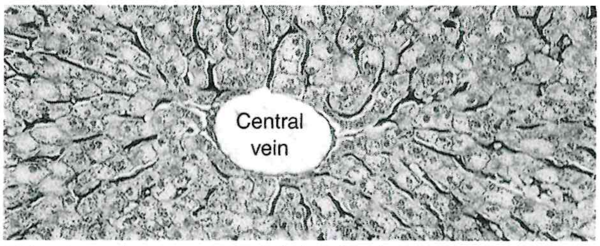
The liver has a double blood supply. The hepatic portal vein brings nutrient-rich blood from the gut, and the hepatic artery branches from the aorta to supply the liver with oxygen-rich blood. The hepatic vein drains the liver to return blood to heart via the vena cava. Branches of the hepatic artery, hepatic portal vein, and hepatic duct form the portal triads surrounding each functional unit (lobule) of the liver (right).

Homeostatic roles of the liver

- Hepatocytes secrete bile, which emulsifies fats in digestion.
- Metabolises amino acids, fats, and carbohydrates.
- Synthesises glucose from non-carbohydrate sources.
- Stores iron, copper, and some vitamins (A, D, E, K, B_{12}).
- Synthesises cholesterol from acetyl coenzyme A.
- Converts unwanted amino acids to urea (ornithine cycle).
- Manufactures heparin and plasma proteins (e.g. albumin).
- Detoxifies poisons or turns them into less harmful forms.
- Some liver cells phagocytose worn-out blood cells.



Liver tissue comprises many roughly hexagonal units called **lobules**. Cords of hepatocytes radiate from a central vein. Portal triads are arranged around the lobule boundary. Blood flows in sinusoids between the cords of hepatocytes towards the central vein. Bile flows in the opposite direction to the bile ductules.



This photo shows part of a lobule. The sinusoids (specialised capillaries) are the dark spaces between the rows of hepatocytes.

1. What cells produce bile? ______________________

2. (a) State one vascular function of the liver: ______________________

(b) State one metabolic function of the liver: ______________________

(c) State one digestive function of the liver: ______________________

(d) State one excretory function of the liver: ______________________

(e) State one storage function of the liver: ______________________

3. What is the basic functional unit of the liver? ______________________

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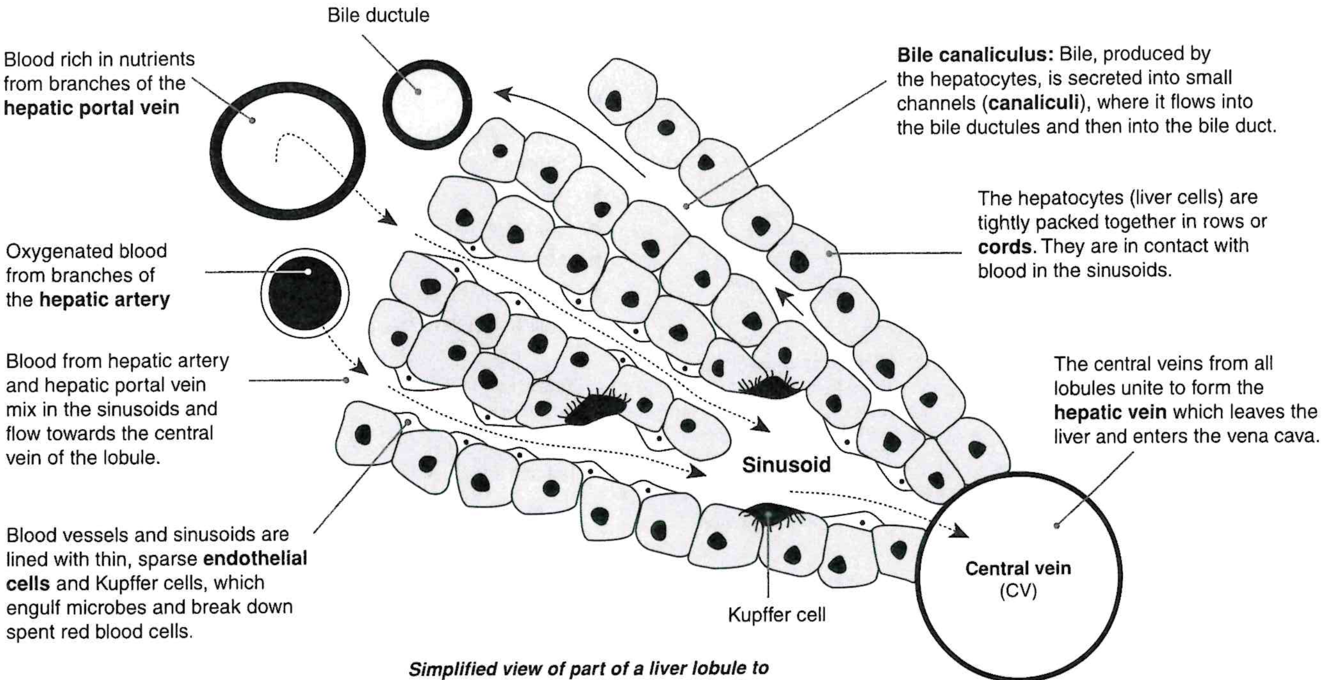
13 The Histology of the Liver

