BIOME

The BIOlogy Education MEssenger

(An ATBS eNewsletter)

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From The Editorial Team.....

Greetings from the editorial team of Biome – the ATBS eNewsletter! We are glad to bring to you the sixth issue of this eNewsletter. We hope you have been reading our previous issues and have found at least something of your interest either as a biology teacher or a student. For those of you who have not accessed the previous issues, you can find them at the following link: http://www.atbs.in/newsletter.html. Also for those of you who are not familiar with what ATBS is, you can get an overview and activities in the official website of Association of Teachers in Biological Sciences (http://www.atbs.in/home.html). Anyone interested in biology is encouraged to become a member of the association and be a part of a common platform to interact with other like-minded people who would like to improve the quality of teaching of biology.

This issue includes an article by Dr. Sasikumar Menon on the flights undertaken by migratory birds. This is a two part article and the second part will be available in the next issue of Biome. This issue also includes an article by Prof. B. B. Nath in the continuing 'Article in Series' section. The article discusses and brings to light examples of some animals which have become extinct in the recent past and the factors which led to their total disappearance. Since we believe that biology is even more fun when we do hands-on activities in the laboratory or in the field, we have included one experimental task that can be easily tried out in your laboratories. Some activities conducted by the ATBS and information related to the Biology Olympiad Programme have also been included.

We sincerely hope you read this issue and send us your comments as well as contributions. Happy reading to all of you!!

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The Avian Flight of Endurance

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❖ Dr. Sasikumar Menon has been a teacher for almost three decades now and has been teaching at the undergraduate as well as postgraduate levels. He is currently the Deputy Director at the Therapeutic Drug Monitoring (TDM) Laboratory in Mumbai. He is also a wildlife and nature conservation enthusiast.

Migration of birds is one of the natural feats amongst animals that still continues to challenge our minds and incites in us a sense of wonder for these winged beauties. The Indian subcontinent, being strategically placed, falls along the Asian Flyway and several Indian cities and villages open their doors to allow many migrant bird species to either spend the winter or offer a brief stopper before they continue their onward journeys down south. It is indeed a feat, beyond our imaginations, to extend human limits to accomplish such journeys. Many species of birds, however, accomplish these journeys so easily and repeat them year after year so efficiently. Science has always been trying to understand the factors that make these birds undertake such journeys and of course, make such journeys an integral part of their survival strategies. Though today, we know a great deal about the factors that make these journeys imminent, we are still to unravel the whole mechanisms that enable these birds to endure the physiological and biochemical challenges to undertake such athletic performances.

Electronic tracking backed by satellite technology has enabled us to unravel migration patterns of several bird species. What is intriguing is the single non-stop migrations achieved by some bird species without refuelling like the bar-tailed godwit (*Limosa lapponica*, L.) that migrates 11000 kilometres between Alaska and New Zealand. Several studies on other migrant bird species have reported that distances of 8000 to 10000 kilometres are easily crossed by many individuals by continuous flying without refuelling stops. To endure such non-stop flights, birds exhibit interesting fuel metabolism of endurance exercise during migration because of their exceptional capacities for energy storage, mobilization, transport and utilization. This is ably supported by their neurosensory coordination for orientation and navigation. It is evident from several studies that migrants make complex compromises for using seasonally available food resources and breeding sites based on the energy requirements on transport that they have to bear. Allometric relationships of mass-specific cost of transport, suggest that swimming would be the most cost effective means of locomotion but it fails to explain why birds accomplish the most extreme migrations rather than fish. Theoretical analyses suggest that birds probably succeed over fish because flying

29th INTERNATIONAL BIOLOGY OLYMPIAD (IBO) 2018 AT A GLANCE!

- **Venue:** Tehran, Iran
- **Dates:** 15th to 22nd July, 2018
- **No. of participating countries:** 71
- **No. of student participants:** 271

is a compromise between running (high energy cost) and swimming (low maximal speed). The style of flight is another way to reduce the drain on energy for example soaring flight is less energy draining than the flapping flight. Soaring flight, however, is exhibited by the large birds like geese, the smaller passerines still manage long distance migrations with flapping flight.

