

科目：普通生物學【海生所碩士班】

Questions (2% each, one answer for each question)

1. Which of the following statements about cell nucleus is **not** correct? (a)The nucleus transmits and expresses genetic information. (b)Chromatin is composed of DNA and ribosomal subunits. (c)Ribosomal subunits are assembled in the nucleolus. (d) Chromatin condense to form chromosomes when a cell divides.
2. During the protein synthesis process: (a)The initiation of synthesis occurs when an mRNA binds to a tRNA. (b)Promoter help forming the initiation complex (c)There is one tRNA binding sites in the ribosome. (d)Chaperones help fold large proteins into their proper conformation as they are released from ribosomes.
3. Which of the following statements about mutation is **not** correct?(a)Point mutation is one type of mutation. (b)Mutation contributes to the evolution of organisms. (c)Mutation can be lethal to cells. (d)Gene translocation is one type of mutation.
4. Which of the following is **not** a second messenger?(a)G protein (b)Ca²⁺ (c)cAMP (d)IP₃
5. _____ is the site of lipid synthesis and calcium storage pool. (a)agranular endoplasmic reticulum (b)granular endoplasmic reticulum. (c)golgi apparatus (d)endosomes
6. Gene expression is **not** controlled by (a)Repressor protein locks onto RNA polymerase. (b)Unpacking of DNA in chromosome. (c)Life time of RNA molecule. (d)Hormone-activator protein complex.
7. An allele is dominant because (a)It is sex-linked (b)It is expressed when both allele present. (c)It is linked to promoter sequence (d)It is important for life.
8. The extracellular fluid is composed of the interstitial fluid and the blood plasma. Interstitial fluid and plasma have essentially the same composition except that plasma contains a much higher concentration of _____. (a)oxygen (b)carbohydrate (c)lipid (d)protein
9. _____ transmit information from the tissue and organs of the body into the central nervous system. (a)afferent neurons (b)efferent neurons (c)interneuron (d)glial cell

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10. Muscle fatigue is **not** due to (a) low concentration of ATP (b) build up of lactic acid (c) glycogen depletion (d) build up of K^+ in the T tubule
11. Which hormone is circulated in blood stream with binding protein? (a) thyroxin (b) epinephrine (c) dopamine (d) growth hormone
12. What is the protecting mechanism against infection in the airways? (a) Phagocytosis by macrophage (b) The alveoli surface contain cilia that beat toward the pharynx (c) The muscle contraction of trachea (d) The epithelial surface engulf inhaled particles and bacteria.
13. Which is **not** the mechanism to block polyspermy? (a) acrosome reaction (b) membrane fusion leads to the release of enzyme by egg. (c) inactivation of sperm-binding site (d) hardening of the entire zona pelucida
14. Compare acclimatization and adaptation, which is **not** correct? (a) Acclimatization is induced by prolonged exposure to the stress with no change in genetic endowment. (b) If acclimatization occurs early in life, it may be irreversible and is known as a developmental acclimatization. (c) Adaptation and acclimatization both denote inherited characteristic. (d) The precise anatomical and physiological changes that bring about increased capacity to withstand change during acclimatization are highly varied.
15. Which is **not** the characteristic of biological rhythms? (a) Biological rhythms are internally driven by brain pacemakers. (b) Biological rhythms are entrained by environmental cues (c) Environmental cues can not reset the rhythms, which must be reset by brain pacemakers. (d) In the absence of cues, rhythms free-run
16. Most plants grow as long as they are alive, growth originates in (a) young xylem (b) young phloem (c) meristems (d) anthers
17. Which of the following plant hormone inhibits plant growth? (a) cytokinin (b) abscisic acid (c) ethylene (d) gibberellin
18. Photosynthesis is (a) consisting of two sets of reactions, light reaction and TCA cycle. (b) Light excites electrons in photosystem II (c) Photosystem I splits water and leaves O_2 as a by-product. (d) The process of photophosphorylation generates ATP by chemiosmosis.

