Output 2: Second aquaculture test pilot (Norway)

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Second Aquaculture test pilot Norway

Content

Output 2 – Second Aquaculture Test Pilot (Norway)

Task 1: Developing the question set with multimedia-based material for the pre-test in English

Summary

Multiple choice question sets have been developed for two units that can be used to support the recognition of prior learning and assess the knowledge gained at the end of a period of study. This method of assessment is effective for both formative and summative assessment.

The Multiple-choice questions can be presented within Articulate based on line courses, or offered within the assessment function of some Learning Management systems, allowing the marking and feed back process to be automated.

Multiple choice questions banks have been developed for:

- Salmon hatchery operations
- Salmon anatomy and physiology

Salmon hatchery operations (Multiple Choice)

Guidance: Multiple Choice

This series of multiple-choice questions have been designed so as there is only one possible correct and complete response. This allows knowledge to be established and the assessment process automated.

Taxonomy: Subject, Bank number, Question title

Subject: Hatchery (Salmon Ova to Nursery fry Transfer)

Banks: questions of equal weighting asking for the same knowledge/understanding

Bank 1 Hatchery operations overview

1.1 Which of the following environmental parameters **can** be controlled in a Recirculation Aquaculture System (RAS) salmon hatchery

Select AS MANY as you believe to be correct.

*a) Water temperature

*b) Water flow rates

*c) Water quality

d) Feed quality

*e) Biosecurity

*f) Light levels

1.2 The eggs purchased for incubation from commercial suppliers of salmon eggs are of an unknown genetic origin

True or **False**

1.3 To calculate the number of days it will take a specific batch of salmon eggs to hatch requires a knowledge of:

Select AS MANY of the following as you believe to be essential to this assessment

*a) the eggs stage of development in Degree-days

b) the dissolved oxygen concentration in the incubation trays

*c) the hatchery incubators temperature regime in Degrees centigrade

d) the hatchery light regime

1.4 The temperature of the water in a RAS hatchery cannot possibly vary, as it is under constant control.

True or **false?**

1.5 The velocity (speed) of water movement can vary in different locations in hatchery fish holding units.

True or false**?**

1.6 Water flow rates in the hatchery fish holding Units should be set so as they are sufficient to remove metabolic wastes

True or false**?**

1.7 The Dissolved oxygen saturation levels in hatchery fish holding units should be maintained at:

Select the CORRECT ANSWER from the options below

*a) 100%

c) > 80%

d) > 70%

d) > 60%

1.8 The release of carbon dioxide from fish respiration in the hatchery fish holding units will cause the water PH to:

Select the CORRECT ANSWER from the options below

a) stay the same

b) increase

b) initially decrease then increase

*c) decrease

1.9 Which gas most commonly causes 'supersaturation' problems in a Recirculation Aquaculture System (RAS) hatchery that can threaten the health of the fish stocks?

Select the CORRECT ANSWER from the options below

a) Carbon dioxide

b) Oxygen

*c) Nitrogen

d) Ammonia

Bank 2 Egg procurement

2.1 What 'desired traits' are in general demand from salmon farmers and guide the selection of brood stock by egg suppliers?

Select AS MANY as you believe to be correct

*a) growth rate

*b) disease resistance

c) skin colouration

*d) flesh quality

2.2 Individual fish within family groups of broodfish (40-50 individuals) established by egg suppliers show the selected desired traits to precisely the same degree.

True or **false**?

2.3 The 'marker assisted selection technology' allows superior individual fish to be identified from family groups.

True or false?

2.4 The genomic selection process is primarily used to establish superior family groups of broodfish

True or **false**?

2.5 The genomic selection process allows superior individual brood fish in family groups to be identified

True or false?

2.6 The genomic selection process allows several different traits to be selected for at the same time.

True or false?

2.7 Atlantic salmon strains are being developed to help to optimise salmon production within RAS

True or false?

2.8 Genomic selection is superior because:

Select AS MANY as you believe to be correct

*a) the Atlantic salmon SNP chip allows up to 930,000 genetic markers to be analysed

b) it is focussed on the family level as opposed to individual level of selection

*c) it is focussed on the individual level as opposed to family level of selection

d) it can analyse the DNA of developing eggs to identify superior individuals

2.9 The problems caused by early sexual maturation when producing salmon within RAS can be countered by:

Select AS MANY as you believe to be correct

*a) stocking an all-female population

b) growing fish on a restricted feed ration

c) increasing 'grow out' holding-unit flow rates

*d) stocking a triploid population

e) delaying smoltification during the hatchery phase

2.10 Atlantic salmon normally have 2 sets of chromosomes at the cellular level.

True or false?

2.11 Triploid Atlantic salmon with 3 sets of chromosomes at the cellular level and can still reproduce normally

True or **false**?

2.12 Commercial salmon egg suppliers can produce all-female Atlantic salmon eggs by:

Select the CORRECT ANSWER from the options below

a) feeding female hormones to salmon fry to make males genetically female, despite being physically male, which on maturing produce milt to fertilise eggs and produce all-female offspring

*b) feeding male hormone to a mixed sex stock of juvenile salmon, to masculinise the females, which on maturing, produce milt to fertilise eggs and produce all-female offspring

c) pressure shocking mixed sex salmon eggs after fertilisation to change the genetic makeup of the eggs destined to become male, so as they become female

d) feeding female hormones to the male brood fish for 3 months before spawning, so as their milt becomes genetically female and fertilises eggs to produce all-female offspring

2.13 Commercial salmon egg suppliers can produce sexually sterile triploid eggs by:

Select the CORRECT ANSWER from the options below

a) feeding female hormones during the first 3 months in the hatchery so as when the male salmon mature, their milt can be used to produce triploid (sexually sterile) fertilised eggs.

b) feeding male hormones to a mixed sex stock of juvenile salmon, to masculinise the females which on maturing produce milt that can be used to produce triploid fertilised eggs

c) pressure shocking mixed sex salmon eggs after fertilisation to change the genetic makeup of the eggs by adding an additional set of chromosomes to transform diploid into triploid eggs

d) feeding female hormones to male brood fish for 3 months before spawning, transforming their milt from diploid to triploid for fertilising salmon eggs to produce 100% triploid stock

*e) Pressure shocking fertilised diploid all female eggs at the appropriate stage of development to produce triploid eggs

2.14 At the cellular level the male has:

Select the CORRECT ANSWER from the options below

a) two sets of X chromosomes

*b) an X and Y chromosome

c) two sets of Y chromosomes

2.15 At the cellular level the female has:

Select the CORRECT ANSWER from the options below

*a) two sets of X chromosomes

b) an X and Y chromosome

c) two sets of Y chromosomes

2.16 When sexually mature, masculinised females can be selected for milt extraction to produce all female eggs by:

Select the CORRECT ANSWER from the options below

a) selecting fish that look female as they lack of a kype (distended lower jaw) but have darker than normal external colouration and a ‘flattened body shape’ (no swollen belly)

*b) killing and dissecting the sexually mature male brood stock to identify those with no sperm duct between the testes and vent and removing their testes

c) by selecting and stripping all males to collect viable milt from masculinised females with milt from normal males, will has been inactivated by the previous hormone treatment.

2.17 Why can triploid fish stocks perform better on the farm than normal diploid stocks?

Select the CORRECT ANSWER from the options below

a) Because the triploidisation process interacts with genes inhibiting fish growth, allowing higher growth rates to be reached.

b) Because triploid fish are far hardier that normal salmon and less affected by water quality variations and stress

c) Because triploid fish respond better to 24-hour light regimes, leading to an increased daily feed intake and greater overall growth

*d) Because triploids are sexually sterile and resources cannot be diverted into the production of sexual products (eggs and milt), allowing all their nutrition to be used for growth

2.18 To calculate the number of eggs needed to produce a given output of fry for transfer to the nursery, the technician needs to know:

Select AS MANY as you believe to be correct

a) the survival rate during incubation up to hatch

b) the water temperature

*c) survival rate from egg receipt to nursery transfer

d) the holding capacity of the incubators

*e) The target number of fry for nursery transfer

2.19 If the survival rate is 80% from egg receipt to nursery transfer how many eggs does the hatchery need to produce an output of 100,000 fry

Select the CORRECT ANSWER from the options below

a) 120,000

b) 180,000

*c) 125,000

2.20 To calculate the egg holding capacity of the hatchery incubation system the technician needs to know:

Select AS MANY as you believe to be correct

*a) the egg stock density limit per egg tray

b) the survival rate during incubation up to hatch

*c) the number of egg trays in the incubation facility

d) The target number of fry for nursery transfer

2.21 To calculate how many batches of eggs the hatchery can incubate annually; the manager needs to know:

Select AS MANY as you believe to be correct

*a) the water temperature regime

b) survival rate from egg receipt to nursery transfer

c) the egg holding capacity of the egg trays

*d) the Degree days exposure the eggs have had on receipt

*e) The Degree days required from fertilisation to first feeding

Bank 3 Egg transit and receipt

3.1 Purchased eggs are transported at the eyed stage, because:

Select AS MANY of the following as you believe to be correct

a) eyed eggs do not need oxygen

b) they are close to hatching

*c) they are physically robust

e) they have just been fertilised

3.2 Different batches of eggs from different brood stock are always identical in size.

True or **false**?