If long distance migration, is an adaptation that has been selected for in many bird populations, it implies that the benefits of migration definitely override the costs and provide enough time for essential activities such as feeding and reproduction. Success of migration therefore depends on the economic management of time and energy in achieving high speeds. Birds show diverse strategies to optimise energy utilization and reduce cost of transport. In addition to their morphological adaptations, some of the physiological strategies that they have adapted are very interesting. These physiological adaptations are integrated with adjustments in morphology, biomechanics, behaviour, nutrition and metabolism. Migratory birds are known to minimize body mass by selecting lipids to store energy for muscles and to atrophy body organs non-essential for flight like the digestive system, during pre-migration. In many of the birds, the pre-migration lipid storage can be up to 50% of the body mass. They exhibit extremely rapid fluctuations in lipid reserves which make them interesting models for obesity related research. Birds primarily store fatty acids as triacylglycerol which are with only 5% water as compared to carbohydrate stores in liver and muscle (glycogen) and protein stores which are with 70 – 80% water. Being virtually free of water, these stored lipids provide highest ATP yields per gram making them the best fuel for migration. Interestingly, birds also use energy from oxidising proteins during migration and this share could be up to 15%. This protein oxidation can increase the cost of transport but use of heavier fuel could help substantially reduce the load on flight muscles, as migration progresses. Additionally, the amino acid metabolites generated by protein breakdown will help replenish intermediates of citric acid cycle (anaplerotic pathways) which in turn will ensure that the lipid breakdown continues. Protein could also be mobilized to provide water during conditions of dehydration while in flight. Unlike birds, mammals rely on carbohydrate and fatty acids as fuel for exercise. In mammals, during low intensity exercise, almost all energy requirements are met by fatty acid oxidation. During high intensity exercise, however, the relative contribution of fatty acid to energy demand declines and the deficiency is made up mainly by carbohydrates (glycogen) stored within muscle cells. The reliance on muscle glycogen for high intensity endurance exercise explains the “carbohydrate loading” in human endurance athletes (cyclists, runners). Therefore, when

glycogen stores are exhausted a running mammal will experience fatigue and loss of energy. What fuel source the bird uses is influenced by the distance of migration, the lipid reserves or both. A long distance migrant like Garden warbler (*Sylvia borin*) uses more of lipid than protein during migration as compared to a short distance migrant like European robin (*Erithacus rubecula*). European robins have lesser fat reserves as compared to Garden warblers. Studies have shown that fruit-eating omnivores like Blackcaps, Garden warblers, and Lesser whitethroats utilize less protein and more lipids during migration as compared to insectivores like Orphean warblers, Redstarts, Barred warblers, Nightingales and Thrush nightingales. Diet thus, affects the fuel use in flight because of the biochemical adaptation and the possibility of replenishing reserves. Fruit-eating omnivores eating carbohydrate-rich diets like fruit and nectar are able to attain larger glycogen reserves at the beginning of a migratory flight than insectivores eating carbohydrate-poor diets.

----------*To be continued in the next issue.*

29th INTERNATIONAL BIOLOGY OLYMPIAD (IBO) 2018 AT A GLANCE!

❖ **Medal tally of Team India:**

4 Silver medals!!

Student Team members:

- **Kunjal Parnami**
- **Shaswat Jain**
- **Stuti Khandwala**
- **Vishwesh Bharadiya**

TEAM INDIA – IBO 2018

From Left to right: Mr. Vikrant Ghanekar, Prof. Kauresh Vachhrajani, Kunjal Parnami (student) , Vishwesh Bharadiya (student), Shaswat Jain (student), Stuti Khandwala (student), Prof. Pradeep Burma, Dr. Sasikumar Menon.