Key Idea: Liver lobules are made up of mostly of hepatocytes. These receive blood via sinusoids, which transport blood from the hepatic portal vein and hepatic artery to the central vein. The functional repeating unit of the liver is the **lobule**, which is made up of tightly packed rows (cords) of liver cells radiating from a central vein and surrounded by small blood vessels called sinusoids. Branches of the hepatic artery and the hepatic portal vein supply the lobules. This highly vascular structure is a reflection of the liver's important role as dynamic blood reservoir, able to both store and release blood as required. More than half of the 10-20% of the total blood volume normally in the liver resides in the sinusoids. Sinusoids are similar to capillaries but have a more porous endothelium. The increased permeability of the sinusoids allows small and medium-sized proteins, such as albumin, to readily enter and leave the bloodstream.



Simplified view of part of a liver lobule to show the direction of blood and bile flow

1. State the two sources of blood supply to the liver, describing the primary physiological purpose of each supply:

   (a) Supply 1: ______________________ Purpose: ______________________

   (b) Supply 2: ______________________ Purpose: ______________________

2. Briefly describe the role of the following structures in liver tissue:

   (a) Bile canaliculi: ______________________

   (b) Phagocytic Kupffer cells: ______________________

   (c) Central vein: ______________________

   (d) Sinusoids: ______________________

   ____

3. Explain the significance of the venous supply to the liver through the hepatic portal system: ______________________

   ____

   ____

4. Describe how the histology of the liver contributes to its considerable ability to serve as a blood storage organ:

   ____

   ____

5. Explain the significance of the leaky endothelium of the sinusoids: ______________________

   ____

   ____

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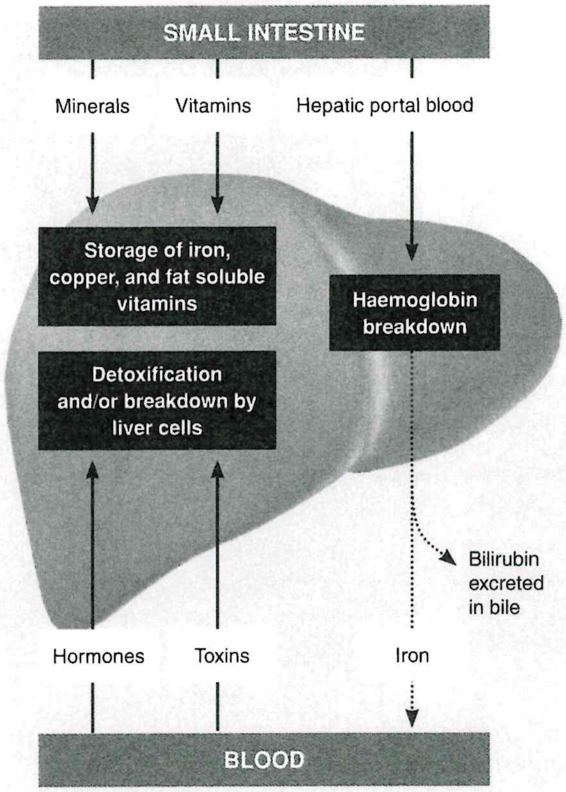
14 The Liver's Role in Protein Metabolism