3.3 The supplier measures the eggs into the egg trays for transport by:

Select AS MANY of the following as you believe to be correct

a) counting by eye

b) machine counting

*c) volumetric measurement

e) their weight

3.4 In transit the polystyrene egg boxes have two trays of ice above the egg trays which:

Select AS MANY of the following as you believe to be correct

a) keeps eggs just above freezing (0.5-1 oC) and stop their metabolism

b) keeps the egg box internal temperature within 8 -12 oC

*c) helps to keep the eggs moist with any ice melt

*e) keeps the internal egg box temperature within 4-6 oC

3.5 Which of the following activities should staff undertake as soon as the eggboxes carrying the eggs arrive at the hatchery:

Select AS MANY of the following as you believe to be correct

*a) check the egg box packaging for signs of damage

b) immediately arrange the return of all damaged egg boxes

*c) photograph any signs of damage to any egg box and record

*d) check the eggs for signs of physical damage and record

e) discard all eggs from any boxes that are damaged or contain damaged eggs

*f) set up hatchery monitoring of all eggs from any damaged boxes

3.6 To avoid thermal shock on arrival the temperature of the eggs in the egg boxes should not differ to the incubation system by more than:

Select the CORRECT ANSWER from the options below

a) 4 oC

b) 3 oC

c) 2 oC

*d) 1 oC

e) O.5 oC

3.7 To acclimatise the eggs the process should include:

Select AS MANY of the following as you believe to be a part of the egg acclimatisation process

*a) trickling incubator water over the eggs at intervals (< 5 minutes) from a low height (<15”)

b) gradually warming the eggs in a thermostatically controlled bath (if cooler than the incubator water)

c) checking and recording the temperature of the eggs at 15-minute intervals

*d) checking and recording the temperature of the eggs at 5-minute intervals

3.8 The acclimatised salmon eggs are disinfected with:

Select AS MANY of the following as you believe to be correct

a) Bleach

b) Dilute Hydrochloric acid

*c) Buffodine

d) Alcohol

3.9 Sodium carbonate is added during egg disinfection to:

Select AS MANY of the following as you believe to be correct

a) increase the potency of the disinfectant and help kill pathogens

b) dampen the exothermic reaction and moderate the temperature

c) soften the eggshells carbonates to assist the hatching process

*d) maintain the pH of the solution within safe limits (pH 6-8) during disinfection

Bank 4 Egg incubation

4.1 The rate of salmon egg development in a hatchery can be manipulated by controlling:

Select AS MANY of the following as you believe to be correct

a) water flow rate

b) dissolved oxygen

*c) water temperature

d) light regime

4.2 The target temperature during incubation in the hatchery is:

Select the CORRECT ANSWER from the options below

a) 10 oC with a maximum daily temperature variation of O.5 oC

*b) 8 oC with a maximum daily temperature variation of O.5 oC

c) 10 oC with a maximum daily temperature variation of O.5 oC

d) 8 oC with a maximum daily temperature variation of 1.5 oC

e) 6 oC with a maximum daily temperature variation of O.5 oC

4.3 The eggs are sometimes sampled on receipt to assess the number of eggs per litre to:

Select AS MANY of the following as you believe to be correct

*a) check the egg suppliers egg count is accurate

b) check that the eggs have not shrunk during transport due to dehydration

*c) calculate the volume of eggs to lay out in the incubators to achieve the correct stock density

d) check whether the eggs have swollen during transport due to water absorption

4.4 The potential disadvantage(s) of horizontal incubators compared with vertical incubators are:

Select AS MANY of the following as you believe to be correct

a) they need less hatchery floor space

b) they offer water flow control in each individual hatchery tray

c) they are designed to offer a more comfortable working position

*d) they are dual purpose as fry can be first fed in them

4.5 The advantage(s) of vertical over horizontal incubators are:

Select AS MANY of the following as you believe to be correct

*a) they offer water flow control in each individual egg tray

*b) they are more compact and require less hatchery floor space

*c) they are designed to offer a more comfortable working position

d) they are dual purpose as fry can be first fed in them

4.6 When setting up the incubator egg trays technicians must ensure there is no air entrapment within the incoming water flow, because:

Select AS MANY of the following as you believe to be correct

*a) the water flow through incubation tray screens can be blocked, reducing Dissolved Oxygen

b) metabolic wastes will collect in the incubation trays due to the disrupted flows

c) the water level in the incubation trays will drop

*d) the eggs can be unnecessarily agitated when the entrapped air is released

4.7 A batch of developing eggs 'Degree days' exposure can be calculated by:

Select the CORRECT ANSWER from the options below

a) the number of days multiplied by the water temperature in degrees Fahrenheit

b) the number of days divided by the water temperature in Degrees Centigrade

c) the water temperature in Degrees Centigrade divided by the number of days

*d) the number of days multiplied by the water temperature in Degrees Centigrade

4.8 The biological development of Atlantic salmon eggs at temperatures lower than 5°C is:

Select the CORRECT ANSWER from the options below

a) slower than the Degree days calculation would suggest

b) the same as the Degree days calculation would suggest

*c) quicker than the Degree days calculation would suggest

4.9 The thermal regime in Atlantic salmon hatcheries aims to provide a stable water temperature of:

Select the CORRECT ANSWER from the options below

a) 6 oC

*b) 8 oC

c) 10 oC

d) 12 oC

4.10 The hatchery target temperature is changed following an unexpected deviation to keep to the planned hatch date.

True or false?

4.11 The staff must notify the hatchery manager when the egg incubation temperature deviates from the target temperature by :

Select the CORRECT ANSWER from the options below

a) +/- 2.0 °C

b) +/- 1.5 °C

c) +/- 1.0 °C

*d) +/- 0.5 °C

4.12 The target flow rate during incubation is:

Select the CORRECT ANSWER from the options below

a) 5 Litres/Minute

*b) 7 Litres/Minute

c) 9 Litres/Minute

d) 12 Litres/Minute

4.13 If flow rates in the incubators vary by +/- 0.5 L/min from the technician should immediately:

Select the CORRECT ANSWER from the options below

a) Inform the hatchery manager so as they can remediate

*b) Increase or decrease the flow to meet the target flow rate

c) Record the flow rate deviation in the Hatchery Records

4.14 If the water level of the trays is beneath the standpipe level, this indicates that:

Select the CORRECT ANSWER from the options below

a) the water inflow rate has reduced below the optimum

b) the standpipes have been dislodged or tampered with

*c) the incubation tray's water inlet screen has been blocked and needs to be cleaned

d) the incubation tray has been removed and not returned to its correct position

4.15 The eggs should always be kept in the dark during incubation

True or false?

4.16 When working on the eggs the staff must:

Select AS MANY of the following as you believe to be correct

a) only put the main hatchery lights on for 10 minutes at a time

*b) never put the main hatchery lights on

c) only put the main hatchery lights on for 30 minutes at a time

*d) only ever use red light to allow them to see what they are doing

e) only ever use Ultraviolet light to allow them to see what they are doing

Bank 5 Egg husbandry

5.1 How often is water quality routinely monitored by the hatchery staff during egg incubation?

Select the CORRECT ANSWER from the options below

a) twice daily

*b) daily

c) once every two days

d) one a week

5.2 Which of the following parameters are routinely monitored by the hatchery staff?

Select AS MANY of the following as you believe to be correct

*a) Dissolved oxygen

*b) Water temperature

c) Heavy metals

*d) pH

*e) Conductivity

5.3 How are dead and moribund (almost dead) eggs identified by the hatchery staff?

Select AS MANY of the following as you believe to be correct

a) They float to the water surface

*b) They are completely white

c) They break up into fragments

*d) They have white patches

*e) They are pale or discoloured

f) They are orange in colour

5.4 How can dead and moribund (almost dead) eggs be removed by hatchery staff?

Select AS MANY of the following as you believe to be correct

a) With their fingers

*b) With forceps

c) With a teaspoon

*d) With a pipette

f) By lancing them with a mounted needle

5.5 Why should the number of dead eggs removed from the incubator trays be low?

Select AS MANY of the following as you believe to be correct

a) Dead eggs completely dissolve within 12 hours

*b) Most of the unviable eggs are removed by the supplier

c) No more than 1 in a 100,000 salmon eggs will ever die

d) All egg mortalities occur before the eyed stage

5.6 How is the egg hatching process initiated?

Select AS MANY of the following as you believe to be correct

a) The eggs absorb water which eventually splits the eggshell

b) The alevins chew through eggshell to break free

c) The eggshell naturally disintegrates after 420-430 Degree days

*d) Enzymes are released by the embryo that soften the eggshell

5.7 Typically, how long does it take from the first to the last egg to hatch?

Select the CORRECT ANSWER from the options below

a) 4 hours

b) 24 hours

c) 2 days

*d) 4 days

5.8 What happens to the eggshell after the alevin has broken free?

Select AS MANY of the following as you believe to be correct

*a) It starts to break down which releases ammonia

b) It sinks to the bottom of the incubator tray

*c) It floats to the surface and blocks the incubator tray screens

d) It is consumed by the alevin

Bank 6 Alevin husbandry

6.1 How long does it take alevins held at 8 oC to drop through the hatching grid on the base of the incubator tray?

Select the CORRECT ANSWER from the options below

*a) 2- 4 hours

b) 12- 24 hours

c) 2 days

d) 4 days

6.2 What are the benefit(s) of alevin substrate placed in the bottom of the holding units?

Select AS MANY of the following as you believe to be correct

a) It is safe physical habitat within which the alevins can move more freely

*b) Physical contact which pacifies the alevins, helping to conserve their energy

c) It acts as a biofiltration medium, helping to remove metabolic wastes

*d) Physical support, keeping alevins upright, helping to conserve their energy

6.3 What is the daily light regime for alevins during their incubation?

Select the CORRECT ANSWER from the options below

a) Light for 24 hours a day

b) Light for 12 hours a day

c) Light for 12 hours a day increasing to 16 hours a day

*d) Complete darkness

6.4 What happens if the alevins become too active?

Select AS MANY of the following as you believe to be correct

a) They will need more dissolved oxygen than is available at the low flow rates

*b) They will burn up energy and waste their yolk sac reserves

* c) They will risk damage to the yolk sack through pinching off an entrained oil globule

*d) They will become a smaller first feeder, reducing their survival chances

6.5 Hatchery hygiene routines are vitally important, and the alevins yolk sac development should be checked:

Select AS MANY of the following as you believe to be correct

a) During short periods of white light

*b) under red light and without white light

c) Under extended periods of white light

d) In the dark

6.6 How are dead and moribund (almost dead) alevins removed by hatchery staff?

Select AS MANY of the following as you believe to be correct

a) With their fingers

*b) With forceps

c) With a teaspoon

*d) With a pipette

f) Lancing with a mounted needle

6.7 In what way(s) are the moribund (almost dead) alevins treated differently by hatchery staff, compared to dead alevins?