CLIMATE CHANGE AND EXTINCTION OF ANIMALS IN RECENT YEARS

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As the world is getting warmer, you can find a number of species in the 'threatened' list. Endangered animals whose habitats are restricted to limited terrain (e.g. small islands) remain vulnerable to changing climatic factors due to their inability to migrate to another ecological zone beyond their threshold range of tolerance. Dr E.H. Paxton of U.S. Geological Survey of Pacific Island Ecosystem Research Center, recently reported that mosquitoes moved into higher elevation of Hawaiian island of Kauai due to 'global warming'. This has led to near extinction of six species of honey-creeper birds, susceptible to avian malaria. Such invasion of vector species of diseases due to climate changes are going to threaten existence of many other plant and animal groups in near future. In this connection, many conservationists are turning their attention towards a fascinating branch of science, known as 'Phenology'.

Phenology is a branch of science which deals with the timing of natural phenomena with reference to climate and weather. In recent years, environmental biologists have gathered evidence of plant and animal groups adapting to changing pattern of climatic changes and seasonal shifts which are evident from unscheduled migration, shifting of flowering time in plants and altered reproductive cycle in animals. Our concern remains for those species which are incapable to meet this ecological crisis and ultimately face the threat of extinction. Thus, alternation in species phenology and the altered timing of life history patterns are going to be an important area of biology in coming years in order to predict the consequences of global warming and climate changes on plants and animals.

Challenges faced by animals in recent times due to climate changes are evident from the impacts on altering patterns of behaviour and reproductive cycle. It can be noticed that many birds are now forced to nest, breed and migrate earlier as spring arrives earlier than its usual time. Dr. Bob Scholes, an ecologist based at Pretoria, South Africa and Dr. Hans-otto Pörtner, an animal

NCIBE:

- National Competition for Innovative Biology Expeirments (NCIBE) was organized by ATBS.
- Experiments reflecting novelty, innovative approach and easily doable in a regular undergraduate lab were expected.

'Developing BSA-linked AuNP sensors for the detection of myrcetin by fluorescence studies' was selected as the best entry among the various submissions.

physiologist in Bremerhaven, Germany predicted half a dozens of species who would be affected by global warming and it is to be noted that their predictions are found to be true, much to the shock of all conservation biologists and environmental scientists. I would like to highlight a few examples which I hope will make an impact on the readers of this article.

Consequences of global warming are severe in the Arctic region. Arctic sea-ice constitutes the vital ecological niche for almost all the Arctic fauna. This is true for important predatory Arctic animals like polar bear (*Ursus maritimus*). A recent survey of National Geographic has indicated that polar bears are the most vulnerable species inhabiting the Arctic region in the current phase of climate change and global warming. The continued melting of the ice caps forced polar bears to struggle to hunt for this prey. In the Arctic region, another animal is facing threat of total extinction, commonly called Narwhale (*Monodon monoceros*). This unique animal is identified by its single large tusk which protrudes from the canine tooth. Due to global warming, it has been reported that Narwhale's number is shrinking due to the melting of ice in the North pole.

Now look at the opposite end of our planet and you will find elephant seals (*Mirounga leonina*) are also being affected due to melting of ice in and around Antarctica. Nevertheless, the story is quite grave for the Adélie penguin (*Pygoscelis adeliae*). Similar to polar bear of Arctic region, the common prey of Antarctic birds also resides on the undersides of ice sheets. For Adélie penguin, the prey is a small crustacean, commonly known as krill (*Euphausia superba*), which inhabits below ice caps to forage algae as their major food [*Food chain: algae → krill →penguin*]. Now due to retreat of Antarctic sea-ice, the krill population is declining and hence the Adélie penguins are forced to find out alternatives to thrive under a new ecological crisis. Many of these Arctic and Antarctic fauna are posing for an uncertain future. As the sea temperature is rising in every part of this planet, a large portion of the world's coral reefs are getting 'bleached' which are detrimental to all the aquatic fauna inhabiting in the coral reefs. We have already lost a dozens of species from our planet (please refer to Table 1) and it is an alarming situation to face one of the greatest threat that the humanity faces today to save the existing flora and flora of our planet from total extinction.

