BBC

planet earth

as you've never seen it before

A **STUDYGUIDE** BY ANDREW FILDES

3

FRESH WATER

AUSTRALIAN TEACHERS OF MEDIA INC.

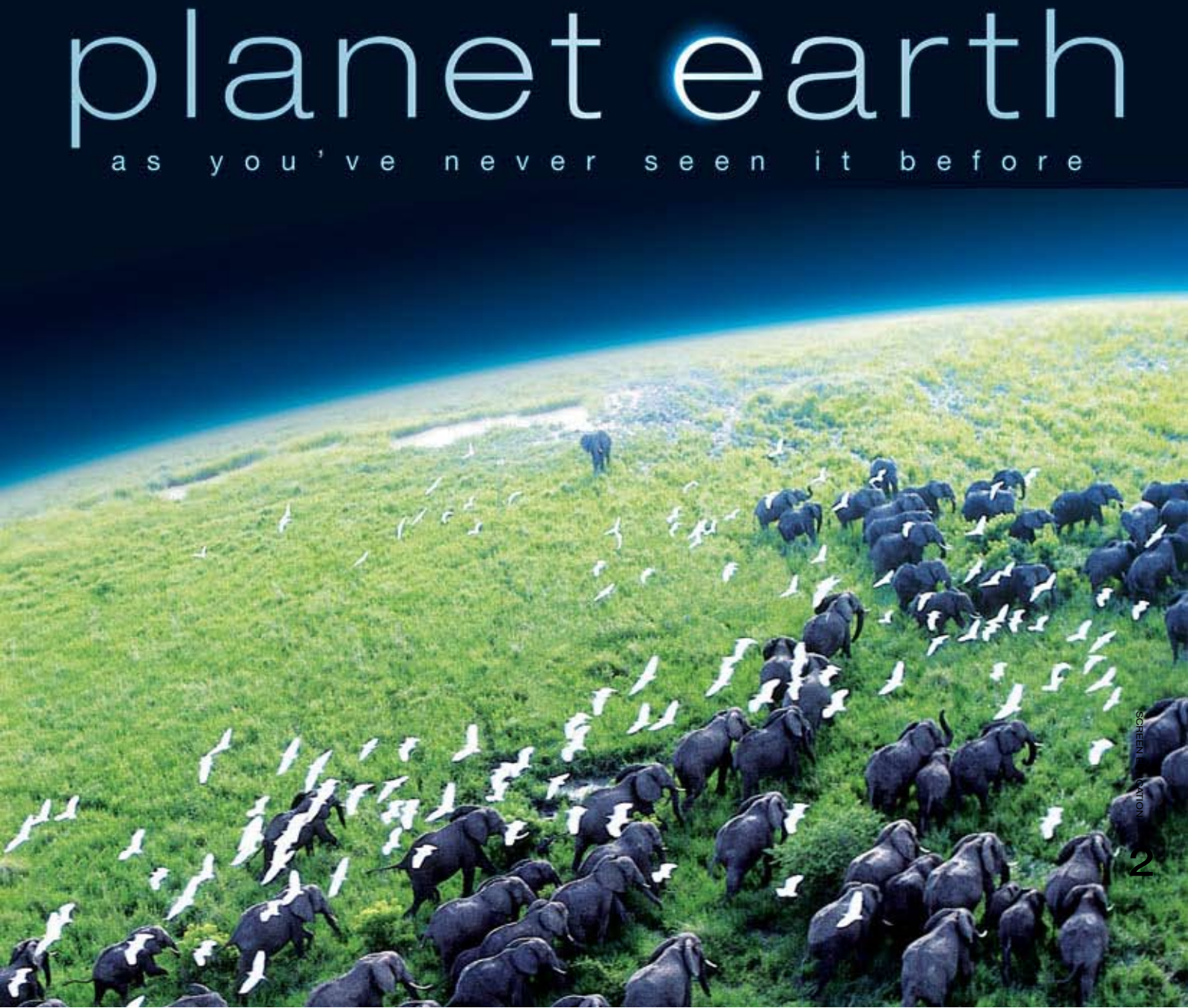
www.metromagazine.com.au

www.theeducationshop.com.au

Overview

Planet Earth is a BBC production with five episodes in the first series, and a second series to follow in 2007. Each episode examines a range of environments, focussing on key species or relationships in each habitat, the challenges they face, the behaviours they exhibit and the adaptations that enable them to survive. Recent advances in photography are used to achieve some spectacular 'first sights' – in particular, stabilized aerial photography gives us remarkable views of migrating animals and the techniques used by their predators to hunt them.