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19. The frequency of various alleles in a gene pool will not change from generation to generation, as long as the population is (a) isolated (b) small enough (c) mating is not random (d) some genotypes are greater in reproductive success.
20. Species evolution may not occur in which of the following manner? (a) geographical barrier (b) postzygotic barrier (c) prezygotic barrier (d) asexual reproduction
21. Which of the following is a density dependent factor that limits population growth? (a) food supply (b) cold weather (c) flood (d) fire
22. Which of the following community do not require daily infusions of solar energy? (a) coral reef (b) rain forest (c) hydrothermal vent (d) tundra
23. Most food chains are limited to three to five levels, because trophic structures are limited by the availability of (a) carbon (b) oxygen (c) energy (d) nitrogen
24. In asking how a bird located her nests, behavioral biologist call _____ as ultimate causes (a) the availability of nest site (b) the position of sun (c) the availability of nest material (d) the survival rate of young chick
25. Systematist do not interpret phylogenetic data based on (a) Homologous structures (b) Similarity in the sequence of amino acid (c) Homologous functions (d) DNA-DNA hybridization relatedness

Essay questions(10% each)

1. Why gold fish can not survive in sea water?
2. Why oyster can still alive after six-hour exposure in air?
3. Why the productivity is high in coral reef?
4. Why ice fish will not be frozen in Antarctic water?
5. What kind of gas inside the fish swim bladder? Why?

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4 points for each question. Write all your answers in the answering booklet, not question sheets.

Please answer Questions 1-4 based on the abstract of a paper in the following.

Contribution of Fish to the Marine Inorganic Carbon Cycle

Wilson RW, Millero FJ, Taylor JR, Walsh PJ, Christensen V, Jennings S, Grosell M
Science 323(5912):359-362, 2009

Oceanic production of calcium carbonate is conventionally attributed to marine plankton (coccolithophores and foraminifera). Here we report that marine fish produce precipitated carbonates within their intestines and excrete these at high rates. When combined with estimates of global fish biomass, this suggests that marine fish contribute 3 to 15% of total oceanic carbonate production. Fish carbonates have a higher magnesium content and solubility than traditional sources, yielding faster dissolution with depth. This may explain up to a quarter of the increase in titratable alkalinity within 1000 meters of the ocean surface, a controversial phenomenon that has puzzled oceanographers for decades. We also predict that fish carbonate production may rise in response to future environmental changes in carbon dioxide, and thus become an increasingly important component of the inorganic carbon cycle.

1. How many authors does this paper have? a) 1 b) 3 c) 5 d) 7 e) 9
2. This paper is most relevant to a) UV absorption b) Ozone hole c) Green house effect d) Species diversity decrease e) fisheries decline
3. The fishes mentioned here a) eat coccolithophores and foraminifera b) represent 3-15% of total fishes in the sea c) prefer to eat food with high magnesium content d) lives in deep water e) none above
4. The carbonate excreted by the marine fishes is in a) crystal form b) dissolved form c) organic form d) gaseous form

Please answer Questions 5-8 based on the abstract of a paper in the following.

Control of Toxic Marine Dinoflagellate Blooms by Serial Parasitic Killers

Chambouvet A, Morin P, Marie D, Guillou L, Science 322 (5905): 1254-1257, 2008

The marine dinoflagellates commonly responsible for toxic red tides are parasitized by other dinoflagellate species. Using culture-independent environmental ribosomal RNA sequences and fluorescence markers, we identified host-specific infections among several species. Each parasitoid produces 60 to 400 offspring, leading to extraordinarily rapid control of the host's population. During 3 consecutive years of observation in a natural estuary, all dinoflagellates observed were chronically infected, and a given host species was infected by a single genetically distinct parasite year after year. Our observations in natural ecosystems suggest that although bloom-forming dinoflagellates may escape control by grazing organisms,

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they eventually succumb to parasite attack.

5. Dinoflagellate is a) a common microbe in lab cultures b) a plankton causing red tides
c) cultured in RNA d) able to live for 3 years e) all above
6. According to this study algal bloom is controlled by a) predation b) parasitism c)
RNA depletion d) toxic materials accumulated in water e) tides
7. The red-tide causing dinoflagellate is infected by a) A naked RNA b) a naked DNA
c) a bacteria d) a dinoflagellate e) its own offspring
8. The host dinoflagellates get infected a) specifically b) without specificity by other
dinoflagellates

Please answer Questions 9-11 based on the abstract of a paper in the following.

