

平成19年度 大学院理学系研究科 生物科学専攻  
博士前期課程  
冬募集 入学試験問題

外国語（英語）

試験時間：10:30～12:00  
配点：150点

注意：問題冊子はこのページを含めて5ページある。  
問題1から4まで、問題ごとに別々の解答用紙に記入すること。  
4枚の用紙それぞれに受験番号と氏名を記入すること。  
解答用紙の表面に書ききれない場合は裏面の線より下を使用すること。

問題 1. 次の英文を読んで下の問いに答えなさい。

The honeybee is the third insect to have its genome sequenced, following the fruitfly (*Drosophila*) and mosquito (*Anopheles*). We can therefore compare the honeybee gene number and content with those of the other two insects, which do not form colonies, to make some guesses at how its social lifestyle has evolved from and in turn shaped its genome.

Honeybees have more genes involved in producing royal jelly, which makes sense as they make it to feed their young, whereas the other two insects do not. (a)They also have far more genes encoding odorant receptors — mirroring the importance of pheromones in sensory communication during the various bee dances, as well as in distinguishing different castes and bees alien to the colony.

A communal lifestyle lessens some of the hazards faced by a solitary insect. For instance, a hive environment means the honeybee can get away with a simpler outer cuticle than the other insects, and so it has fewer genes encoding cuticle proteins. It also has fewer taste receptors, possibly because most bees feed where another bee has already eaten, reducing the likelihood of ingesting poisonous food.

But not all the differences between the genomes are so easily explained. (b)It seems odd that honeybees have fewer genes involved in immunity than the other insects. These bees live in crowded quarters, and diseases are easily transmitted in a small space. Perhaps novel pathways help them resist disease, or maybe they are protected sufficiently by social behaviors such as grooming.

The genome paper also reports initial studies of changes in gene expression during the honeybee lifespan. (c)Significantly, developmental transitions, such as that at 2–3 weeks when bees begin to work outside the hive, are accompanied by altered activity of genes expressed in the brain. Moreover, there are prominent differences between the castes in terms of which metabolic genes are expressed.

(Nature, 443, p. 920, 2006 より引用一部改変)

<参考>

odorant, 匂い物質; caste, 階級、カースト; alien, よそ者; lessen, 軽減する; solitary, 単独の; hive, ミツバチの巣; cuticle, 外皮、クチクラ; ingest, 食べる; quarter, 住み家; grooming, 身づくろい

- (1) 下線部(a)が示す内容について、“はるかに多くの遺伝子を持つ”理由を著者はどのように述べているか、日本語で答えなさい。
- (2) 下線部(b)が示す内容について、なぜ著者はその事実を“奇妙に思える”と述べているのか、その理由を日本語で答えなさい。
- (3) 下線部(c)を和文に訳しなさい。

問題 2. 次の英文を読んで下の問いに答えなさい。

### WHAT MAKES US DIFFERENT?

You don't have to be a biologist or an anthropologist to see how closely the great apes — gorillas, chimpanzees and orangutans — resemble us. (a)Even a child can see that their bodies are pretty much the same as ours, apart from some exaggerated proportions and extra body hair. Apes have dexterous hands much like ours but unlike those of any other creature. And, most striking of all, their faces are oddly expressive, showing a range of emotions that are eerily familiar. That's why we delight in seeing chimps wearing tuxedos, playing the drums or riding bicycles.

It isn't just a superficial resemblance. Chimps, especially, not only look like us, they also share with us some human-like behaviors. They make and use tools and teach those skills to their offspring. They prey on other animals and occasionally murder each other. They have complex social hierarchies and some aspects of what anthropologists consider culture. They can't form words, but they can learn to communicate via sign language and symbols and to perform complex cognitive tasks. (b)Scientists figured out decades ago that chimps are our nearest evolutionary cousins, roughly 98% to 99% identical to humans at the genetic level. When it comes to DNA, a human is closer to a chimp than a mouse is to a rat.

Yet tiny differences, sprinkled throughout the genome, have made all the difference. Agriculture, language, art, music, technology and philosophy — all the achievements that make us profoundly different from chimpanzees — are somehow encoded within minute fractions of our genetic code. Nobody yet knows precisely where they are or how they work, but somewhere in the nuclei of our cells are handfuls of nucleotides, arranged in a specific order, that endow us with the brainpower to outthink and outdo our closest relatives on the tree of life.

Until recently, there was no way to unravel these crucial differences. Exactly what gives us advantages like complex brains and the ability to walk upright—and certain disadvantages, including susceptibility to a particular type of malaria, AIDS and Alzheimer's, that don't seem to afflict chimps — remained a mystery.

But that's rapidly changing. Just a year ago, geneticists announced that they had sequenced a rough draft of the chimpanzee genome, allowing the first side-by-side comparisons of human and chimpanzee DNA. Laid side by side, these sets of genetic blueprints — plus the genomes of gorillas and other primates, which are already well on the way to being completely sequenced — will not only begin to explain precisely what makes us human but could lead to a better understanding of human diseases and how to treat them.

(TIME, 2006年12月4日号, p39-40 より引用一部改変)

<参考>

ape, 類人猿 ; anthropologist, 人類学者 ; exaggerated, 大きくきわだった ; dexterous, 器用な ; eerily, 無気味に ; tuxedos, タキシード ; offspring, 子孫 ; prey on, 捕食する ; cognitive task, 認知処理 ; sprinkle, 散在させる ; endow, 授ける ; outthink, より深く考える ; outdo, ~に勝る ; unravel, 解明する ; susceptibility, 感受性 ; afflict, 苦しめる ; blueprints, 青写真

- (1) 下線部(a)を和文に訳しなさい。
- (2) 下線部(b)を和文に訳しなさい。
- (3) 著者はヒトとチンパンジーはどのような点が似ていて、どのような点が異なると述べているか、日本語で書きなさい。
- (4) 著者は類人猿のゲノムの配列を並べることでどのようなことがわかると述べているか、日本語で書きなさい。

### 問題 3

(1) 次の説明文から 5 つを選び、説明文が意味する単語をそれぞれ英語と日本語（カタカナを含む）で答えなさい。

1. The basic structural building block of living organisms, consisting of protoplasm delimited by a membrane.
2. Organelle that is the site of aerobic respiration and ATP generation in eukaryotic cells.
3. The process resulting in the production of a strand of messenger RNA that is complementary to a segment of DNA.
4. Substance that releases  $H^+$  ions (protons) in solution and thus causes a rise in proton concentration in the solution.
5. Nerve cell, basic unit of the nervous system, specialized for the generation and conveyance of electrical impulses.
6. Invasion of the tissues of the body by bacteria, viruses, fungi and other internal parasites.
7. Any substance capable of binding specifically to an antibody or a T-cell receptor.
8. The process and the developmental stages by which a cell becomes specialized for a particular function.
9. Area defended by an animal or group of animals, mainly against other members of the same species.
10. The study of the interrelationships between organisms and their environment and each other.

(2) 次の語から 2 つを選び、(1) にならって英語で簡単明瞭に説明しなさい。

1. Oxidation (酸化)
2. Ribosome (リボソーム)
3. Photosynthesis (光合成)
4. Hormone (ホルモン)
5. Reproduction (生殖)
6. Symbiosis (共生)
7. Predator (捕食者)

問題4. 次の文章を英語に訳しなさい。

女性は両親からそれぞれ1本のX染色体を受け取るが、男性は母親からX染色体を1本受け取る。このことは、男性ではX染色体に関連した疾患が多数生じることを意味する。女性では個々の細胞で2本のX染色体のうちの1本が発生初期にランダムに不活性化される。