The series is suitable for middle secondary students studying Science and SOSE/HSIE, and for senior secondary students of Biology, Environmental Science and Geography.



Episode Three: Fresh Water

The third episode explores the cycle of fresh water, from the great storms sweeping inland with their vital cargo of rain, to the return to the oceans at the great river deltas. All life on Earth has a fundamental need for clean, fresh water and yet only three per cent of all the water on the planet is fresh at any one time.

We visit the high tepui of Venezuela, the strange isolated jungle plateau, which gave rise to legends of 'lost worlds' where perhaps even dinosaurs still survive. They don't, of course, but on these highlands it rains every day giving rise to spectacular sights such as the Angel Falls which plunge almost a thousand metres off the escarpment of Auyantepui and reach the ground as mist.

Mountain streams are fast and clear and home to invertebrates which must hang on tight among the stones in the river rapids. Further down, where things are less turbulent, huge Japanese salamanders ambush their prey. Among the largest amphibians left, these 1.5m living fossils sense small fish in the dark by their movement alone. Pacific salmon make their long and dangerous journey into the upper reaches of the river systems and must pass the barrier of hungry bears, ready for the annual feast before hibernation.

Rivers are one of the most powerful erosive forces and nowhere is this more evident than in the Grand Canyon of the south-west USA. A system of gorges cut into the sandstone, it is 1600km long and up to one-and-a-half kilometres deep.

Rivers maintain unique ecosystems. In India, otters form clans to hunt fish like aquatic wolf-packs, and they're almost as fearless too, as we see them bravely face off a huge mugger crocodile intent on a furry snack. In Africa, huge Nile crocodiles have larger game in mind as they select their victims from the huge wildebeest migration which must cross their wide rivers.

Further north we examine the unique life of the huge Rift Valley lakes. Lake Malawi is a virtual inland sea which is home to a remarkable population of exquisite cichlids, hundreds of distinct fish species which have descended from a few common ancestors to fill every imaginable ecological niche. They are hunted by the electric dolphin fish which sense their presence in the field that they generate. But large as Lake Malawi may be it is dwarfed by the frozen Siberian Lake Baikal, a lake so vast that it holds one-fifth of the planet's fresh water. Home to unique freshwater seals and strange crustaceans, it is frozen over for five months of the year but is still rich in life.

The world's greatest river is the Amazon, carrying huge quantities of silt to the ocean each year and again, a system so large that it can support unique life forms. The only freshwater dolphins in the world, the pink boto, chase shoals of fish to the point where they leap from the water in desperation. Further south, the Iguaçu Falls are one of the world's largest broad waterfalls at over two kilometres wide and the Paranar River forms the huge Pantanal Swamp where the infamous piranha can strip a victim to the bone in minutes.

Episode 3: Fresh Water	Time Log
Intro	00:00 - 01:18
Venezuelan Plateau	01:18 - 05:40
Stream Invertebrates	05:40 - 07:15
Japanese Salamanders	07:15 - 09:35
Salmon and Bears	09:35 - 12:25
Grand Canyon	12:25 - 14:15
Otters and Crocodiles	14:15 - 18:30
Crocodiles and Wildebeest	18:30 - 23:05
Lake Malawi Cichlids	23:05 - 28:35
Lake Baikal	23:25 - 30:55
The Amazon and Dolphins	30:55 - 35:35
Brazilian Pantanal	35:35 - 34:30
Bangladesh Mangroves	43:20 - 44:15
Crab-eating Macaques	44:15 - 46:15
Snow Geese	46:15 - 48:20

(TIMINGS ARE APPROXIMATE)

Finally we return to the sea at the great estuaries and deltas where huge tropical mangrove swamps are home to swimming monkeys and the northern salt swamps are home to vast flocks of snow geese.

