

Answers to Practice Questions

Biology Today: An Issues Approach, third edition

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Chapter 1:

1.
 - a. selective response
 - b. metabolism
 - c. homeostasis
 - d. population structure
 - e. reproduction
 - f. genetic material
 - g. growth & biosynthesis
 - h. selective response
2.
 - a. esthetic preference or opinion (not testable)
 - b. testable (falsified if they turn left most of the time or right most of the time)
 - c. testable (falsified if all the offspring resemble the same parent)
 - d. ethical principle (not testable)
 - e. esthetic preference or opinion (not testable)
 - f. testable (get grades from school officials and compare them statistically; hypothesis is falsified if college records show higher average grades for humanities majors, or similar averages for both groups)
3.
 - a,d,e are deductive; b,c are inductive
4.
 - a,b,d,f,g all have scientists communicating with other scientists (or using information communicated to them from others)
5.
 - a. deontological (right to be left alone is implied)
 - b. utilitarian (no rights implied)
 - c. utilitarian (no rights implied)
 - d. utilitarian (greater value to my food than to animal's life, which is greater than trophy value); could also be deontological if human right to food is assumed to be higher than the animal's right to life
 - e. answer similar to d.
 - f. deontological (animal rights are implied)
 - g. utilitarian (no rights implied)
 - h. utilitarian (right to be free of pain and suffering is assumed)
 - i. utilitarian (no rights implied)

Chapter 2:

1. male T; female T
2. Offspring are all genotypically Tt and phenotypically tall. Outcome is the same if parents are switched.
3. 1/4 would be TT; 1/2 Tt; and 1/4 tt
4. Half would be TT and tall; half would be tt and short.
5. Yes in both cases.
6. All are tall and yellow
7. 9/16 will be yellow and tall (genotypes TTYy, TtYY, TTYy, TtYy)
3/16 will be yellow and short (genotypes ttYY, ttYy)
3/16 will be green and tall (genotypes TTyy, Ttyy)
1/16 will be green and short (genotype ttyy)
8. 1/4 will be TtYy (tall, yellow);
1/4 will be ttYy (short, yellow);
1/4 will be Ttyy (tall, green);
1/4 will be ttyy (short, green).
9. a. half Vv, half vv
b. 1/4 VV; 1/2 Vv; 1/4 vv
c. all vv
d. all VV
e. half Vv, half VV
10. 2N before mitosis and 2N after mitosis.
11. 2N before meiosis and N after meiosis.
12. In mitosis, one of each attached pair goes to each end.
In the first division of meiosis, each attached pair goes either to one end of the cell or the other (half of them go to each end).
13. a. No, in mitosis, they line up at random.
b. Yes, in meiosis, they line up in pairs.
14. a. all of them
b. all of them
15. a. 2N=10
b. 2N=10
c. 4N=20
d. 2N=10
16. a. ATCCGT b. AUCCGU c. two d. UAG and GCA
17. the combination of live, nonvirulent bacteria and heat-killed virulent bacteria; because neither one by itself could kill the mice
18. a. normal female
b. male with Klinefelter syndrome
c. female with Turner syndrome
d. normal male
e. female with Down syndrome

Chapter 3:

1. 100%
2. Usually not, because DNA markers are much shorter length sequences than a full gene would be. Some markers may be parts of genes, and other markers are from the DNA that is not transcribed.
3. Find a relative who also has the disease, and test to see which of the 15 DNA markers they also have.
4. a. $.001 \times .001 = .000001$ (one in a million)
b. $.001 \times .00001 = .00000001$ (one in 100 million)
5. a. 2^{20} , or 1,048,576 (just over a million)
b. 2^{30} , or 1,073,741,824 (just over a billion)
6. a. one
b. no, many different mutations are known

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7. Either one or two codons will be altered, depending on the reading frame. The reading frame determines where each new codon begins, and thus whether two adjacent bases could belong to the same codon or to two adjacent codons.