Table 1. Extinction of animals in the last four decades:

Animal		Natural habitat and the place where the animal was last found	Probable cause/s of extinction	Year of extinction *(officially declared)*
Common name	**Scientific name**			
Round Island Burrowing Boa	*Bolyeria multicarinata*	Round Island, offcoast of Mauritius	Invasion of non-native species of herbivores and it destroyed the vegetation and Boa's habitat	1975
Javan Tiger (similar looking to Sumatran Tiger)	*Panthera tigris* ssp. *sondaica*	Indonesian island of Java	Habitat loss due to agricultural development	1979
Dutch Alcon Blue Butterfly	*Phengaris alcon arenaria*	Grassland of Netherlands	Closely related species still exists, however subspecies of Alcon blue is totally extinct due to habitat loss as a result of increase in farming and development of buildings	1979
Tecopa pupfish	*Cyprinodon nevadensis calidae*	Hot springs of Mojave desert, California	Habitat loss due to encroachment by developers	1982
Golden Toad	*Incilius perigienes*	High altitude ridges, Costa Rica	Fungal skin infections	1989
Zanzibar leopard	*Panthera pardus adersi*	Zanzibar archipelago of Tanzania	Superstition among the locals that these leopards were reared by witches led to indiscriminate hunting.	1996
Pyrenaica Ibex	*Capra pyrenaica pyrenaica*	Pyrenees mountains along the borders of France & Spain	Hunting	2000
Spix's Macaw	*Cyanopsitta spixii*	Brazil & other neotropical regions	Habitat destruction & illegal trapping and trade (all blue	2004

bird			macaw birds in the wild are extinct, a few are still surviving in captivity).	
Po'ouli (Black-faced Honey creeper bird)	*Melamprosops phaeosoma*	Southwestern slope of Haleakala volcano at Maui, Hawaii	Habitat loss and avian malaria infection due to sudden	2004
West African Black Rhinoceros	*Diceros bicornis longipes*	Cameroon, West Africa	One of four subspecies of rhinoceros became totally extinct due to hunting and smuggling of horns to Yemen and China where it is believed to have aphrodisiacal power as superstition	2006
Madeiran large white butterfly	*Pieris brassicae wollastoni*	Valleys of the Laurisilva forests on Portugal's Madeira islands	Habitat loss due to construction activities and chemical pollution from fertilizers	2007

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Biology can be fun……..

REQUIREMENTS:

- Leaf sample
- Mortar & pestle
- Test tubes
- 250ml glass beaker (to be used as chromatography chamber)
- Capillary tubes
- TLC strip (silica gel), dried for 30 min at 60 - 80°C
- Aluminium foil

Thin-Layer Chromatography (TLC) is an important technique for analysis of molecules. This technique can separate different kinds of molecules based on their relative affinities for a stationary phase and a mobile phase. The stationary phase is usually a thin layer of silicic acid (silica gel) on a glass or metal plate, while mobile phase is a mixture of appropriate solvents. Although largely replaced by several new and more efficient and accurate techniques, TLC remains a rather simple but effective technique to make a first qualitative analysis of photosynthetic pigments in samples.

Plants contain different types of pigments such as chlorophylls, water soluble flavanoids and fat soluble carotenoids. Flavanoids include anthocyanins (red/ scarlet /violet) and flavanols (yellow). Some plant species contain a different type of flavanoid such as betacyanins. These pigments can be extracted using appropriate solvents and then separated on the basis of their varying solubilities using a mobile phase.

Method:

1. Take the given plant material.
2. Cut into fine pieces and grind in a mortar.
3. Add small quantity of acetone intermittently and macerate well.
4. Pour in test tube, allow the precipitate to settle.
5. Carefully decant the supernatant into a fresh vial. Allow to settle for 5 minutes.