Web Resources

Tepuis: **http://www.planeta.com/planeta/97/0897ven.html**
Cichlids: **http://malawicichlids.com/mw01100.htm** OR **http://malawicichlids.com/mw01002.htm**
Salamanders: **http://www.caudata.org/cig/japanesegiant.html** OR **http://coloherp.org/cb-news/Vol-28/cbn-0108/GiantSala.htm**

Species list

- Hellgrammite – *Corydalus commutus (larva)*
- Blackfly Larva – *Simulidae ssp.*
- Bamboo Shrimp – *Atyopsis ssp.*
- Giant Salamander – *Andrias japonicus*
- Pacific Salmon – *Oncorhynchus ssp.*
- Grizzly Bear – *Ursus arctos*
- Smooth-coated Otter – *Lutrogale perpicillata*
- Mugger Crocodile – *Crocodylus palustris*
- Wildebeest – *Connochaetes taurinus*
- Nile Crocodile – *Crocodylus niloticus*
- Dolphin Fish – *Gnathonemus sp.*
- Lake Fly Midges – *Chaoborus edulis*
- Baikal Seal – *Phoca sibirica*
- Boto (Dolphin) – *Inia geoffrensis*
- Victoria Giant Water Lily – *Victoria amazonica*
- Red-bellied Piranha – *Serrasalmus nattereri*
- Spectacled Caiman – *Caiman crocodilus*
- Dorado – *Salminus maxillosus*
- Roseate Spoonbill – *Platalea ajaja*
- Crab-eating macaque – *Macaca fascicularis*
- Greater Snow Goose – *Chen caerulescens atlantica*

1

Blackline Master | *Planet Earth* | Episode 3: Fresh Water

Viewing Questions

1a

1. What percentage of the Earth's water is fresh?

2. How high are the Angel Falls?

3. How does the blackfly larvae hold on against the current?

4. What class of animal is a salamander?

5. Why do salmon lay their eggs so far up the rivers?

6. What is the hazard they face getting up there?

7. How long in miles is the Grand Canyon system? One mile is approximately 1.6 kilometres. Convert your answer to kilometres.

8. How large is a clan of smooth-coated otters?

9. How many wildebeest migrate every year?

10. What type of crocodile is found in African rivers?

11. How big do they get?

12. How many species of cichlid fish are there in Lake Malawi?

13. How do dolphin fish hunt in the dark?

14. What is the world's largest fresh water lake?

15. What proportion of the world's fresh water does it hold?

16. Which is the largest river?

17. What is the famous carnivorous fish of Brazil?

18. What kind of animal is a caiman?

19. What small tree grows in the salty mud of river estuaries and deltas?

20. What kind of animal is a macaque?

2

Case Study | *Planet Earth* | Episode 3: Fresh Water

Trophic Adaptations

2a

Cichlids (pronounced 'sick'lids')

One of the most fascinating areas of evolutionary adaptation is trophic adaptation – the physical changes in species to adapt to a specific food source. For instance, humans have the teeth of an omnivore – we have incisors, canines and molars that allow us to eat almost anything. A crocodile has the teeth of a carnivore and cannot chew like us – it has adapted to a diet of raw meat, which it can tear off in chunks and then swallow whole.

In fact, Darwin first began to formulate the idea of evolution after looking at the ways that similar animals on the separate Galapagos islands had changed to make best use of the different food sources available – particularly the finches. In this episode of *Planet Earth*, we see half-blind Japanese giant salamanders which can sense the movement of their prey in the dark water; dolphin fish in Lake Malawi which emit an electric field and sense the distortions in it made by their small prey fish; boto pink river dolphins of the Amazon which use sonar to find their food in muddy water. These are all trophic adaptations that aid hunting. They involve an animal changing to different shapes or developing specific physical structures that help it find and eat its food.