Select AS MANY of the following as you believe to be true

a) They are counted and recorded

*b) They are euthanised with an overdose before recording and disposal

c) They are classified using a standardised classification system

d) They are subjected to a full post-mortem

6.8 Which of the following statements are true?

Select AS MANY of the following as you believe to be true

*a) Before disposal, all mortalities should be classified by ‘suspected cause’ using a standardised classification system

b) Any dead or moribund fish found to have signs of a pathological infection (bacteria, fungi, virus, or parasite), are disposed of in a different container to separate them from any other mortalities

c) Any infection should be reported to the manager and disclosed to the facility veterinarian.

*d) Any infection other than fungal (Saprolegnia) should be reported to the manager and disclosed to the facility veterinarian.

* e) A full Post-Mortem should normally follow the reporting of any secondary infection

6.9 Yolk sac elongation, contraction and posterior displacement of the lipid drop can be indicative of:

Select AS MANY of the following as you believe to be correct

*a) high fish activity due to high water flow or stress

b) excessive gas pressure

c) genetic problems

d) nutritional problems

e) water quality problems

f) low hardness (<50mg/L $CaCO_3$)

6.10 The presence fluid between the yolk sac and yolk sac membrane (yolk sac adema) can be indicative of:

Select AS MANY of the following as you believe to be correct

a) high fish activity due to high water flow or stress

*b) excessive gas pressure

c) genetic problems

d) nutritional problems

e) water quality problems

f) low hardness (<50mg/L $CaCO_3$)

6.11 Spinal deformities (kyphosis) can be indicative of:

Select AS MANY of the following as you believe to be correct

a) high fish activity due to high water flow or stress

b) excessive gas pressure

*c) genetic problems

*d) nutritional problems

e) water quality problems

f) low hardness (<50mg/L $CaCO_3$)

6.12 White spots on the yolk area (coagulation of the yolk sac) can be indicative of:

Select AS MANY of the following as you believe to be correct

a) high fish activity due to high water flow or stress

*b) excessive gas pressure

c) genetic problems

d) nutritional problems

*e) water quality problems

*f) low hardness (<50mg/L CaCO3)

6.13 A week prior to when the alevins are predicted to have absorbed their yolk sac (800 Degree days from fertilisation) how often are the alevins yolk sacs checked for full absorption?

Select the CORRECT ANSWER from the options below

a) once every 2 days

b) once a day

*c) twice a day

d) four times a day

6.14 As a direct visual guide, the alevins are ready for first feeding once:

Select the CORRECT ANSWER from the options below

a) all the sample has consumed all their yolk sac

b) all the sample has consumed 90% of their yolk sac

*c) 90% of the sample has consumed 90% of their yolk sac Once a day

d) 70% of the sample has consumed all their yolk sac

e) 70% of the sample has consumed 70% of their yolk sac

6.15 If first feeding (and transfer) must be delayed for any reason the water temperatures should be:

Select the CORRECT ANSWER from the options below

a) increased by 1.0 oC

b) increased by 0.5 oC

c) reduced by 0.5 oC

d) remain unchanged

*e) reduced by 1 oC

Bank 7 First feeding

7.1 What proportion of the alevins will not have fully absorbed their yolk sac when the majority are ready for transfer to the first feeding unit?

Select the CORRECT ANSWER from the options below

a) 1- 2%

b) 1-5 %

*c) 5- 10%

d) 10-20%

7.2 How are alevins that have not fully absorbed their yolk sac dealt with, when the majority are ready for transfer?

Select the CORRECT ANSWER from the options below

a) reducing the flow rate to conserve their energy whilst they complete yolk sac absorption

b) stocking them in a screened off an area of the tank, undisturbed by the first feeding fry

c) euthanasia with an overdose and disposal, to avoid them dying in the tank

*d) installing five or six small areas of alevin substrate away from the central screen.

7.3 When first feeding fry are evenly distributed within the first feeding units what is the typical maximum stocking density?

Select the CORRECT ANSWER from the options below

*a) 9,000/M2

b) 15,000/M2

c) 25,000/M2

d) 40,000/M2

7.4 As an approximate guide, the first feeding holding unit should be set up to run at a flow rate equivalent to:

Select the CORRECT ANSWER from the options below

a) 10.0 body length/sec

b) 3.0 body length/sec

*c) 0.3 body length/sec

d) 0.1 body length/sec

7.5 To avoid temperature shocking the fish any temperature difference between the hatchery incubation facility and the nursery unit must not exceed:

Select the CORRECT ANSWER from the options below

a) 0.5 Degrees Celsius

*b) 1 Degrees Celsius

c) 2 Degrees Celsius

d) 3 Degrees Celsius

7.6 The dissolved oxygen level of the first feeding unit must be maintained at:

Select the CORRECT ANSWER from the options below

a) no less than 80% saturation and 5 mg/L.

b) no less than 90% saturation and 6 mg/L.

*c) no less than 100% saturation and 7 mg/L.

7.7 To stock the alevins in the first feeding units they are:

Select the CORRECT ANSWER from the options below

a) syphoned into a bucket for transport to the fry holding unit

*b) moved in their incubation trays, designed to be removed and transported on a trolley

c) captured in a fine mesh hand net, placed in a bucket for transport to the fry holding unit

d) moved automatically by a fish pump with no handling involved and minimal stress

7.8 First feeding fry can actively swim to capture food particles

True or **false**?

7.9 The feed particles fed to first feeding fry should be designed to:

Select AS MANY of the following as you believe to be correct

a) sink quickly to where the fish can effortlessly ingest them from the tank base

*b) float before gently sinking to stimulate the young salmon's natural feeding response.

c) float continuously, so as weaker first feeders can easily capture them from the surface film

*d) be presented in low water flow rates to make them more readily available

e) be presented in moderate flow rates to stimulate the fish's appetite

7.10 The feed is presented to first feeders:

Select the CORRECT ANSWER from the options below

a) by automatic feeders from the outset

*b) by hand only for two days to establish appetite, before introducing automatic feeders

c) by hand only for the first two weeks before introducing automatic feeders

d) by hand only until the fry reach a 2 gramme average weight

7.11 High standards of hygiene in the holding units must be maintained during the first week of feeding fry, by:

Select AS MANY of the following as you believe to be correct

a) daily removal of waste feed accumulating on the tank base with a syphon

*b) gently lifting and replacing the substrate twice a day to allow any accumulated waste feed to be removed.

*c) gently brushing waste towards the centre screen at the same time as the tank is flushed

d) increasing the flow rate for 20 minutes twice a day to flush away waste feed.

Bank 8 Feeding growing fry

8.1 After the first feeding fry have been feeding for a week:

Select AS MANY of the following as you believe to be correct

*a) water flow adjustments should be made to ensure feed particles continually pass the fish

b) feed rates should be adjusted every 3 days, following sample weighing to determine the fish average weight and biomass

*c) Feed rates should be adjusted daily, to ensure constant feed availability to the rapidly growing fish.

d) The water temperature should be increased by 2 oC to increase fish metabolism and food intake

*e) The position of the automatic feeders should be optimised by adjusting the 'drop height' and angle of delivery when the pellet meets the water

*f) Lighting should be provided constantly to ensure 24 hrs a day feeding to maximise feed intake and growth.

8.1 Flow rates should be adjusted and can be guided by fish distribution from the water inlet to a position two thirds around the tank perimeter, so as:

Select the CORRECT ANSWER from the options below

a) The weakest fish is 5 centimetres from the side of the tank

*b) The strongest fish is 5 centimetres from the side of the tank

c) The strongest fish is 15 centimetres from the side of the tank

d) The weakest fish is 15 centimetres from the side of the tank

8.3 Which of the following are key elements to include within a salmon fry rearing strategy:

Select AS MANY of the following as you believe to be correct

*a) brush the base of the tank two or three times a day to remove any waste feed

b) never exceed the feed manufacturer's recommended daily feed rate to avoid waste feed

*c) never underfeed as this can lead to territorial behaviour and aggression, resulting in damaged eyes, operculum shortening and/or fin damage

d) sample weigh the fish every 2 days to monitor growth, stock biomass and densities and determine feed pellet size changes

*e) sample weigh the fish every week to monitor growth, stock biomass and densities and determine feed pellet size changes

*f) mix feed pellets for 3 days to allow for a smooth transition when increasing the particle size

Salmon anatomy and physiology (Multiple Choice)

Guidance: Multiple Choice

This series of multiple-choice questions have been designed so as there is only one possible correct and complete response. This allows prior knowledge to be established through pre-testing, using Response Tools.

Taxonomy: Subject, Bank number, Question title

Subject: SAP = Salmon Anatomy and physiology

Banks: questions of equal weighting asking for the same knowledge/understanding

Bank 1 Skin and scales.