Hopping hotspots: Global shifts in Maine Biodiversity

Renema W, Bellwood DR, Braga JC, Bromfield K, Hall R, Johnson KG, Lunt P, Meyer CP,
McMonagle LB, Morley RJ, O'Dea A, Todd JA, Wesselingh FP, Wilson MEJ, Pandolfi JM
Science 321 (5889):654-657, 2008.

Hotspots of high species diversity are a prominent feature of modern global biodiversity patterns. Fossil and molecular evidence is starting to reveal the history of these hotspots. There have been at least three marine biodiversity hotspots during the past 50 million years. They have moved across almost half the globe, with their timing and locations coinciding with major tectonic events. The birth and death of successive hotspots highlights the link between environmental change and biodiversity patterns. The antiquity of the taxa in the modern Indo-Australian Archipelago hotspot emphasizes the role of pre- Pleistocene events in shaping modern diversity patterns.

9. A species diversity hotspot a) has high temperature b) lasts 50 million years c)
has many species d) is identified by molecular work on fossils e) is located in locations
with high volcanic activities
10. A present marine species diversity hotspot a) may not be one 50 million years ago b)
may not be one 50 million years from now c) may change to another location with time
d) all above apply e) none above apply
11. Pleistocene is a geological epoch in a) Paleozoic b) Mesozoic c) Cenozoic d)
Precambrian

Please answer Questions 12-15 based on the abstract of a paper in the following

Spreading dead zones and consequences for marine ecosystems

Diaz RJ, Rosenberg R Science 321(5891):926-929

Dead zones in the coastal oceans have spread exponentially since the 1960s and have

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serious consequences for ecosystem functioning. The formation of dead zones has been exacerbated by the increase in primary production and consequent worldwide coastal eutrophication fueled by riverine runoff of fertilizers and the burning of fossil fuels. Enhanced primary production results in an accumulation of particulate organic matter, which encourages microbial activity and the consumption of dissolved oxygen in bottom waters. Dead zones have now been reported from more than 400 systems, affecting a total area of more than 245,000 square kilometers, and are probably a key stressor on marine ecosystems.

12. The more fertilizer used on land a) the more dead zones in the sea b) the fewer dead zones in the sea c) is not affecting the formation of dead zones in the sea
13. The cause of dead zone is a) heavy metals b) high temperature c) lack of oxygen d) no light e) low salinity
14. The distribution of dead zone is most likely in a) deep sea b) open ocean c) near estuary d) coral reefs e) close to industrial area
15. Which of the following is directly related to the formation of dead zones in the sea a) too much sun light that increase photosynthetic rates of plants b) too light sun light due to particulate matter in the water column c) too little food for consumers d) too much nutrients that increase primary production of the sea e) malfunction of ecosystem

Please answer Questions 16-19 based on the abstract of a paper in the following.

Local replenishment of coral reef fish populations in a marine reserve

Almany GR, Berumen ML, Thorrold SR, Planes S, Jones GP, Science 316:742-744, 2007

The scale of larval dispersal of marine organisms is important for the design of networks of marine protected areas. We examined the fate of coral reef fish larvae produced at a small island reserve, using a mass-marking method based on maternal transmission of stable isotopes to offspring. Approximately 60% of settled juveniles were spawned at the island, for species with both short (< 2 weeks) and long (> 1 month) pelagic larval durations. If natal homing of larvae is a common life-history strategy, the appropriate spatial scales for the management and conservation of coral reefs are likely to be much smaller than previously assumed.

16. After recapture of juvenile fishes, they were tested a) for ability to swim and disperse b) of their stable isotope ratio c) to see who their mother is d) their ability to spawn e) of their ability to return home
17. The result of this investigation suggests that a) spawning fishes have stable isotopes b) high percentage of fishes return to their parents' reefs c) reef fishes eat a significant proportion of coral eggs d) marine reserves are very effect at protecting fish larvae e) all above

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18. The results of this investigation suggests that marine reserves a) should be as large as possible to be effective b) should be as many as possible c) could be smaller than we expected and still be effective d) could protect adult as well as juvenile fishes e) are ineffective

19. Which term should be used as a key word about this study a) recruitment b) reproduction c) embryology d) migration e) preservation

Please answer Questions 20-23 based on the abstract of a paper in the following.