The cichlids of Lake Malawi are a wonderful example. Cichlids are a very common type of fish around the world but the ones found in the African lakes are rather special. In this one lake there are literally hundreds of unique (endemic) species, some of them so colourful that they are collected and bred by aquarium hobbyists. They are descended from just a few trapped in the lake when it was formed millions of years ago and have speciated (evolved into different species) to take advantage of every possible food source in this enclosed environment. Some just eat other cichlids – simple. Others eat snails or plants and algae. But there are far more specialized feeders, some with very nasty and anti-social habits.

Lepidophages – scale and fin biters. These chew scales off other fish and nip pieces from their fins. They often look like their victim species (mimics) and mimic their behaviour too so they can get close enough. They have strong, small biting mouths with lots of small, sharp teeth.

Paedophages – Some cichlids protect their young by keeping them in their mouth, as you saw in the film. These hunters will ram into the mothers, forcing them to spit out their eggs or young which they then grab. They have a large lower jaw which allows them to hit hard and a big mouth to swallow fast before the young can flee back into the mouth.

Ectoparasite Cleaners – these clean the parasites off larger fish by nibbling them off and eating them. They advertise their services and are welcomed! There are similar cleaner fish in the oceans (parallel evolution) and some birds such as cattle egrets do this on land for large herbivores (convergent evolution).

Crevice Feeders – have extended lips so that they can suck small creatures out of cracks and holes.

Piscivores – fish eaters are big and fast with a large mouth and lots of teeth.

Molluscivores – eat snails and have large, strong mouths to pull them off and crush them.

Pictures and details of species can be found here **http://malawicichlids.com/mw01100.htm**

Research Activities

- Gather examples of trophic adaptations in other groups or divergent species. i.e. microbats, birds.
- Do the same for the case of convergent and parallel evolution.
- Prepare a report or PowerPoint presentation on these critical concepts.
- Some people do not accept evolution. They believe that it cannot explain extremely complex body structures. Find one example of an objection – the development of the eye is a good example – and write an argumentative essay from one point of view or the other.

3

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Fresh Water Life (Senior Level Biology)

3a

Discussion Questions

1. Salamanders are amphibia, a large class of animals of which most species are endangered. What members of this class are found in Australasia and why are they so threatened?

2. The salamanders are slow and have poor eyesight but their food is small and fast. How can they survive?

3. Mountain streams are high in dissolved oxygen and low in nutrients. Why?

4. Rivers and streams in urban and farming areas are the exact opposite. Why?

5. What advantage do you think that there might be for the otters in forming family clans rather than just breeding pairs as in other countries?

Extension Tasks

Frogs and other amphibia are threatened across the world.

1. Find out the reasons for this.
2. Make a list of the amphibia found in your area.
3. Prepare a Conservation Plan to protect the native amphibia in your area.

The hundreds of species of cichlid in Lake Malawi descended from a few ancestors by a process of 'speciation'. Find other examples of speciation among animals and prepare a report on one or two of them.

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SOSE – Geography

4a

1. ‘All life on land is ultimately dependant on fresh water.’ In what ways is this statement true? Is life dependent on other fundamental things too?

2. What is the process that creates fresh water – where does it come from?

3. Draw the fresh water cycle from ocean and back again, showing the processes (use page 4b). Use a flow diagram or an illustrated cross section diagram.

4. Why exactly does it rain every day in the Venezuelan mountains (tepuis)? Explain with a diagram and a short paragraph (use page 4b for the diagram).