1.1 Which of the following are **not** components of salmon skin

Select AS MANY as you believe to be correct.

a) Chromatophores

*b) Gastric pits

c) Epidermis

d) Scales

d) Goblet cells (producing mucus)

e) Dermis

*f) Olfactory organ

1.2 It is possible to age a salmon by reading its scales

True or False

1.3 A salmon can modify its external colouration by changing the type and amount of pigment dispersed.

True or False

1.4 Which of the following **are** functions of salmon skin.

Select AS MANY as you believe to be correct

*a) Produce mucus as a defence against pathogens

b) Produce hormones as a part of the endocrine system

*c) Provide colouration and camouflage

*d) Help to maintain osmotic balance

d) Produce enzymes that aid digestion

*e) Provide physical protection to the body

f) Protect the fish from rapid changes in water temperature

1.5 Where are the salmon's scales rooted?

Select the CORRECT ANSWER from the options below

a) Mucus

*b) Dermis

c) Subcutaneous layer

d) Epidermis

d) Muscle

1.6 Salmon can partially breathe through their skin.

True or **false?**

1.6 Mucus goblet cells are contained in the epidermis

True or false?

1.7 The mucus coating the fish outer surfaces once produced, is never replaced.

True or **false**?

1.8 Chromatophores are controlled by the neuro-endocrine system.

True or false?

1.9 What is the role of the mucus coating the external surface of the salmon?

Select AS MANY as you believe to be correct

*a) 'Sloughs off' pathogenic bacteria to cleanses the salmon

b) Produces hormones as a part of the salmon's endocrine system

c) Provides colouration and camouflage

*d) Helps to maintain the salmon's osmotic balance

d) Holds the salmon's scales in place

e) Insulates the salmon from rapid changes in water temperature

1.10 Which pigment cells increases to turn smolts silver before their journey to sea

Select the CORRECT ANSWER from the options below

a) Melanophores

*b) Iridocytes

c) Erythrophore

Bank 2 Fins

2.1 Which fins prevent rolling and yawning?

Select AS MANY as you believe to be correct.

*a) Dorsal

b) Pectoral

c) Pelvic

*d) Anal

d) Adipose

e) Caudal

2.2 Which fins are paired as opposed to being single?

Select AS MANY as you believe to be correct.

a) Dorsal

*b) Pectoral

*c) Pelvic

d) Anal

d) Adipose

e) Caudal

2.3 Which fins are single as opposed to being paired?

Select AS MANY as you believe to be correct.

*a) Dorsal

b) Pectoral

c) Pelvic

*d) Anal

*d) Adipose

e) Caudal

2.4 Which fins prevent rolling and yawning?

Select AS MANY as you believe to be correct.

*a) Dorsal

b) Pectoral

c) Pelvic

*d) Anal

d) Adipose

e) Caudal

2.5 Which fins assist braking, turning right and left and can raise and lower the fish in the water column?

Select AS MANY as you believe to be correct.

a) Dorsal

*b) Pectoral

*c) Pelvic

d) Anal

d) Adipose

e) Caudal

2.6 All of the salmon's fins contain fin rays (bone-like structures).

True or **False**

2.7 All of the salmon's fins have a well-known and clearly defined function

True or **False**

2.8 Where is the salmon's anal fin located?

Select the CORRECT ANSWER from the options below

a) Immediately in front of the vent

b) On the back of the fish half-way down the body

c) On the back of the fish just in front of the tail

d) On the side of the fish, just behind the gill covers

d) On the side of the fish, half-way down the body

*e) Just behind the vent

f) Attached to the peduncle

2.9 Where is the salmon's dorsal fin located?

Select the CORRECT ANSWER from the options below

a) Immediately in front of the vent

*b) On the back of the fish half-way down the body

c) On the back of the fish just in front of the tail

d) On the side of the fish, just behind the gill covers

d) On the side of the fish, half-way down the body

e) Just behind the vent

f) Attached to the peduncle

2.10 Where are the salmon's pectoral fins located?

Select the CORRECT ANSWER from the options below

a) Immediately in front of the vent

b) On the back of the fish half-way down the body

c) On the back of the fish just in front of the tail

*d) On the side of the fish, just behind the gill covers

d) On the side of the fish, half-way down the body

e) Just behind the vent

f) Attached to the peduncle

2.11 Where are the salmon's pelvic fins located?

Select the CORRECT ANSWER from the options below

a) Immediately in front of the vent

b) On the back of the fish half-way down the body

c) On the back of the fish just in front of the tail

d) On the side of the fish, just behind the gill covers

*d) On the side of the fish, half-way down the body

e) Just behind the vent

f) Attached to the peduncle

2.12 Where is the salmon's caudal fin located?

Select the CORRECT ANSWER from the options below

a) Immediately in front of the vent

b) On the back of the fish half-way down the body

c) On the back of the fish just in front of the tail

d) On the side of the fish, just behind the gill covers

d) On the side of the fish, half-way down the body

e) Just behind the vent

*f) Attached to the peduncle

2.13 Where is the salmon's adipose fin located?

Select the CORRECT ANSWER from the options below

a) Immediately in front of the vent

b) On the back of the fish half-way down the body

*c) On the back of the fish just in front of the tail

d) On the underside of the fish, just behind the gill covers

d) On the underside of the fish, half-way down the body

e) Just behind the vent

f) Attached to the peduncle

2.14 What is the function of the salmon's adipose fin?

Select the CORRECT ANSWER from the options below

a) To help prevent rolling and yawning

b) To assist braking

c) To provide propulsion for forward motion

d) To assist turning

*e) It has no function

2.15 What is the function of the salmon's caudal fin?

Select the CORRECT ANSWER from the options below

a) To help prevent rolling and yawning

b) To assist braking

*c) To provide propulsion for forward motion

d) To assist turning

e) It has no function

2.16 The salmon's fins have pain receptors

True or False

2.17 The condition of a salmon's fins can be evaluated objectively as an indicator of health and welfare?

True or False

2.18 What is the function of the dorsal fin?

Select AS MANY as you believe to be correct.

a) To help to propel the fish through the water

b) To help the fish to steer left and right

*c) To help the fish to maintain an upright position when swimming

d) To help the fish to brake

d) To help to move the fish up and down in the water column

e) It has no real function

2.19 What is the function of the pectoral fins

Select AS MANY as you believe to be correct.

a) To help to propel the fish through the water

*b) To help the fish to steer left and right

c) To help the fish to maintain an upright position when swimming

*d) To help the fish to brake

*d) To help to move the fish up and down in the water column

e) It has no real function

2.20 What is the function of the anal fin?

Select AS MANY as you believe to be correct.

a) To help to propel the fish through the water

b) To help the fish to steer left and right

*c) To help the fish to maintain an upright position when swimming

d) To help the fish to brake

d) To help to move the fish up and down in the water column

e) It has no real function

2.21 What is the function of the pelvic fins

Select AS MANY as you believe to be correct.

a) To help to propel the fish through the water

*b) To help the fish to steer left and right

c) To help the fish to maintain an upright position when swimming

*d) To help the fish to brake

*d) To help to move the fish up and down in the water column

e) It has no real function

2.22 Name the fins of a salmon (visual recognition test)

Articulate creative: Produce image and a drag and drop facility

Bank 3 Lateral line

3.1 What is the function of the lateral line?

Select AS MANY as you believe to be correct.

a) To regulate pigments cells in the skin to aid camouflage

b) To detect chemicals dissolved in the water

c) To excrete metabolic wastes into the water

*d) To detect vibrations via pressure sensitive canals

e) It has no real function

3.2 The lateral line of a salmon is visible with the naked eye.

True or False

3.3 How is the anatomical structure of the salmon's lateral line best described?

Select the CORRECT ANSWER from the options below

a) a series of pits containing chemically sensitive cells

b) a series of pits containing cells sensitive to the earths magnetic field

c) a series of functionless pores in the salmon's scales

*d) a hollow fluid-filled tube with pressure sensitive canals

e) the equivalent of the human inner ear

3.4 The lateral line has an important role in the schooling behaviour of some fish species

True or False

3.5 In some non-salmonid fish species, the receptive organs of the lateral line function as 'electroreceptors', which are organs used to detect electrical impulses.

True or False

Bank 4 Nares and the olfactory organ

4.1 What is the function of the nares?

Select AS MANY as you believe to be correct.

a) To connect the aquatic environment and respiratory system to help the salmon breathe

b) To detect vibrations so as the salmon can more accurately target and capture prey

c) They are functionless pores

*d) To connect the aquatic environment to the olfactory organ to detect dissolved chemicals

e) To contain and protect the pineal gland that is sensitive to light

4.2 What is the main function of the salmon's olfactory organ?

Select the CORRECT ANSWER from the options below

a) To detect chemicals in the water

b) To detect vibrations

c) To detect light and control photoperiodicity

e) To provide balance

4.3 The salmon is more dependent on its olfactory organ than its eyes when capturing food

True or **False**

4.4 How are odours perceived by the salmon?

Select the CORRECT ANSWER from the options below

a) When dissolved chemicals contact the olfactory pit

*b) when dissolved chemicals contact the olfactory rosette

c) When dissolved chemicals contact the ciliated epithelium in the olfactory pit

Bank 5 Eyes and photoreception

5.1 How is the salmon's quality of vision assisted?

Select AS MANY as you believe to be correct.

*a) By the presence of cones giving it the ability to detect colour

b) By its ability to regulate the level of light entering the eye

*c) By its ability to move the lens closer to and further away from the retina to focus

d) By its ability to change the shape of its lens to focus

*e) By the independent and wide angled field of view of each eye

5.2 How does the salmon's eye differs to the mammalian eye?

Select AS MANY as you believe to be correct.

a) Its lack of sensitivity to the Ultra-Violet end of the light spectrum

*b) Its lack of ability to regulate light entering the eye due to its fixed Iris

c) Its lack of the ability to detect colour

*d) Its lack of ability to change the shape of its lens to focus

*e) its ability to focus by moving the lens closer to and further away from the retina

5.3 What are the similarities and differences between the structure and function of the salmon eye compared to the mammalian eye?

Select AS MANY as you believe to be correct.