Chapter 4:

1. $0.001 \times 3 \text{ billion} = 3 \text{ million}$
2. a. two fragments (one site for the restriction enzyme)
b. one fragment (no sites)
3. Because the ends of these fragments will spontaneously link back together and can therefore be used to insert new fragments into DNA sequences.
4. No, because AA at one end would need to match TT, and AA at the other end would also need to match TT, and the two TTs could not both be generated at any given cleavage site because they don't match each other.
5. No, because DNA contains T and not U; the U would not be recognized by DNA polymerase
6. so that the sticky ends will match
7. yes, if maternity is disputed (which happens less often than disputed paternity)
8. yes

Chapter 5:

1. a. iii (and vi),
b. v,
c. ii,
d. vi,
e. iv,
f. iii (and vi),
g. i
2. c.
3. c.
4. b.
5. a.
6. Reproductively isolated groups of interbreeding natural populations.
7. a. The argument is that some structures are "irreducibly complex" and incapable of functioning until fully formed, so that they could not have evolved piecemeal, in small steps.
b. One could show that partial or incomplete versions of the complex structure do serve an adaptive function, so that each could have evolved by natural selection before the entire structure was complete.
In particular, functions could change, and the function served initially could well differ from the present function.

Chapter 6:

1. One major aim is to help people communicate about meaningful groups of organisms. Another major aim is to help describe the course of life's evolution on planet Earth.
2. Archaea, Eubacteria (=Monera), Protista, Animalia, Plantae, Mycota
3. Mitochondria, nucleus, endoplasmic reticulum, golgi, lysosomes.
Plants also contain chloroplasts and other plastids.
The nuclear envelope and cytoskeleton are also characteristic of eucaryotic cells but are technically not organelles.
4. a. evolution of embryos (helped reproduction in nonaquatic habitats)
b. vascular tissues (allowed support of plant on land; also allowed division of labor and differentiation of plant parts)
c. seeds (allowed reproduction in harsher, drier habitats)
d. flowers (facilitated pollination and fertilization, esp. by insects)
5. a. they possess a set of derived traits that originated in a common ancestor
b. protostome traits: spiral, determinate cleavage; coelom formation by splitting; origin of mouth from embryonic blastopore; sense organs concentrated at anterior end
c. mollusks have mantle cavity and usually a shell; segmented worms have body segments (all fairly similar) but no legs; arthropods have body segments (fewer and often different from one another), also legs with joints and a more rigid exoskeleton
6. a. similar stimuli from all directions in a nonmotile animal
b. new stimuli mostly at the front end in a moving animal, but similar needs on right and left sides

- c. greater efficiency of digestion, especially stepwise processing
 - d. burrowing
 - e. crawling through sediment or along surfaces
7. They share derived traits that originated in a common ancestor.
These deuterostome traits include radial, indeterminate cleavage, development of a mouth as a secondary structure (not from blastopore), coelom that usually arises by outpocketing from gut, and other embryonic similarities.
 8. a. Apes use arms in locomotion; humans walk upright (erect) and do not use their arms in locomotion
b. Increased ratio of brain size to body size
 9. amniotes, sauropsids, sauropsids with two-windowed skull (diapsids), sauropsids with a window-like opening in the lower jaw (archosaurs), birds, mammals, mammals with live birth, placental mammals.

Chapter 7:

1. Two: BB (homozygous) and Bb (heterozygous)
2. One: AB (heterozygous)
3. One: oo (homozygous)
4. One: cde/cde
5. There are 63 in all.
7 are homozygous: CDE/CDE, CDe/CDe, CdE/CdE, Cde/Cde, cDE/cDE, cDe/cDe, and cdE/cdE
56 are heterozygous combinations of CDE, CDe, CdE, Cde, cDE, cDe, cdE, and cde
(Any of these 8, combined with any of the remaining 7)

Chapter 8:

1. a. Babies can't eat with utensils until they learn how, and people in different cultures learn different habits: some use forks, some use chopsticks, some don't use any utensils, table manners differ, etc.
b. Babies don't speak any language; they learn the language spoken by those around them (which differs from place to place); infants adopted across cultures grow up speaking the language of their adopted family, not that of their birth mother.
c. Hunting behavior needs to be taught; it differs from one culture to another; it improves with practice and with instruction.
2. a. All dogs wag their tails the same way, even as puppies, and even if raised alone; they also wag under similar circumstances.
b. All cows moo similarly, even if raised alone.
c. All people, even babies, smile the same way, and even blind babies smile. Smiles exist in all cultures and are everywhere recognized.
3. a. Nobody, at any age, can play a tune unless they learn how, and playing even moderately well takes a lot of practice.
b. Not everyone can play well, even with practice; no matter how much I practice, I can't sound as good as talented individuals like Ray Charles or Arthur Rubinstein.
4. Field observations; comparing different species or different genetic strains; rearing animals in isolation; rearing animals under different environmental conditions; adoption studies; twin studies, etc. (See text pages 249–251, including Box 8.1).
5. a
6. b
7. a (because it does not decrease her fitness)
8. c (termites belong to the order Isoptera; the others belong to the order Hymenoptera)
9. d (because future conditions are uncertain)
10. Strictly defined subgroups (castes); cooperative brood care; overlapping generations
11. Selection that favors individuals with the greatest inclusive fitness.

Chapter 9:

1. In both cases, $200,000/7,900,000 = .0253$ or 2.53%
2. In both cases, $500,000/100,000,000 = .005$ or 0.5%
3. In both cases, $2\% - 1\% = 1\%$
4. a. 2% of 50,000,000 = 1,000,000
b. 4% of 50,000,000 = 2,000,000
c. 2% of 5,000,000,000 = 100,000,000
d. 4% of 5,000,000,000 = 200,000,000

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5. In both cases, $0.69315/0.02 = 34.575$ years
6. In both cases, 3% because birth and death rates are balanced
7. $r = 0.067 - 0.024 = 0.043$
doubling time = $0.69315/0.043 = 16.12$ years
8.
 - a. 193,500
 - b. 4,693,500
 - c. 201,820
 - d. 4,895,320
9. The first population will increase by 66,000 this year; the second population will increase by only 55,000.
10.
 - a. The interstitial cells of the testes secrete the most testosterone; the ovaries and the brain secrete lesser amounts.
 - b. Estrogen is produced mostly by the ovaries, but also by the brain, the testes, by certain cells of the immune system, and during gestation by the placenta.
11.
 - a. Estrogen and progesterone are secreted by the ovaries.
 - b. FSH, LH, and LTH (prolactin) are secreted by the pituitary gland.
12. When taken before fertilization, the hormones inhibit the pituitary from releasing LH and inducing ovulation. Hormones taken after fertilization can also block implantation.
13. They prevent the sperm from reaching the uterus or the eggs inside the female reproductive tract.
14. 2% of 400,000 = 8,000 will become pregnant.
15.
 - A. \$1600 for 20 years = \$80 per year for each 0.99 pregnancy prevented, or \$80.81 per year for each pregnancy prevented, or 12.375 fewer pregnancies per thousand dollars spent.
 - B. \$20 per month is \$240 per year for each 0.78 pregnancy prevented, or \$307.69 per year for each pregnancy prevented, or 3.25 fewer pregnancies per thousand dollars spent.
 - C. \$200 per year for each 0.88 pregnancy prevented, or \$227.27 per year for each pregnancy prevented, or 4.4 fewer pregnancies per thousand dollars spent.

Thus, method A is the most cost-effective and B is the least.

Chapter 10:

1. Chemical digestion means those chemical reactions that break down food materials into simpler molecules; it only occurs at or near surfaces.
Mechanical breakdown exposes new surfaces by breaking apart fragments and removing loose material, without changing any chemical structure.
2. $\text{pH } 2 / \text{pH } 7 = 10^{-2}/10^{-7} = 10^5$ or 100,000 times more concentrated.
3. A molecule is polar if most of its chemical bonds have unequally distributed electrons. A molecule is nonpolar if most bonds have electrons that are equally shared. In a molecule with many bonds, some may be polar and others nonpolar, making some parts of the molecule polar and some parts nonpolar.
4. Carbohydrates, lipids, and proteins.
5. Glucose usually enters cells by facilitated diffusion or by active transport, depending on glucose concentrations (and on insulin levels in some animals).
6. Insulin.
7.
 - a. by receptor mediated endocytosis.
 - b. by combining with proteins to form LDL or HDL particles that have polar (thus water-soluble) outer surfaces.
8. It blocks blood vessels by making interior passages smaller, thus inhibiting blood from flowing past unless pressure is raised. Blood vessels may also become calcified and thus much less flexible.
9. It's the ratio of outbound (good) cholesterol to inbound (bad) cholesterol. A higher ratio is healthier, and a lower ratio represents a greater risk of cardiovascular disease and stroke.
10. It keeps cell membranes fluid and serves as a precursor in the formation of sex hormones.
11. On a per gram basis, fats (lipids) provide more: 9 kcal/g for fats, 4 kcal/g for proteins, 4 kcal/g for carbohydrates.
12. Mostly in the mitochondria
13. See Table 10.2 on page 337 for details.
14. Electrolytes maintain the balance of water in body cells and the electrical and chemical gradients across membranes. Other micronutrients serve to help various cellular processes, for example by forming parts of enzymes.
15. Either one can.