Research Activities

1. Water action is a major mechanism of erosion, an important natural force. Investigate its role in shaping the landscape of Australia or New Zealand and the problems that it may cause. Prepare a PowerPoint stye presentation.
2. A tepui is an unusual mountain type. Investigate the way in which it is formed and the unique characteristics of this structure. Prepare a written report showing their shape, location and similar structures in other environments. (Hint: mesa)

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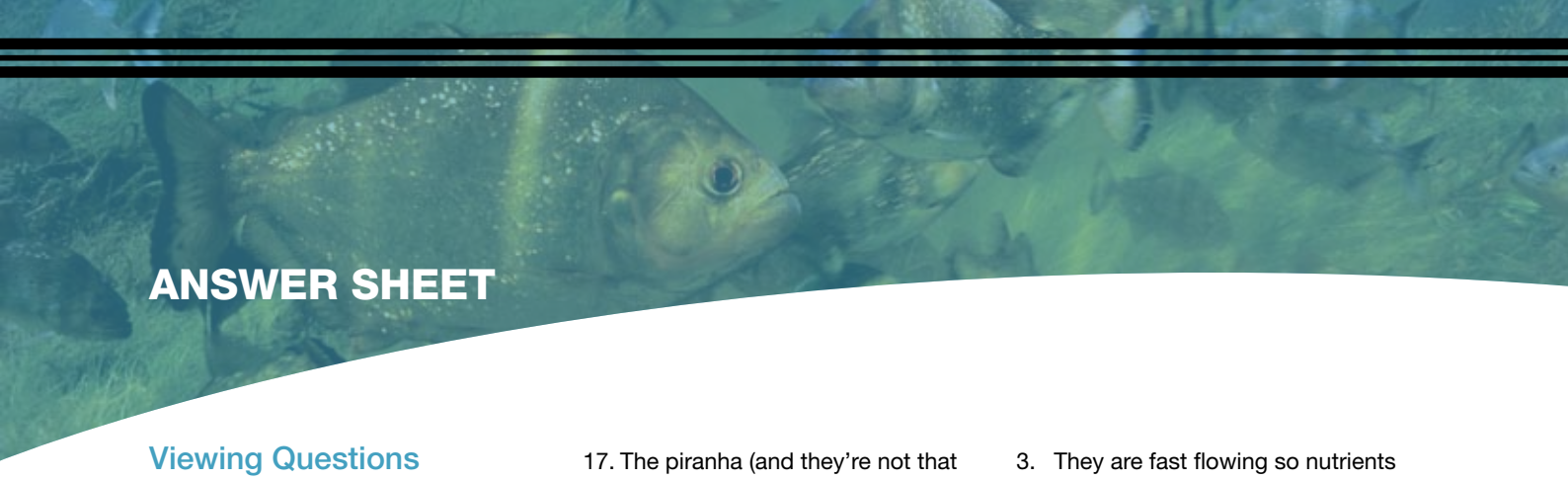

ANSWER SHEET

Viewing Questions

1. Three per cent
2. Angel Falls are almost 1000 metres high (one kilometre)
3. Hooks plus a silk safety thread
4. An amphibian
5. There are fewer predators to eat the salmon's eggs
6. Bears and a long journey upstream
7. 1,000 miles long (1600km)
8. Up to seventeen members
9. 2 million
10. Nile crocodile (the mugger is in India)
11. Up to five metres long
12. 850
13. They sense distortions in their electric field
14. Lake Baikal in Siberia
15. One fifth or twenty per cent of the world's fresh water
16. The Amazon is the largest river
17. The piranha (and they're not that dangerous)
18. A caiman or cayman is a small alligator
19. Mangrove trees grow in tropical river deltas
20. A monkey

Fresh Water Life

1. Frogs and toads. These animals are endangered because they are very vulnerable to water pollution. They can absorb toxins directly through their skin very easily. Most of their habitats are under threat as well.
2. They have a slow metabolism and don't need to eat much. They are well camouflaged (they look like rocks) and can sense the movement of fish and other prey if they get close to their mouths in the dark.
3. They are fast flowing so nutrients (organic materials) are washed away quickly. The action of water bubbling over rocks absorbs oxygen from the air.
4. They are slower moving and absorb less oxygen from the air. Many pollutants are organic (nutrients) and use up oxygen as they break down. This includes fertilizers and animal wastes. The result is massive overgrowth of algae and weeds – algal 'blooms' – and the death of animals like fish from suffocation.
5. They can defend themselves against the crocodiles and the loss of a clan member from time to time is less of a problem for a group.

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This study guide was produced by **ATOM**
editor@atom.org.au

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