SOLVENTS:

❖ **Solvent for extraction:**

Acetone 100%

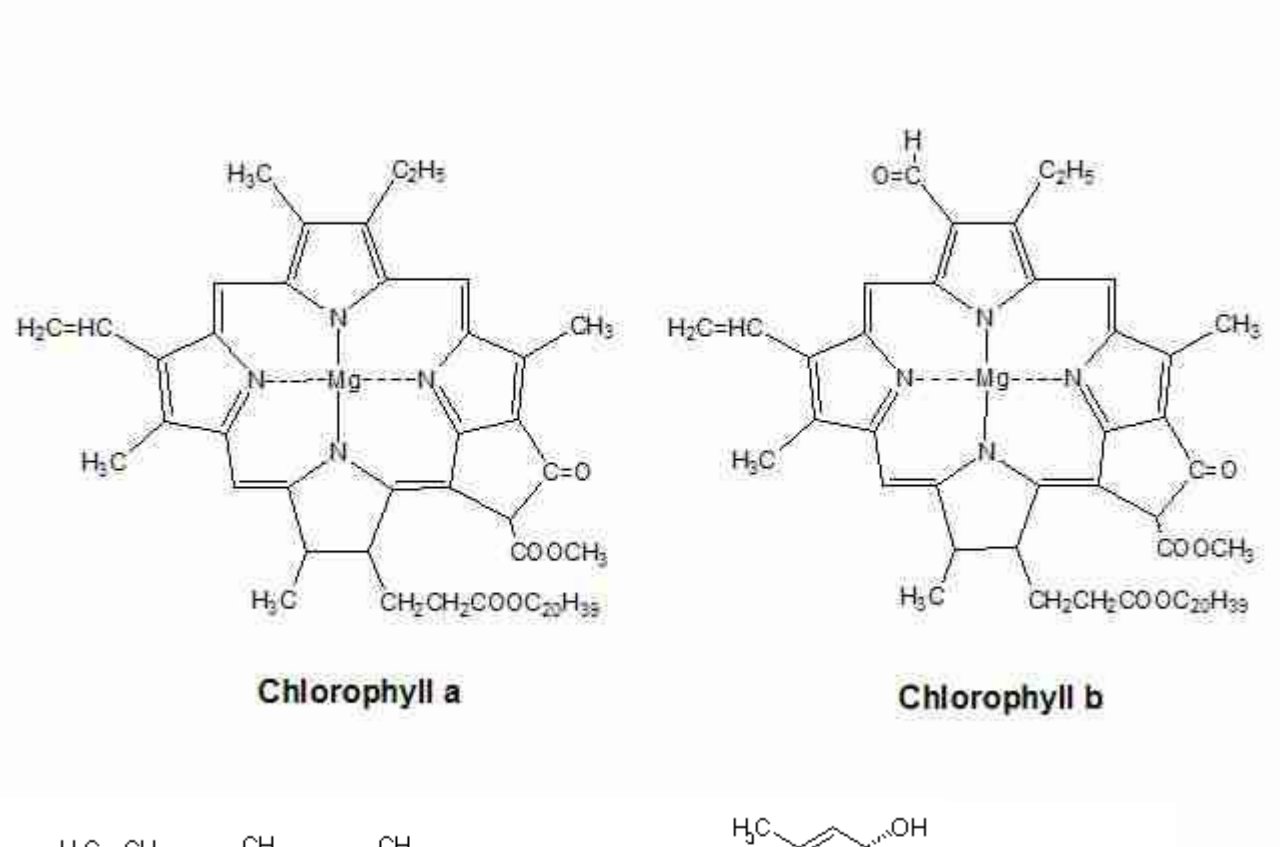
❖ **Running Solvent for TLC:**

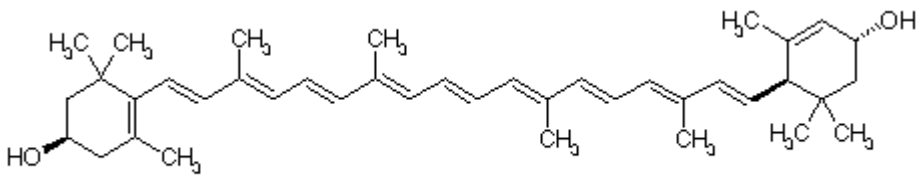
Petroleum ether: Iso-propanol: Water :: 100:11:0.3