*a) The salmon eye has the same basic structure as a mammalian eye

b) The shape of the lens can be altered in the salmon eye in the same way as a mammalian eye

*c) The iris in the salmon's eye is fixed and cannot regulate the amount of light entering the eye

d) The salmon eye cannot detect colour whereas the mammalian eye can

*e) Salmon focus by moving the lens closer to or further away from the retina

5.4 Relatively low levels of turbidity in the water hinder the salmon's ability to detect prey.

True or **False**

5.5 Salmon can see the following wavelengths of light

Select AS MANY as you believe to be correct.

*a) Red

*b) Green

*c) Blue

*d) Ultraviolet

5.6 What wavelengths of light can salmon see that humans cannot see?

Select the CORRECT ANSWER from the options below

a) Red

b) Green

c) Blue

*d) Ultraviolet

5.7 The pineal gland is photoreceptive.

True or False

5.8 Where is the salmon's light sensitive pineal gland found?

Select the CORRECT ANSWER from the options below

a) In the retina of the eye

b) In the optic nerve

*c) At the base of the skull

d) In the cornea of the eye

5.9 What is the role of the salmon's pineal gland?

Select the CORRECT ANSWER from the options below

*a) To detect changing daily length and control sexual maturation and smolting

b) To control the movement of the lens of the eye when focussing

c) To release growth hormones in response to increasing day length

d) To release opsin to improve vision in turbid water

Bank 6 Gills

6.1 The salmon's gills only role is gas exchange, including the uptake of oxygen and expulsion of carbon dioxide.

True or **False**

6.2 The salmon gill is a multifunctional organ with diverse roles.

True or False

6.3 What is the function of the salmon gill?

Select AS MANY as you believe to be correct.

*a) To help maintain the osmotic balance by actively transporting salts, mainly sodium and chloride.

b) To absorb micro-nutrients from the external environment

*c) To uptake dissolved oxygen from the water by diffusion

d) To uptake dissolved oxygen from the water by osmosis

*e) To excrete ammonia and carbon dioxide

6.4 Which of these physiological processes are part of the salmon gill's role?

Select AS MANY statements as you believe to be correct.

*a) Gas exchange

*b) Ion exchange

*c) Acid-base regulation

d) Production of red blood cells

*e) Nitrogenous waste excretion

6.5 Describe the structure and function of the salmon's gill arch.

Select AS MANY descriptions as you believe to be correct.

*a) A curved bony structure that supports the primary gill lamellae

*b) Contains and protects the branchial artery supplying blood to the gill

c) A tough plate covering the gill lamellae that helps ventilation

*d) Carries a series of projecting gill rakers

e) Produces replacement white blood cells

6.6 Describe the structure and function of the salmon's gill rakers.

Select AS MANY statements as you believe to be correct.

a) Numerous and long

*b) Infrequent, short, and spiked

c) A site for gas exchange

d) Able to excrete nitrogenous wastes

*e) Used to help to trap food particles

6.7 What is the role of the salmon's operculum?

Select AS MANY statements as you believe to be correct.

a) To support the primary gill lamellae

*b) To cover and protect the gill lamellae

c) To help to trap food particles

d) To carry and support the gill rakers

*e) To help gill ventilation

6.8 What is the role of the salmon's gill epithelium?

Select AS MANY statements as you believe to be correct.

*a) Has mucus producing goblet cells to protect from particulate deposits

b) Provides strong physical protection from damage

*c) Has taste receptor cells in the gill arch region

6.9 What is the primary site for gas exchange in the salmon's gills?

Select the CORRECT ANSWER from the options below

*a) lamellar epithelium

b) gill arches

c) gill rakers

d) branchial artery

e) operculum

6.10 How can the efficiency of gas exchange by the salmon's gill lamellae be increased?

Select AS MANY statements as you believe to be correct.

*a) The large surface area provided by secondary lamellae

b) The high blood pressure maintained in the secondary lamellae

*c) The secondary lamellae being composed of a single layer of cells

d) The mechanism for actively transporting oxygen across the lamellae

*e) Oxygenated water moving in the opposite direction to deoxygenated blood

6.11 Gill mucus cells are present throughout the epithelium of the salmon's gill arch and gill lamellae.

True or False

6.12 Gill mucus cells are only present in the salmon's gill arch epithelium.

True or **False**

6.13 Gill mucus cells are only present in the salmon's gill lamellae.

True or **False**

6.14 The salmon's gill mucus cells have a protective role only.

True or **False**

6.15 What is the role of the salmon's gill mucus cells?

Select AS MANY as you believe to be correct.

*a) Reduce friction

*b) Help water exchange

*c) Repel pathogens

*d) Help gas exchange

6.17 The carbon dioxide (CO_2) generated from respiration can **readily** leave through the salmon's gill without a substantial build up in the tissues.

True or False

6.18 The salmon's blood bicarbonate concentration is low.

True or False

6.19 How is ammonia (NH_3) is excreted across the salmon's gill lamellae?

Select AS MANY as you believe to be correct.

a) By osmosis

c) Through microbial activity

*d) By passive diffusion

*e) By active transport

6.20 The salmon's gills help to regulate blood pH.

True or False

6.21 What can change the pH of the salmon's blood?

Select the CORRECT ANSWER from the options below

a) Excretion of ammonia (NH_3)

c) Uptake of dissolved oxygen

d) Water ingress by osmosis

*e) Excretion of carbon dioxide (CO_2)

6.22 Which gill activities is the regulation of the salmon's blood pH is dependent on?

Select AS MANY as you believe to be correct.

*a) Reversable hydration reaction ($CO_2 + H_2O \leftrightarrow H^+ + HCO_3$)

*b) Catalysation of the hydration reaction by the enzyme carbonic anhydrase

c) Excretion of nitrogenous wastes in the form of Ammonia (NH_3)

*d) Exchange of protons (H^+) and bicarbonate (HCO_3) ions for Sodium (Na) and Chloride (Cl) ions

6.23 Gill mitochondria are essential to active ion transport

True or False

6.24 Why is the active transport of ions by the salmon's gills important?

Select AS MANY as you believe to be correct.

a) To enable gill cell mitochondria can strip energy from the ion transport process to power all other important gill functions

*b) To enable specialised gill chloride cells to transport scarce Sodium (Na) and Chloride (Cl) ions into the salmon during its freshwater phase

c) To enable metabolic waste products Ammonia (NH_3) and Carbon dioxide (CO_2) to be cleansed from the system completely

*d) To enable specialised gill chloride cells to transport surplus Sodium (Na) and Chloride (Cl) ions out of the salmon during its marine phase

Bank 7 Muscular system and locomotion

7.1 The salmon uses its white muscle to cruise at relatively low speeds during its ocean migration.

True or **False**

7.1 The salmon uses its red muscle for bursts of activity such as jumping waterfalls or catching prey.

True or **False**

7.1 The salmon's red muscle is aerobic and needs oxygen supplied by myoglobin.

True or False

7.1 The salmon's white muscle is aerobic and needs oxygen supplied by myoglobin.

True or **False**

7.1 The salmon's white muscle can function without oxygen for a limited time period .

True or False

7.2 Which capital letter best describes the distinctive shape of a salmon's muscle group configuration?**.**

Select the CORRECT ANSWER from the options below

*a) They are W shaped

b) They are T shaped

c) They are N shaped

d) They are C shaped

e) They are S shaped

7.2 What advantage does the 'W shaped' configuration of muscle groups provide the salmon? **OKAY.**

Select the CORRECT ANSWER from the options below

a) Increased flexibility

b) Increased strength

*c) Increased gearing

7.2 At the cellular level, what is responsible for salmon muscle contraction and movement? **OKAY.**

Select AS MANY as you believe to be correct.

*a) Actin cells

b) Myosepta

*c) Myosin cells

Bank 8 Heart and circulatory.

8.1 How many chambers does the salmons heart have?.

Select the CORRECT ANSWER from the options below

a) 2

b) 3

*c) 4

d) 5

8.2 The salmon's heart has 4 chambers. .

True or False

8.3 All of the salmon's heart chambers are muscular..

True or **False**

8.4 Salmon have less blood per gram of body weight than mammals.

True or False

8.5 Which chamber of the salmon's heart is muscular?

Select the CORRECT ANSWER from the options below

a) Sinus venosus

b) Atrium

*c) Bulbus arteriosus

d) Ventricle

8.6 Which chamber of the salmon's heart is the preliminary blood collecting chamber?

Select the CORRECT ANSWER from the options below

*a) Sinus venosus

b) Atrium

c) Bulbus arteriosus

d) Ventricle

8.7 Which chamber of the salmon's heart works to reduce the 'pulsed nature' of the blood supply, giving it a more even, constant flow?

Select the CORRECT ANSWER from the options below

a) Sinus venosus

b) Atrium

*c) Bulbus arteriosus

d) Ventricle

8.8 Where does the blood first go after it has left the salmon's heart?

Select the CORRECT ANSWER from the options below

*a) To the gills

b) To the body tissues

c) To the brain

d) To the muscles

8.9 The resting heart rate in salmon resembles mammals.

Bank 9 Blood

9.1 Which of the following components of the salmon's blood is responsible for transporting nutrients, hormones and proteins?.

Select the CORRECT ANSWER from the options below

a) Red blood cells

b) White blood cells

c) Platelets

*d) Plasma

9.2 Which of the following components of the salmon's blood is responsible for transporting oxygen around the body?.

Select the CORRECT ANSWER from the options below

*a) Red blood cells

b) White blood cells

c) Platelets

d) Plasma

9.3 Which of the following components of the salmon's blood is responsible for forming clots to stop bleeding?.

Select the CORRECT ANSWER from the options below

a) Red blood cells

b) White blood cells

*c) Platelets

d) Plasma

9.4 Which of the following components of the salmon's blood is responsible for fighting viruses and bacteria as a part of the immune system?