Chapter 11:

1. An autotroph can make its own organic (carbon-containing) compounds from carbon dioxide; a heterotroph cannot do so and must therefore eat other organisms.
2. Answers may vary, but may include:
 - a. nearly any bacteria, or microscopic protists or fungi
 - b. any animals large enough (people, dogs, cows, etc.)
 - c. any green plants (or photosynthetic bacteria)
3.
 - a. water
 - b. oxygen (and electrons and hydrogen ions)
4.
 - a. carbon dioxide
 - b. sugars (including glucose)
5.
 - a. sunlight
 - b. chemical bonds of sugars
 - c. proton gradients, also chemical bonds of ATP, also electron transport proteins boosted to higher energy states
6. Sugars and starches, most of which function in the plant as storage products.
7.
 - a. amino acids, proteins, nucleic acids, vitamins, pigments, and plant hormones; also alkaloids (bitter chemicals that deter the feeding activities of herbivores).
 - b. of the compounds mentioned, humans need amino acids, proteins, vitamins and nucleic acids.
8.
 - a. Most plants usually obtain nitrogen by absorbing soluble nitrates from soil; some plants get nitrogen from symbiotic nitrogen-fixing microorganisms, and a few plants get nitrogen from eating insects and other very small animals.
 - b. Humans get their nitrogen from eating other organisms, including plants, animals that eat plants, and animals that eat other animals.
 - c. Neither plants nor animals can get nitrogen from the air without the help of symbiotic nitrogen-fixing microorganisms.
9.
 - a. A limiting nutrient is one whose amount is less than optimal, meaning that it limits the growth of plants; supplying more of a limiting nutrient always allows more growth to take place.
 - b. Nitrogen and phosphorus are often limiting nutrients for plants. Potassium can be limiting in some circumstances.
 - c. Farmers can supply limiting nutrients as fertilizers.
10.
 - a. roots
 - b. leaves
 - c. stems
 - d. stems
 - e. roots
11. Water
12. Humus provides nutrients to plants; it also binds rock particles (giving the soil its texture) and holds both moisture and inorganic ions.
13.
 - a. More money and time is spent on biological controls and education; this may include trapping pests and monitoring their populations, also (in some cases) protecting and perpetuating populations of natural enemies to the pest species.
 - b. Less money is spent on pesticides and on the labor and equipment associated with pesticide application; these savings are usually much greater than the additional expenses listed in (a).
14. By traditional breeding with a species or strain containing the gene; by genetic engineering using plant viruses as vectors; by genetic engineering using bacterial plasmids; by the particle-gun method of gene insertion; or by electroporation.

Chapter 12:

1. G₁: cell synthesizes proteins and increases in size
S: DNA synthesis
G₂: cell prepares to divide
M: mitosis
G₀ is not actually part of the cell cycle (text page 364).
2. Normal cells
3. Surface area
4.
 - a. all of them
 - b. all of them
 - c. tracheal cells in the lungs (see fig. 12.8, p. 424)

Answers to Practice Questions

5. a. 3.5 days
b. 450 days
c. 75 years or more (see table 12.1, p. 428)
6. a
7. a. they induce cells to divide
b. they prevent cells from dividing
8. a. just one
b. no, most die from competition with other cells or by being killed by cells of the immune system.
9. smoking
10. a. release of second messengers, DNA gene transcription, and translation of RNA into protein, all resulting in cell division
b. only in cells that have the right receptors
11. No
12. Some takes place in adults, too.