6. Take a TLC strip and draw a faint line using pencil at about 1.5cm from the bottom (avoid damaging the silica gel layer).
7. Gently spot the pigment extract on the start line with a small capillary tube.
8. Dry the spots by blowing.
9. Repeat this 8 to 10 times.
10. Put the TLC plate in the tank, close the lid and allow to run using solvent I. Mark the solvent front line using pencil.
11. Calculate R_f values for the photosynthetic pigments that have separated.
12. Cover your TLC strip with aluminium foil to prevent photo-deterioration of the pigments.

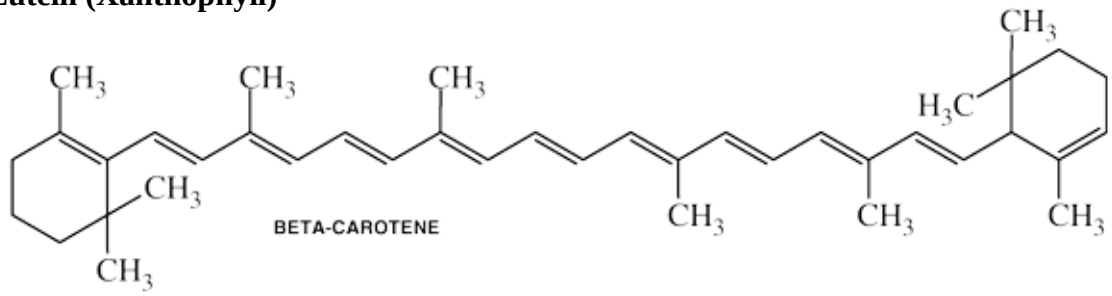
Note: Despite the precautions, pheophytins may appear. If they show up, you might see them as a grey-blue haze. We do not consider them as photosynthetic pigments because they are derived from photosynthetic pigments through chemical alteration.

Structures of some plant pigments are given below. Correlate the pigment bands obtained in the chromatogram with the correct pigment.





Lutein (Xanthophyll)



---------- *From the Biology Olympiad Cell*

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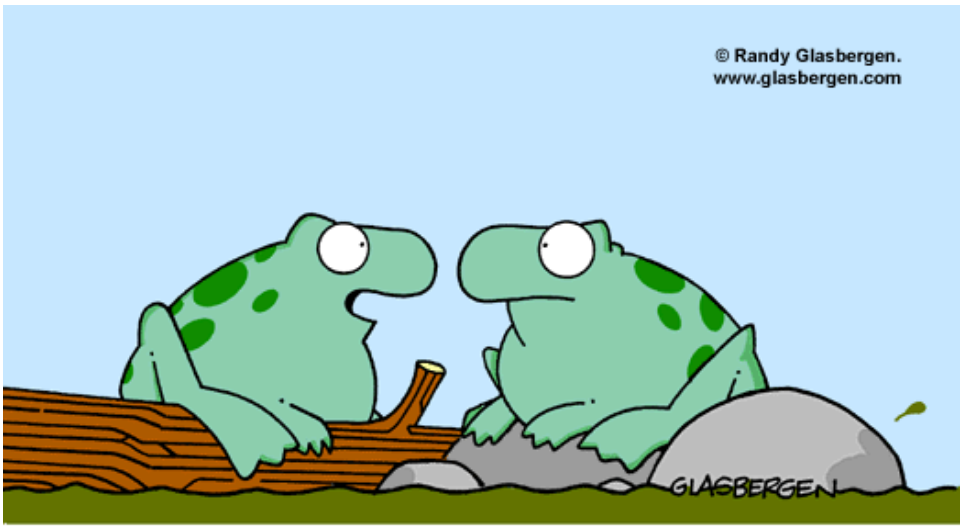
Recreation Corner .....



"Looks aren't everything. It's what's inside you that really matters. A biology teacher told me that."

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