Select the CORRECT ANSWER from the options below

a) Red blood cells

*b) White blood cells

c) Platelets

d) Plasma

9.5 What is the difference between the erythrocytes (red blood cells) of a salmon and those of humans?

Select the CORRECT ANSWER from the options below

a) They can carry more oxygen

*b) They are nucleated (have a nucleus)

c) They are much smaller

d) They are more plentiful (cells/Ml)

e) They do not contain haemoglobin

9.6 Erythrocytes are the least common cells found in the salmon's blood plasma.

True or **False**

9.7 The salmon's haemoglobin is not pH sensitive.

True or **False**

9.8 What is the effect of a reduction in the pH of a salmon's blood?

Select the CORRECT ANSWER from the options below

*a) It can carry less oxygen

b) It can carry more oxygen

c) Carbon dioxide is less readily excreted

d) Carbon dioxide is more readily excreted

e) Ammonia excretion is less efficient

9.9 Which of the following phenomena can cause a reduction in the oxygen carrying capacity of the salmon's blood?

Select AS MANY as you believe to be correct.

*a) Root effect

b) Osmosis

c) Low blood pressure

*d) Bohr effect

e) Low dissolved oxygen levels

9.10 Which of the salmon's white blood cells attack pathogenic bacteria?

Select AS MANY as you believe to be correct.

a) Lymphocytes

b) Thrombocytes

*c) Monocytes (macrophages)

*d) Granulocytes

e) Non-specific Cytotoxic Cells

9.11 Which of the salmon's white blood cells are important in blood-clotting?

Select the CORRECT ANSWER from the options below

a) Lymphocytes

*b) Thrombocytes

c) Monocytes (macrophages)

d) Granulocytes

e) Non-specific Cytotoxic Cells

9.12 Which of the salmon's white blood cells specialise in attacking protozoan parasites?

Select the CORRECT ANSWER from the options below

a) Lymphocytes

b) Thrombocytes

c) Monocytes (macrophages)

d) Granulocytes

*e) Non-specific Cytotoxic Cells

9.10 Which of the salmon's organs produce red blood cells?

Select AS MANY as you believe to be correct.

*a) Spleen

*b) Kidney

*c) Heart

d) Pancreas

*e) Liver

Bank 10 Liver

10.1 What is the role of the salmon's liver?

Select AS MANY as you believe to be correct.

*a) Destroy and recycle old blood cells

*b) Cleanse metabolic wastes

c) Osmoregulation

*d) Nutrient storage

*e) Enzyme production

10.2 What is the role of the bile produced by the salmon's liver?

Select the CORRECT ANSWER from the options below

a) To act as an antioxidant

b) Break down proteins

*c) Emulsify fats

d) Break down carbohydrates

10.3 Where is the bile stored that is produced by the salmon's liver?

Select the CORRECT ANSWER from the options below

a) In the stomach

b) In the pancreas

c) In the liver

*d) In the gall bladder

10.4 What is the role of cholecystokinin, a hormone secreted by cells in the salmon's duodenum?

Select AS MANY as you believe to be correct.

*a) induces satiety (lack of hunger)

b) Increases fish appetite

*c) Stimulates the release of bile into the intestine

d) Stimulates sexual maturation

*e) Stimulates the secretion of pancreatic enzymes

Bank 11 Swim bladder

11.1 All species of fish have a swim-bladder.

True or **False**

11.2 What is the role of the salmon's swim bladder?

Select AS MANY as you believe to be correct.

a) Abstracts carbon dioxide from the blood stream for excretion via the pneumatic duct

b) Acts as a reserve oxygen supply when dissolved oxygen levels in the water suddenly decline

*c) Provides buoyancy, which makes it easier to maintain position and swim

d) It collects excess water entering by osmosis for expulsion

e) It has no known function

11.3 How does the salmon's swim bladder fill with gas?

Select the CORRECT ANSWER from the options below

a) Buoyancy is slowly adjusted by gasses secreted from the circulatory system

b) Water entering the gills and other tissues is expelled via the pneumatic duct

c) Fills with excess oxygen abstracted by the gills not needed for respiration

*d) Connected to the gut via the pneumatic duct, allowing buoyancy to be adjusted quickly

e) Fills with carbon dioxide produced as a by-product of respiration

11.4 All fish swim bladders function the same way, regardless of the species.

True or **False**

11.5 At what stage of the freshwater phase of its lifecycle does the salmon first inflate its swim bladder?

Select the CORRECT ANSWER from the options below

a) Alevin (yolk sac fry)

* b) Swim up fry

c) Parr

d) Smolt

Bank 12 Kidney

12.1 The salmon's kidney has a bilobed structure with a front (anterior) and rear (posterior) lobe.

True or **False**

12.2 The salmon's kidney is a single fused structure and intimately embedded between the vertebrae.

True or False

12.3 What is the role of the salmon's kidney?

Select AS MANY as you believe to be correct.

*a) The front of the kidney has an endocrine function producing steroid hormones to regulate carbohydrate and fat metabolism

b) The front of the kidney is excretory and removes ammonia

c) The rear of the kidney has an endocrine function producing steroid hormones which regulate carbohydrate and fat metabolism

*d) The rear of the kidney is excretory and removes ammonia

*e) The front of the kidney replenishes red blood cells

12.4 Most of the ammonia produced from protein catabolism is excreted by the salmon's gills.

True or False

11.5 Most ammonia produced from protein catabolism is excreted by the kidney.

True or **False**

12.5 What role does the salmon's kidney play in osmoregulation?

Select AS MANY as you believe to be correct.

*a) Produces a lot of dilute urine to counteract water ingress when in freshwater

b) Minimises urine production to conserve water to counteract dehydration when in freshwater

c) Produces a lot of dilute urine to counteract water ingress when at sea

*d) Minimises urine production to conserve water and counteract dehydration when at sea

12.6 Which structure in the salmon's kidney is responsible for filtering out metabolic wastes?

Select AS MANY as you believe to be correct.

a) The afferent and efferent arterioles

*b) The glomerulus and Bowman’s capsule

c) The mesonpheric tubule

d) The aorta

e) The lumen of the Bowmans capsule

Bank 13 Digestive organs and system

13.1 The Atlantic salmon is omnivorous and can utilise proteins, fats, and carbohydrates equally well.

True or **False**

13.2 The Atlantic salmon's gill rakers and pharyngeal teeth are short and pointed to help move prey down the salmon's throat..

True or False

13.3 The salmon's lower intestine has a role in osmoregulation.

True or False

13.4 Which two classes of digestive enzymes are dominant in the salmon's digestive system?

Select THE TWO as you believe to be correct.

*a) Proteases

b) Carbohydrases

*c) Lipases

13.5 How does the salmon's stomach function in digesting food?

Select AS MANY as you believe to be correct.

a) Stomach wall secretes carbohydrases

*b) Muscular contractions physically break down the food

*c) Stomach wall secretes pepsinogen

d) Stomach wall secretes lipases

*e) Hydrochloric acid is secreted by gastric pits

13.6 What is the pH of the salmon's stomach?

Select the CORRECT ANSWER from the options below

a) 7-8

b) 5-7

*c) 2-4

d) 1-2

13.7 What is the function of the salmon's pyloric sphincter?

Select AS MANY as you believe to be correct.

a) Provides muscular physical compression to aid digestion in the lower intestine

b) A muscular tube that connects the pharynx to the stomach

c) Muscular valve that expels waste products from the digestive tract via the anus

*d) Muscular valve to preventing premature movement of the food bolus out of the stomach.

13.8 What is the function of the pyloric caecae?

Select AS MANY as you believe to be correct.

a) Supports osmoregulation

*b) Digestion and absorption of nutrients

c) Produces red blood cells

d) Produces white blood cells

13.9 What is the function of the pancreatic tissue?

Select AS MANY as you believe to be correct.

*a) Exocrine secretion of digestive enzymes into the intestine

b) Absorption of nutrients from the digestive system for circulation

c) The absorption of water ingress during the freshwater phase to aid osmoregulation

*d) Endocrine secretion of the hormones insulin and glucagon that regulate blood sugar

13.10 What are the villi in the salmon's intestine and what function do they perform?

Select the CORRECT ANSWER from the options below

a) Muscle fibres that help to move solids down the digestive tract

b) Glands that produce digestive enzymes

c) Capillaries that absorb nutrients released by digestion

*d) Finger like projections increasing the surface area for nutrient absorption

13.11 How do the nutrients released by digestion move into the salmon's intestinal capillaries?

Select AS MANY as you believe to be correct.

*a) By diffusion

b) By osmosis

*c) Active transport by ATPases

d) By muscular pressure

13.12 The salmon's intestine is much shorter than the intestine of cyprinids (carp family).

True or False

13.13 Why do cyprinids have a much longer intestine than salmon?

Select AS MANY as you believe to be correct.

*a) The cyprinid's carbohydrate rich diet breaks down slowly

b) The cyprinids have a lower concentration of intestinal enzymes

*c) The salmonids protein-based diet breaks down rapidly

d) Cyprinids have less intestinal villi to absorb nutrients

13.14 What is the pH of the salmon's hind gut.

Select the CORRECT ANSWER from the options below

*a) 7-9

b) 5-7

c) 3-5

d) 2

13.15 The salmon's intestine has low concentrations of carbohydrase.

True or False

13.16 In addition to digestion, what role does the salmons intestine have?

Select the CORRECT ANSWER from the options below

a) Red blood cell replacement

*b) Osmoregulation

c) Ammonia excretion

d) The regulation of pH

13.17 Which of the following microorganisms are part of the microbiota in the salmon's intestine?

Select AS MANY as you believe to be correct.