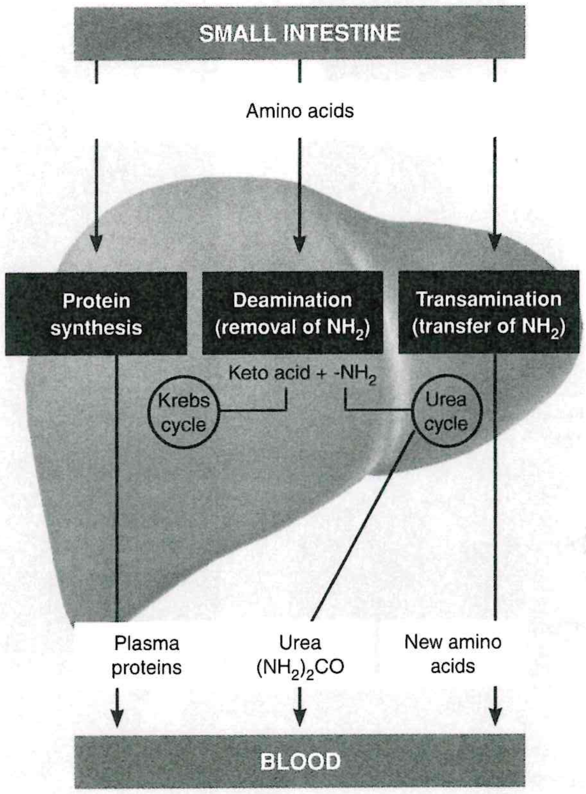
Key Idea: The liver has a crucial role in the metabolism of proteins and the storage and detoxification of hormones and ingested or absorbed poisons (including alcohol).

The most critical aspects of protein metabolism occurring in the liver are deamination and transamination of amino acids, removal of ammonia from the body by synthesis of urea, and synthesis of non-essential amino acids. Hepatocytes are responsible for synthesis of most of the plasma proteins, including albumins, globulins, and blood clotting proteins. Urea formation via the ornithine cycle occurs primarily in the liver. The urea is formed from ammonia and carbon dioxide by condensation with the amino acid ornithine, which is recycled through a series of enzyme-controlled steps. Urea is transported in the blood to the kidneys and excreted.

Storage and detoxification



Protein metabolism



1. Describe three aspects of protein metabolism in the liver:

   (a) ______________________________

   ____

   (b) ______________________________

   ____

   (c) ______________________________

   ____

2. Identify the waste products arising from deamination of amino acids and describe their fate:

   ____

   ____

   ____

3. An X-linked disorder of the ornithine cycle results in sufferers lacking the enzyme to convert ornithine to citrulline. Suggest what the symptoms and the prognosis might be:

   ____

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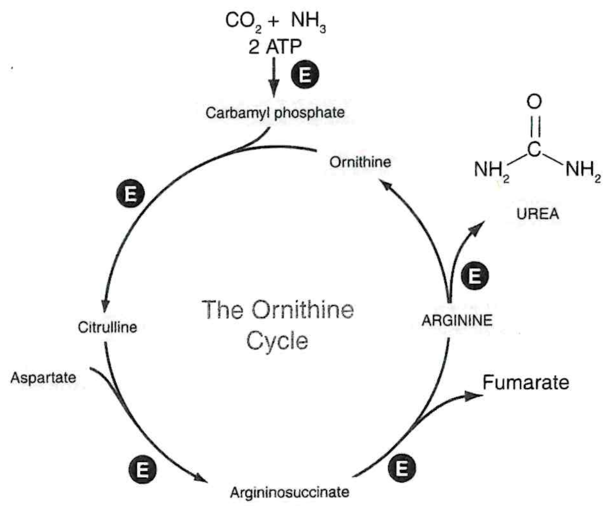

Ammonia (NH_3), the product of protein metabolism, is toxic in even small amounts and must be removed. It is converted to the less toxic urea via the ornithine cycle and is excreted from the body by the kidneys. The liver contains a system of carrier molecules and enzymes (**E**) which quickly convert the ammonia (and CO_2) into urea. One turn of the cycle consumes two molecules of ammonia (one comes from aspartate) and one molecule of CO_2, creates one molecule of urea, and regenerates a molecule of ornithine.

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12. The Structure and Role of the Liver (page 21)

1. Hepatocytes
2. (a) Vascular functions (one of):
   Manufactures heparin and blood proteins.
   Acts as a reservoir of blood, being able to store and release blood as required to maintain blood volume.
   (b) Metabolic functions (one of):
   Central to the metabolism of amino acids (e.g. deamination), fats (gluconeogenesis), and carbohydrates (e.g. glycogenolysis, glycogenesis). Synthesises cholesterol.
   Stores minerals and vitamins.
   Detoxifies poisons.
   (c) Digestive function: Secretes biles for the emulsification of fats.
   (d) Excretory functions (one of):
   Produces urea from amino acids for excretion of nitrogen
   Excretes hormones
   Metabolises haemoglobin which is excreted in the bile.
   (e) Storage functions (one of):
   Stores blood
   Stores iron, copper, and vitamins (A, D, E, K, B_{12}).
3. The lobule

