

## **Nothern Ireland BioScience Olympiad**

### **Example Questions**

**Q:** *It is known that animals can change the colour of all or parts of its body. Different animals use different mechanisms which provide such colour change. Suggest as many mechanisms as you can. If it is possible, please accompany each mechanism with an example(s).*

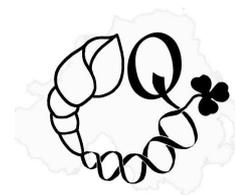


**A:** Main mechanisms:

1. Change of pigment distribution in special cells called chromatophores. Colour seems more intense when pigment is evenly distributed in a cell in a form of small granules. If pigment is localised in the centre of the cell, colour is duller. Pigment redistribution is provided by so-called cytoskeleton molecules inside the cell as a result of stimuli: temperature, light or certain substances.
2. Chromatophores can be unevenly distributed in the skin. So when skin flaps or wrinkles are formed they can be either inside or outside therefore providing change in overall colour (frogs).
3. If a chromatophore contains several different pigments, the granules can be distributed in various combinations and/or mask granules of other colours (stick-insects).
4. Chromatophores can extend its processes (arms-like) above neighbouring cells of different colours, increasing the area of their colour. In this way, sometimes several layers of chromatophores can interact with each other. It is managed by the nervous system and hormones (together with 1, it is the basis of the colour change in bottom-dwelling fish, tree frogs and squids).
5. Light emitting animals can change colour by regulating their glowing in various ways: curtaining off the light emitting organ, biochemical regulation of the luciferin-luciferase system or affecting light-producing symbionts by changing the pH in the areas of their localisation (some fish and molluscs)
6. Transparent or semi-transparent animals can change colour when eating food or digestion of coloured symbionts.
7. Rush of blood to the skin after hormone release or change in temperature conditions - when man is blushing
8. Very simple way: behavioural, when an animal is dirty or soaking wet (results in darkening) (furry animals or crabs)
9. Change of coat or molting: another very common way. Fresh upper skin layers can have different colour usually because of distinct redistribution of the pigment.

Other mechanisms also exist, but all those mentioned above can be found in nature.

Q. Sometimes intake of antibiotics against bacteria would cause negative effects on humans. Please list as many reasons as you can to explain why this may happen.



**A:** It would be good to specify two types of effects: some are based on specific antibacterial activity (1-3) and other effects are not connected with antibacterial action (4-6).

1. Antibiotics kill any bacteria including those that live in our guts suppressing the symbiotic microflora in the intestines and therefore eliminating the beneficial products synthesized and secreted by these bacteria (for examples some vitamins and fatty acids). Additionally, microflora provide several very important breaking-up activities (catabolism) for the human body: some compounds are degraded only by these bacteria (cholic acids, our digestive enzymes, pectin from food). Therefore, if these functions are not provided it would result in a negative effect on our body.
2. Suppression of the normal internal microflora would allow bad or “pathogenic” bacteria and fungi to settle down in our intestines and cause various types of diseases.
3. Intake of the antibiotics would result in massive death of microorganisms in our intestines – products of decomposition of dead bacteria could be toxic and their release would cause a negative effect on our health.
4. The liver is a place where all substances coming from the outside, including drugs and poisons, are metabolised for further excretion. Intake of some antibiotics could result in a heavy load on this detoxification system and cause the liver to shutdown (failure). Some sulfanilamides, taken in high doses, precipitate in the liver and form crystal deposits in the tissue.
5. Certain antibiotics could cause an allergic reaction.
6. Some antibiotics can increase peristaltic activity of intestines and cause stomach upset and diarrhea (Erythromycin can bind to special protein motilin in the cells of the duodenum and stimulate gastrointestinal motility).
7. Some antibiotics can have poisonous side effects: e.g. gentamicin can cause permanent loss of hearing by damaging cells in the inner ear.

See also <http://www.qub.ac.uk/Olympiad>

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