*a) Fungi

*b) Bacteria

*c) Viruses

*d) Yeasts

13.18 Which of the following microorganisms are most abundant within the microbiota in the salmon's intestine?

Select the CORRECT ANSWER from the options below

a) Fungi

*b) Bacteria

c) Viruses

d) Yeasts

13.19 What has been the main cause of microvilli damage observed in farmed salmonids?

Select the CORRECT ANSWER from the options below

a) The increased use of heat damaged fish meal in salmonid diets

b) High rates of marine fish oil inclusion in salmonid diets

c) Increased use of low temperature fish meal in salmonid diets

*d) Increased plant protein such as non-heat treated soya meal in salmonid diets

13.20 What is the impact of microvilli damage observed in farmed salmonids?

Select the CORRECT ANSWER from the options below

*a) Reduced nutrient uptake and deterioration in growth and performance

b) A noticeable reduction in the salmon's appetite

c) Increased output of metabolic waste products (Ammonia and Carbon Dioxide)

d) An increase in the incidence of nutritional deficiency diseases

13.21 How can gut microvilli be protected to safeguard farmed salmon against enteritis and poor gut morphology?

Select the CORRECT ANSWER from the options below

a) By reducing the carbohydrate content of the diet by 50%

b) By not feeding the fish one day a week, to allow the gut to fully empty

c) By increasing the level of essential minerals and vitamins in the diet

*d) By adding protective oligosaccharides derived from yeasts to the diet

Bank 14 Metabolism and acclimation.

14.1 Which one of these water temperatures is closest to the salmon's optimum for growth and activity?

Select the CORRECT ANSWER from the options below

a) 18 oC

*b) 15 oC

c) 12 oC

d) 9 oC

14.2 Why can salmon be described as cold blooded?

Select the CORRECT ANSWER from the options below

a) Their body temperature is regulated, but held at a level lower that the surrounding environment

*b) Their body temperature is the same as the surrounding environment

c) Their body temperature is inversely proportional to their surrounding environment

d) Their internal body temperature is maintained at a low level of 4 oC and never changes

14.3 The Atlantic salmon is ectothermic.

True or False

14.4 Which of the salmon's life processes are affected by water temperature?

Select AS MANY as you believe to be correct.

*a) Enzyme reactions

*b) Appetite

c) Osmoregulation

*d) Growth

14.5 The increase in the salmons' oxygen consumption and metabolic rate, is greater when the water temperature increases from 12 to 18 oC abruptly, as opposed to gradually.

True or False

14.2 How does thermal acclimation safeguard the salmon?

Select the CORRECT ANSWER from the options below

*a) By stopping overheating at high temperatures (within tolerance limits)

b) By reducing oxygen uptake at high temperatures

c) By increasing oxygen uptake at low temperatures

*d) By stopping metabolism from grinding to a standstill at low temperatures

14.5 Salmon grow faster at higher temperatures compared with colder temperatures (within tolerance limits)

True or False

14.6 What is the term for the salmon's level of metabolism when resting and not feeding?

Select the CORRECT ANSWER from the options below

a) Routine Metabolic Rate (RMR)

*b) Basal Metabolic Rate (BMR) or Standard Metabolic Rate (SMR)

c) Specific Dynamic Action (SDA)

d) Active Metabolic Rate (AMR).

14.7 What is the term for the salmon's level of metabolism when the undertaking normal spontaneous activity but not feeding?

Select the CORRECT ANSWER from the options below

*a) Routine Metabolic Rate (RMR)

b) Basal Metabolic Rate (BMR) or Standard Metabolic Rate (SMR)

c) Specific Dynamic Action (SDA)

d) Active Metabolic Rate (AMR).

14.8 What is the additional consumption of energy called when salmon are feeding, digesting, and biochemically processing their food intake?

Select the CORRECT ANSWER from the options below

a) Biochemical Metabolic Rate (BMR)

b) Specific Dynamic Digestion (SDD)

*c) Specific Dynamic Action (SDA)

d) Active Metabolic Rate (AMR)

14.9 What is the salmon's level of metabolism called when undertaking maximum sustained activity?

Select the CORRECT ANSWER from the options below

a) Routine Metabolic Rate (RMR)

b) Basal Metabolic Rate (BMR) or Standard Metabolic Rate (SMR)

c) Specific Dynamic Action (SDA)

*d) Active Metabolic Rate (AMR).

Bank 15 Sensing the outside world.

15.1 What is the salmon's central nervous system composed of?.

Select the CORRECT ANSWER from the options below

*a) Brain

b) Endocrine glands

c) Peripheral nerves

*d) Spinal-chord

15.2 What is the salmon's peripheral nervous system composed of?

Select AS MANY as you believe to be correct.

*a) Ganglia

b) Endocrine glands

*c) Neurons

*d) Receptors

*e) Axon (nerve fibres)

15.3 The salmon's neurons cannot display the characteristics of both nervous and hormonal systems.

True or **False**

15.4 The part of the salmon's peripheral nervous system known as 'somatic' is under conscious control and controls movement.

True or False

15.5 The part of the salmon's peripheral nervous system known as 'autonomic' or 'visceral' is not under conscious control.

True or False

15.6 The part of the salmon's peripheral nervous system known as 'autonomic' or 'visceral' directly controls body functions.

True or False

15.7 The part of the salmon's peripheral nervous system known as 'somatic' is not under conscious control.

True or **False**

15.8 Where are the salmon's nerve cells messages transmitted to?

Select AS MANY as you believe to be correct.

*a) Endocrine glands

b) The aquatic environment

*c) Other nerve-cells

*d) Muscles

15.9 The salmon's brain is bigger than a similar size mammal or bird.

True or **False**

15.10 How big is the salmons brain compared to that of a similar sized bird or mammal?

Select the CORRECT ANSWER from the options below

a) Twice as big

b) The same size

c) Half the size

d) One sixth the size

*e) One fifteenth the size

15.11 What part of the brain, lying at the rostral, or nose end of the fish provides the sense of smell?

Select the CORRECT ANSWER from the options below

*a) Olfactory lobes

b) Telencephalon

c) Diencephalon

d) Myelencephalon

e) Hypothalamus

f) Metencephalon

15.13 What part of the brain acts as a hormone-balancing structure and is associated with the pineal body which detects light and dark and coordinates colour changes?

Select the CORRECT ANSWER from the options below

a) Olfactory lobes

b) Telencephalon

*c) Diencephalon

d) Myelencephalon

e) Hypothalamus

f) Metencephalon

15.14 What part of the brain is the equivalent to the cerebrum in other vertebrates and which allows humans to be able to read?

Select the CORRECT ANSWER from the options below

a) Olfactory lobes

*b) Telencephalon

c) Diencephalon

d) Myelencephalon

e) Hypothalamus

f) Metencephalon

15.15 What is the largest part of the salmon's brain that contains the cerebellum and controls balance and movements enabling it to swim?

Select the CORRECT ANSWER from the options below

a) Olfactory lobes

b) Telencephalon

c) Diencephalon

d) Myelencephalon

e) Hypothalamus

*f) Metencephalon

15.16 What part of the salmon's brain connects the hindbrain to the spinal cord and has a function in osmoregulation (water balance) and respiration?

Select the CORRECT ANSWER from the options below

a) Olfactory lobes

b) Telencephalon

c) Diencephalon

* d) Myelencephalon

e) Hypothalamus

f) Metencephalon

15.17 What part of the salmon's brain is connected by a thin stalk to the pituitary gland hanging beneath it?

Select the CORRECT ANSWER from the options below

a) Olfactory lobes

b) Telencephalon

c) Diencephalon

d) Myelencephalon

*e) Hypothalamus

f) Metencephalon

15.18 There are touch and pain receptors on the salmon's body surface that are necessary to feeling pain.

True or False

15.19 Compared with humans, salmon can hear a much wider range of sound frequencies.

True or **False**

15.20 Sound waves, especially low frequencies, travel readily through water and are transmitted to the hearing organs by the bones and fluids in the salmon's head.

True or False

15.21 Changes in water pressure detected by the lateral line allow the salmon to sense its prey and predators.

True or False

15.22 The salmon's tase buds are only located in its mouth cavity.

True or **False**

15.23 What is the function of the inner ear?

Select AS MANY as you believe to be correct.

*a) Sensing gravity

b) Detect water pressure changes

*c) Sound detection

*d) Vestibular (balance)

15.24 The salmon's otoliths are biomineralized 'ear stones'.

True or False

15.25 The salmon's otoliths contribute to hearing only.

True or **False**

15.26 Biologists can estimate a salmon's age by counting the opaque zones called annuli visible in its otoliths.

True or False

15.27 Which of these anatomical structures help the salmon to hear?

Select AS MANY as you believe to be correct.

*a) Otolith

b) Nares

*c) Internal organs of hearing

d) Olfactory organ

15.28 Which of these anatomical structures help the salmon to maintain its balance?

Select AS MANY as you believe to be correct.

*a) Otolith

b) Nares

c) Internal organs of hearing

d) Lateral line

*e) Endolymphatic duct

Bank 16 Endocrine system

16.1 The external stimuli controlling the salmon's endocrine system are detected by the nervous and sensory system..

True or False

16.3 The salmon's endocrine glands secreting hormones, together with the nervous and sensory system, regulate and control many bodily functions.

True or False

16.5 Which of the following are salmon endocrine glands?

Select AS MANY as you believe to be correct.