Chapter 13:

1. a. potassium b. sodium
2. a. sodium
b. toward the interior
3. a. nitric oxide
b. acetylcholine
c. dopamine
d. acetylcholine
e. serotonin
f. dopamine, epinephrine, norepinephrine, serotonin, histamine
4. a. acetylcholine b. cholinesterase
5. olfactory bulbs and lobes, cerebrum, diencephalon
6. a. ear
b. eye
c. eye
d. skin
e. ear
f. ear
g. taste buds on tongue
7. a. declarative learning
b. sensitization (a form of procedural learning)
c. habituation (a form of procedural learning)
d. classical conditioning (a form of procedural learning)
8. It removes feedback inhibition: GABA-secreting neurons inhibit production of dopamine (feedback inhibition), so their loss results in excessive dopamine secretion (see p. 475).
9. By inhibiting the breakdown of amine neurotransmitters, they cause stimulation of postsynaptic neurons to last longer.
10. Skin: cold temperatures, warm temperatures, light touch, pressure, and stimuli sensed by naked nerves and perceived as pain.
Eye: light
Ear: sound waves; gravity and acceleration
Tongue: chemicals in moderate concentrations (usually in watery fluids), which are perceived as tastes.
Nose: chemicals in very low concentrations (usually airborne), which are perceived as odors.
11. To keep toxic chemicals and bacteria out of the brain but allow nutrition to brain cells and removal of wastes from them.
12. Cerebral hemispheres have gotten larger; so has the cerebellum.
By comparison, the midbrain and olfactory bulbs have become smaller. Many changes also took place in response to changes in the relative importance of particular sense organs.
13. Forebrain: originally, interpretation of olfactory stimuli; now also vision and higher consciousness.
Midbrain: vision in nonmammals; contains part of reticular formation that keeps us awake.
Hindbrain: hearing and balance, also coordination.

Chapter 14:

1. 89 to 160 cups
2. all of them
3. a. 7.5 drinks
b. about 25 drinks
4. alcohol
5. nicotine, marijuana (THC), cocaine, inhalants
6. 50 mg
7. 25 mg
8. 150 mg
9. caffeine
10. It stimulates opiate receptors (and thus has effects similar to those of opiates).
11. It interferes with or counteracts estrogen and its effects.
12. The effect of using them together is more than the sum of the effects of each used separately.
13. It now requires more of the drug than before to achieve the same painkilling effect.

Chapter 15:

1. B lymphocytes
2. Cytotoxic T lymphocytes
3. Neutrophils and macrophage cells
4. Mast cells
5. Hypothalamus
6. Sympathetic nervous system
7. Parasympathetic nervous system
8. All except bladder and eyes
9. Cytokines are shared (secreted by one system but affecting another).
Immune organs have nerve endings.
Immune cytokines stimulate hormone secretion.
Neuroendocrine status can affect immune functions.
Stress can depress the immune system.
Immune responses can be conditioned.
Immune responses can sometimes be consciously controlled.
10. A stressor is a stimulus that induces a stress response (which includes secretion of norepinephrine and cortisol); stress is the body's response to such stressors.
13. Stage 1. Alarm: release of norepinephrine and cortisol; activation of lymphocytes.
Stage 2. Resistance: sympathetic nervous system and immune system are both stimulated.
Stage 3. Exhaustion: secretion of endorphins and enkephalins.

Chapter 16:

1. RNA
2. From the plasma membranes of previously infected host cells.
3. It helps the virus make a DNA copy of its RNA genome.
Only the virus uses it, not the host.
4. Because it uses those molecules to attach to the cell, so it cannot infect any cell that does not have CD4.
5. Machinery for DNA gene transcription (using RNA polymerase), translation (using ribosomes and tRNA), and the assembly of proteins onto various membranes and organelles.
6. Tests (such as the ELISA or western blot tests) that show the presence of antibodies to the virus HIV.
7. When the count of helper (CD4) T cells falls below 200 cells per microliter of blood. (In countries that do not have the facilities to conduct this test, AIDS is diagnosed primarily by the appearance of opportunistic infections.)
8. The probability of something occurring, such as contracting a given disease or other condition.
9. a. unprotected sex (especially anal sex) and intravenous drug use with nonsterile needles
b. because these behaviors can transmit blood, semen, and vaginal fluids which may contain HIV