Ferritin is used for iron storage in bloom-forming marine pennate diatoms

Marchetti A, Parker MS, Moccia LP, Lin EO, Arrieta AL, Ribalet F, Murphy MEP, Maldonado MT, Armbrust EV,

Nature 457(7228):467-470, 2009

Primary productivity in 30 - 40% of the world's oceans is limited by availability of the micronutrient iron. Regions with chronically low iron concentrations are sporadically pulsed with new iron inputs by way of dust or lateral advection from continental margins. Addition of iron to surface waters in these areas induces massive phytoplankton blooms dominated primarily by pennate diatoms. Here we provide evidence that the bloom-forming pennate diatoms *Pseudo-nitzschia* and *Fragilariopsis* use the iron-concentrating protein, ferritin, to safely store iron. Ferritin has not been reported previously in any member of the Stramenopiles, a diverse eukaryotic lineage that includes unicellular algae, macroalgae and plant parasites. Phylogenetic analyses suggest that ferritin may have arisen in this small subset of diatoms through a lateral gene transfer. The crystal structure and functional assays of recombinant ferritin derived from *Pseudo-nitzschia* multiseres reveal a maxi-ferritin that exhibits ferroxidase activity and binds iron. The protein is predicted to be targeted to the chloroplast to control the distribution and storage of iron for proper functioning of the photosynthetic machinery. Abundance of *Pseudo-nitzschia* ferritin transcripts is regulated by iron nutritional status, and is closely tied to the loss and recovery of photosynthetic competence. Enhanced iron storage with ferritin allows the oceanic diatom *Pseudo-nitzschia* *granii* to undergo several more cell divisions in the absence of iron than the comparably sized, oceanic centric diatom *Thalassiosira oceanica*. Ferritin in pennate diatoms probably contributes to their success in chronically low- iron regions that receive intermittent iron inputs, and provides an explanation for the importance of these organisms in regulating oceanic CO₂ over geological timescales.

20. Which of the following is likely to be a limiting factor of the primary productivity in the open ocean? a) Fe b) N c) P d) S e) Br

21. With iron store *Pseudo-nitzschia* is able to a) resist oxidation b) divide a few times without external source of iron c) sink to cooler waters d) use light more efficiently e) prevent blooming

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22. Ferritin is a) a diatom that stores iron b) a protein that binds and stores iron c) an enzyme that prevents oxidation of iron d) a protein that controls the flux of iron e) a macroalga

23. Ferritin enables the cell to inhabit a) low light b) low oxygen c) low ph d) low iron e) low salinity Habitats

Please answer Questions 24-25 based on the abstract of a paper in the following.

Structure and metal exchange in the cadmium carbonic anhydrase of marine diatoms

Xu Y, Feng L, Jeffrey PD, Shi YG, Morel FMM, Nature 452:56-U3, 2008

Carbonic anhydrase, a zinc enzyme found in organisms from all kingdoms, catalyses the reversible hydration of carbon dioxide and is used for inorganic carbon acquisition by phytoplankton. In the oceans, where zinc is nearly depleted, diatoms use cadmium as a catalytic metal atom in cadmium carbonic anhydrase (CDCA). Here we report the crystal structures of CDCA in four distinct forms: cadmium- bound, zinc- bound, metal- free and acetate- bound. Despite lack of sequence homology, CDCA is a structural mimic of a functional beta- carbonic anhydrase dimer, with striking similarity in the spatial organization of the active site residues. CDCA readily exchanges cadmium and zinc at its active site - an apparently unique adaptation to oceanic life that is explained by a stable opening of the metal coordinating site in the absence of metal. Given the central role of diatoms in exporting carbon to the deep sea, their use of cadmium in an enzyme critical for carbon acquisition establishes a remarkable link between the global cycles of cadmium and carbon.

24. Carbonic anhydrase is needed for a) respiration of CO₂ b) incorporation of CO₂ into pyruvic acid c) change gaseous form of CO₂ to soluble form d) transfer of CO₂ between cell membrane e) biosynthesis of CDCA

25. Which statement is correct a) Carbonic anhydrase cannot work without Zn b) Carbonic anhydrase cannot work without Cd c) Zn is a trace metal in the ocean d) Cd is abundant in the sea