13. The Histology of the Liver (page 22)

1. (a) **Supply 1**: Branches of the hepatic artery. **Purpose**: Supply of oxygen and nutrients to the liver tissue.
   (b) **Supply 2**: Hepatic portal vein. **Purpose**: Brings nutrient-rich blood to the liver for processing by the liver cells.
2. (a) **Bile canaliculi**: Carry the bile (secreted by the hepatocytes) to the bile ductules where it then flows into the bile duct.
   (b) **Phagocytic Kupffer cells**: Engulf microbes and break down spent red blood cells.
   (c) **Central vein**: Carries blood (mix of hepatic portal and arterial blood) that has passed through the liver lobule to the hepatic vein (which exits the liver).
   (d) **Sinusoids**: Blood spaces that carry the mix of hepatic portal and arterial blood through the lobules, for processing, and supply of oxygen and nutrients.
3. Venous supply through the hepatic portal system provides a supply of nutrient-rich blood from the gut directly to the liver for processing.
4. The liver is richly vascularised with a system of capillary-like sinusoids ramifying throughout. At any one time, more than half of the 10-20% of liver's volume is in the sinusoids.
5. Sinusoids are leakier than capillaries so small and medium sized proteins can easily leave and enter the blood. This facilitates exchanges between the blood and the hepatocytes.

14. The Liver's Role in Protein Metabolism (page 23)

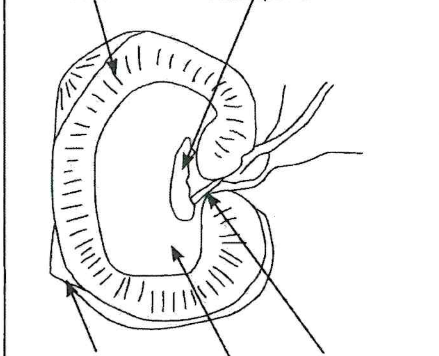
1. Aspects of protein metabolism (a-c in any order):
   (a) Transamination of amino acids to create new, non-essential amino acids.
   (b) Deamination of excess amino acids and production of urea in the urea cycle.
   (c) Synthesis of plasma proteins.
2. Deamination produces keto acids and an amino group. The keto acids feed into the Krebs cycle and are oxidised to yield ATP. NH_2 is converted to ammonia (toxic) and joins with CO_2 and enters the orninthine cycle to produce urea.
3. Symptoms would be a build up of ammonia in the tissues and, unless addressed by management of diet to minimise protein content, it would be fatal.

15. The Urinary System (page 24)

1. (a) Kidney: produces urine and regulates blood volume.
   (b) Ureters: convey urine to the bladder
   (c) Bladder: stores urine
   (d) Urethra: conveys urine to the outside
   (e) Renal artery: carries blood from aorta to kidney. Supplies the kidney with blood carrying oxygen and urea.
   (f) Renal vein: carries blood from kidney to vena cava. Returns blood from the kidney to the venous circulation.
   (g) Renal capsule: covers the kidney and protects it against trauma and infection.
2. 99.4%
3. (a) A nephron is the selective filtering element in the kidney. It is the functional unit of the kidney.
   (b) The nephron produces a filtrate from the blood, modifies the filtrate and produces the final excretory fluid (urine).
4. (a) Transitional epithelium is found in the bladder.
   (b) It means the walls of the bladder can be stretched without the outer cells breaking apart from one another.
5. The sphincter allows the voluntary voiding of urine (urination or micturition).

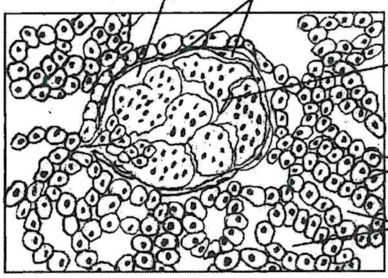
16. Drawing the Kidney (page 26)

Task 1: Student's own drawing.



Task 2: Student's own drawing. Points to note:

- Cells should be drawn with unbroken lines and not overlapping.
- Cell borders may sometimes be inferred from the positions of the nuclei.
- Structures to label include tubule lumen, cuboidal cells lining tubules, Bowman's capsule, squamous epithelium lining capsule, lumen of capsule.



17. The Physiology of the Kidney (page 27)

1. The high blood pressure is needed for ultrafiltration, i.e. to force small molecules such as water, glucose, amino acids, sodium chloride and urea through the capillaries of the glomerulus and the basement membrane and epithelium of Bowman's capsule.
2. (a) Glomerular filtration: Produces an initial filtrate of the blood that is similar in composition to blood and can be modified to produce the final urine.
   (b) Active secretion: Secretion allows the body to get rid of unwanted substances into the urine.
   Explanatory detail: Active secretion of chloride in the ascending limb (with sodium following passively) contributes to the maintenance of the salt gradient in the extracellular fluid (this gradient allows water to be

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