Answers to Practice Questions

10. They prevent HIV from reverse transcribing its RNA genome into DNA, thus preventing the insertion of viral DNA into the host, replication of the viral genome, and completion of the viral life cycle.
11. The genes of HIV are initially translated into proteins that are too long to function in the HIV life cycle. Protease could cut these long proteins into shorter, functional pieces, but protease inhibitors interfere with this enzyme, preventing the virus from completing its life cycle.
12. a. humans and a few other higher primates (monkeys and apes)
b. humans only. (Other species can get immunosuppressive diseases caused by other viruses.)
13. everybody
14. Yes, by dissolving the viral envelopes. HIV does not survive very long outside of cells. However, blood can also contain HIV inside cells, which are much harder to kill.
15. The ELISA test is the least expensive for large-scale use, but it has a high rate of false positives and it does not detect antibody until several months after exposure.
The Western blot test is much more expensive, but it has fewer false positives. It also does not detect antibody until several months after exposure.
The PCR test is the most expensive and is less widely available, but it is the most sensitive and can detect viral RNA much sooner following exposure.

Chapter 17:

1. Incidence is the number of new cases per year.
Prevalence is the number of cases at any given time. It includes both new and continuing cases.
If many persons who have a disease remain sick, their numbers will increase the prevalence rate even if the incidence rate remains unchanged.
2. Incidence is the number of new cases in a given interval of time (usually a year). The incidence rate is calculated per 100,000 population, so you need to know the population size in order to calculate it.
3. The antibiotic kills off the most susceptible bacteria first, so noncompletion of antibiotic treatment selectively favors the most resistant bacteria and they become more widespread in the bacterial population. See Fig. 17.6 on p. 626.
4. All three can grow inside cells.
All three can cause pneumonia-like lung infections.
All can be spread via airborne droplets (although chlamydia is more often transmitted sexually).
All three have antibiotic-resistant strains (big problem for tuberculosis and chlamydia, less of a problem in Legionnaire's). All three are therefore increasing in prevalence or re-emerging.
5. A "no" answer could be justified by saying that bubonic plague can be treated with antibiotics, and that the vectors responsible for its transmission can in theory be controlled.
A "yes" answer could also be justified by saying that it might well spread panic and fear, although it would be harder to spread than anthrax because the bacteria is not a spore-former. The vectors (fleas, rodents) that transmit the disease may in practice be hard to control where sanitation is poor, and the perpetrators would always be at risk of exposure themselves.

Chapter 18:

1. They are the same.
2. 410 square km per day equals 158.3 square miles per day or 101,313 acres per day. Answers to last part of question will vary.
3. a. about $9040/1,032,000 = .00876$, or about 0.9%, are birds.
b. over 83 times as many species ($751,000/9,040$) are insects.
Insects make up $751,000/1,032,000 = 73\%$ of all animals.
4. Answers will vary; see Fig. 18.9 on p. 659.
5. Cool, dry air descends near latitudes 30 degrees north and south; winds blow away from these latitudes in either direction, carrying away moisture and drying up the air and land, thus creating deserts in many places. See p. 669–670, especially Fig. 18.17.
6. Costa Rica: $820/9040 = 0.091$, or 9.1% of bird species
Hawaii: $50/9040 = 0.0055$, or 0.55% (at time of European discovery)
7. a. Extinction of 85% of 500,000 genera = 425,000 genera in 5 million years, or 85,000 genera per million years. At an average of 5 species per genus, this represents the demise of 425,000 species per million years, in the greatest mass extinction of the geologic past.
b. Extinction in the 1980s was over 23,500 times as fast!

Chapter 19:

1. a. 100 times more
b. 10 times more (see Ch. 10 for review)
 2. They are the same because acidity depends only on pH.
 3. Biodegradation is a natural process in which microorganisms break down potentially harmful substances. Bioremediation is a purposeful, human-engineered use or enhancement of similar processes to clean up pollution. The same microorganisms and the same chemical reactions contribute to both processes.
 4. Ultraviolet light causes mutations in DNA, including those that cause tissue damage and increase cancer rates, especially in skin cells. An increase in ultraviolet light will therefore increase skin cancer rates.
 5. The microorganisms responsible for biodegradation work best at some optimal temperature. Cold temperatures often inhibit biodegradation.
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