*a) Thyroid

*b) Adrenal

*c) Pancreatic islets

*d) Pineal

*e) Pituitary

16.6 What direct roles does the pituitary gland have?

Select AS MANY as you believe to be correct.

a) Appetite

*b) Growth

*c) Reproduction

*d) Pigmentation

*e) Osmoregulation

16.6 Where is the salmon's pituitary gland found?

Select the CORRECT ANSWER from the options below

a) Running along the spinal-chord

b) Underneath the front half of the kidney

c) On top of the brain's optic lobes

*d) On the underside of the brain

16.7 Which gland is responsible for secreting melatonin and has a photosensory function?

Select the CORRECT ANSWER from the options below

a) Corpuscles of Stannius

b) Adrenal

c) Thyroid

*d) Pineal

e) Pancreatic Islets

16.8 Which gland is responsible for secreting the cortisol which can be monitored as an indicator of fish stress?

Select the CORRECT ANSWER from the options below

a) Corpuscles of Stannius

*b) Adrenal

c) Thyroid

d) Pineal

e) Pancreatic Islets

16.9 Which gland is responsible for secreting thyroxine that controls oxygen consumption and influences growth?

Select the CORRECT ANSWER from the options below

a) Corpuscles of Stannius

b) Adrenal

*c) Thyroid

d) Pineal

e) Pancreatic Islets

16.10 Which gland is responsible for secreting insulin for carbohydrate metabolism and the control of blood sugar levels?

Select the CORRECT ANSWER from the options below

a) Corpuscles of Stannius

b) Adrenal

c) Thyroid

d) Pineal

*e) Pancreatic Islets

16.11 Which gland is responsible for secreting hypocalcin to regulate calcium balance?

Select the CORRECT ANSWER from the options below

*a) Corpuscles of Stannius

b) Adrenal

c) Thyroid

d) Pineal

*e) Pancreatic Islets

16.12 What salmon life processes are under the direct influence of photoperiod?

Select AS MANY as you believe to be correct.

a) Osmoregulation

*b) Growth

*c) Reproduction

d) Respiration

e) Appetite and feeding

16.13 Which environmental conditions influence the salmon's photoperiod regulatory processes?

Select AS MANY as you believe to be correct.

*a) Intensity of light

*b) Duration of light

c) Water temperature

*d) Colour of light

16.14 Which mechanisms contribute to the salmon's photoperiod regulatory function?

Select AS MANY as you believe to be correct.

*a) Light detection by the pineal gland

b) Light detection by the eyes

*c) Release of the hormone melatonin

*d) Neuro- transmitters regulating physiological processes

16.15 Photoperiod depends on light being detected by the salmon’s eyes.

True or **False**

16.3 Photoperiod depends on light being detected by the pineal gland.

True or False

Bank 17 Appetite control

17.1 Salmon will continue to feed until they have satiated their appetite.

True or False

17.2 Salmon will continue to feed even when satiated

True or **False**

17.3 What enables the salmon to increase its food intake and gorge following a period of food scarcity?

Select AS MANY as you believe to be correct.

*a) An elastic muscular stomach

b) Increased secretions of digestive enzymes

*c) Increased appetite

d) Available intestine (hind gut) capacity

e) Enhanced feed detection

17.4 What does the complex feedback system that signals hunger and satiation respond to?

Select the CORRECT ANSWER from the options below

*a) Blood nutrients

*b) Hormones

c) Movement

*d) Energy status

*e) Neuropeptides

17.5 Which nutrient in the blood is detected by sensors to signal hunger and satiation?

Select the CORRECT ANSWER from the options below

a) Fatty acids

*b) Amino acids

c) Glucose

d) Vitamin C

e) Calcium

Bank 18 Respiratory system and oxygen consumption

18.1 Salmon will breathe faster and heavier when exercised.

True or False

18.2 What does cellular respiration convert the chemical energy from oxygen molecules and nutrients into?

Select the CORRECT ANSWER from the options below

a) Amino acids and protein

b) Glycogen as an energy store

*c) Adenosine triphosphate (ATP)

d) Metabolic energy

18.3 What is the role of Adenosine triphosphate (ATP)?

Select the CORRECT ANSWER from the options below

a) A waste product of catabolism for excretion

b) An intermediary product in the anabolic pathway

*c) High energy molecule used to power cellular functions

d) An essential amino acid for muscle development

Bank 19 Immune system

19.1 The salmon's immune system only combats internal pathogens.

True or **False**

19.2 How is the salmon physically protected from invasion by pathogens?

Select AS MANY as you believe to be correct

*a) Scales

*b) Dermis

c) White blood cells

*d) Mucus

*e) Epidermis

19.3 How does mucus help to combat pathogen entry and contribute to the salmon's first line of defence?

Select AS MANY as you believe to be correct

*a) It contains fungicides and bactericides which can kill pathogens on contact

b) It emits an electromagnetic field that deters parasites from settling

c) It speeds up tissue repair following physical damage to the epidermis

*d) It periodically 'sloughs off, removing debris and parasites

19.4 How does the salmon combat internal pathogens once they have entered?

Select AS MANY as you believe to be correct

a) Expulsion via gill lamellae

b) Expulsion via the digestive tract

*c) Adaptive immune system

d) Protection by mucus secretions

*e) Innate immune system

19.5 Pathogens entering the salmon via the digestive tract are completely inactivated by enzymes and the low pH.

True or **False**

19.6 Physical injury makes the salmon more vulnerable to pathogen entry.

True or False

19.7 The first response by the salmon following pathogen entry is to seal off the entry point and correct any osmoregulatory problems.

True or False

19.8 The first response by the salmon following pathogen entry is undertaken by the innate immune system.

True or False

19.9 The salmon's innate immune system provides protection to specific pathogens only.

True or **False**

19.10 The salmon's adaptive immune system provides protection to specific pathogens only.

True or False

19.11 The salmon's innate immune system provides protection to a wide range of pathogens.

True or False

19.11 The salmon's innate immune system provides lasting immunity.

True or **False**

19.12 How do the damaged cells respond once the defences against physical invasion have been broken by pathogens?

Select AS MANY as you believe to be correct

*a) Histamines cause inflammation and red blood cell production at the site of invasion

*b) White blood cells are attracted to consume foreign bodies at the site of invasion

*c) Captured foreign bodies are taken to the spleen and kidney for disposal

*d) A barrier of fibrin is created to build a physical barrier at the site of invasion.

19.13 The salmon's innate immune system is infallible and cannot be breached by bacteria.

True or **False**

19.14 Bacteria can dissolve the fibrin produced by damaged cells to open the way to infection.

True or False

19.15 Pathogenic bacteria can produce toxins to destroy the white blood cells that are capturing them.

True or False

19.16 What are the characteristics of the salmon's innate immune system?

Select AS MANY as you believe to be correct

*a) Response is non-specific

b) Pathogen and antigen specific response

*c) Exposure to a pathogen leads to immediate maximal response

*d) No immunological memory

e) Found only in jawed vertebrates

19.17 What are the characteristics of the salmon's adaptive immune system?

Select AS MANY as you believe to be correct

a) Response is non-specific

*b) Pathogen and antigen specific response

c) Exposure to a pathogen leads to immediate maximal response

*d) Found only in jawed vertebrates

*e) Lag time between pathogen exposure and maximal response

19.18 The salmon's kidney and spleen can make antibodies to fight each specific pathogen as part of the adaptive immune response.

True or False

19.19 How does the salmon's antibodies fight pathogens?

Select AS MANY as you believe to be correct

a) They engulf the pathogen whilst it is transported to the spleen and kidney

*b) Detoxify the pathogen so as white blood cells can destroy it

*c) Attach another blood component that helps destroy the pathogen

*d) Deactivate reproduction by the pathogen so as it cannot proliferate

19.20 Which of the following are primary lymphoid organs producing mature stem cells?

Select AS MANY as you believe to be correct

a) Intestine

b) heart

*c) Thymus

*d) Head kidney

e) Liver

19.21 Which of the following are secondary lymphoid organs?

Select AS MANY as you believe to be correct

*a) Intestine

*b) heart

c) Thymus

*d) Spleen

*e) Liver

Bank 20 Osmoregulatory system

20.1 The salmon is a euryhaline fish species.

True or False

20.2 What is osmosis?

Select the CORRECT ANSWER from the options below

a) The movement of water from a solution containing a higher concentration of dissolved materials through a semi permeable membrane to a solution with lower concentration of dissolved materials

*b) The movement of water from a solution containing a lower concentration of dissolved materials through a semi permeable membrane to a solution with higher concentration of dissolved materials

c) The movement of dissolved materials from a solution containing a lower concentration through a permeable membrane to a solution with higher concentration.

d) the movement of dissolved materials from a solution containing a higher concentration through a permeable membrane to a solution with lower concentration

20.3 Water moves into or out of the salmon because of differences between its internal salt concentration and the salt concentration of the external environment.

True or False

20.4 How does osmoregulation stabilise the salmon's internal salt concentration during its freshwater phase?

Select AS MANY as you believe to be correct

*a) The kidney produces a lot of dilute urine to expel water ingress

*b) Mitochondria-rich gill chloride cells abstract, and conserve salt form the environment

c) The salmon drinks constantly to regain water lost by osmosis

d) Chloride cells in the gill lamellae excrete and expel excess salts.

e) The kidney produces small quantities of concentrated urine to conserve water and expel more salts

20.5 How does osmoregulation stabilise the salmon's internal salt concentration during its marine phase?

Select AS MANY as you believe to be correct

*a) Chloride cells in the gill lamellae excrete and expel excess salts.

b) Mitochondria-rich gill chloride cells abstract, and conserve salt form the environment

*c) The salmon drinks constantly to regain water lost by osmosis

d) The kidney produces small quantities of concentrated urine to conserve water and expel more salts

*e) The kidney produces small quantities of concentrated urine to conserve water and expel more salts

20.6 Once the salmon has fully adapted to cope with the marine environment water it is called a smolt.

True or False

20.7 What are the physical signs that a juvenile salmon has become a smolt?

Select AS MANY as you believe to be correct

*a) More streamlined body shape

b) black edge to pectoral fins

*c) Silver in appearance

*d) Black edge to the caudal fin (tail)

e) Red spots