Feedback

The ASAB education newsletter

Feedback ISSN 2042-5724

Issue 50 **Summer 2011**

In this issue

Association for the
Study of
Animal
Behaviour

Dear Colleague,

I am very excited to produce for you the 50th Edition of Feedback. I would like to take this opportunity to thank Michael Dockery for all his support and help.

Hopefully you will find inside a set of useful resources, ideas, contacts and the means to access many additional engaging and valuable ideas for lessons and practicals. You may recognise some of the questions from previous editions of Feedback and acknowledgements go to Michael for these.

We are working very hard to ensure that most of our resources will soon be freely downloadable from our exciting new website - details to follow. However, you can also keep track of us via our facebook page. Just search for ASAB education and 'like' us – in return you will find interesting links and up to date news.

At the beginning of December I was lucky enough to attend my first ASAB conference at the Zoological Society of London. A very wintery atmosphere greeted the delegates and the flamingos' knees were knocking...

© Charlotte Evans

The Association for Science Education Conference followed very quickly in January. Rupert Marshall (Aberystwyth University) gave an outstanding ASAB lecture entitled 'Birdsong: sing it again Sam' which was enjoyed by a large audience of teachers and other educators. His lecture, amongst others from the 'Biology in the Real World' series, can be found on the Society of Biology website here: http://www.societyofbiology.org/education/educational-resources/bitrw

ASAB Education Officer,
Charlotte Evans

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ASAB education website is:
http://asab.nottingham.ac.uk/

EVENTS

I hope you enjoy the 50th edition of ASAB's Feedback newsletter. This is an exciting time for the ASAB Education work, with Charlotte Evans, our new Education Officer, settled into her post, and with a range of new initiatives underway. Inside Feedback you'll find teaching resources, news and lots of great ideas. This 50th edition of Feedback includes some highlights from the archive as well as new material. We intend to have a much more extensive archive of materials available soon via the ASAB Education web-pages, but in the meantime, please do get in touch with us by email, Facebook or telephone, if there is anything that we can help you with, in terms of resources, activities, ideas or advice.

Dr. Rob Thomas
ASAB Education Secretary
Cardiff University

Acknowledgements
Photographs were kindly supplied by Chalotte Evans, Mick Hoult, Sue Howarth, Rob Thomas, Tom Flower, Giulia Cutuli, Jennifer Sanderson, Zoe Muller, Nic Charlton, J Memmott, Deborah Harvey, Caroline Harrop, and Dr. G. Borgia

We also thank Elsevier for permission to use material from articles in Animal Behaviour for the GCSE Biology, AS/A2 Biology, Advanced Higher Biology and the AS/A2 Psychology exercises.

Design by Mick Hoult

2011

18th -19th Aug	ASAB Summer Meeting 2011: Understanding Animal Intelligence, University of St Andrews
3rd -4th Sept	International Vulture Weekend, Glasgow, www.rspb.org.uk for more details
10th -15th Sept	British Science Festival, University of Bradford, http://www.britishscienceassociation.org/web/BritishScienceFestival/index.htm for more details
17th-18th Sept	Beachwatch Big Weekend, www.mcsuk.org for more details
1st -9th Oct	Red Suirrel Week, www.wildlifetrusts.org for more details
5th Nov	Bonfire Night, watch out for Hedgehogs...
1st & 2nd Dec	ASAB Winter Meeting 2011: Why do animals mate with the "wrong partner"? The Zoological Society, London
1st Dec	ASAB Education Committee Meeting, The Zoological Society, London

2012

4th - 7th Jan	ASE Annual Conference 2012, University of Liverpool. This will include an ASAB sponsored lecture by Dr Rob Thomas on `The Race to Reproduce` the lecture will be on Friday 6th January at 1400 hours in the `Biology in the real world` series.

NEWS

Our very own Rob Thomas – ASAB's Education Secretary - will be giving the 2012 ASAB lecture at the ASE conference in Liverpool as part of the 'Biology in the Real World' lecture series. This year the series has an Olympic theme and the title of ASAB's contribution is 'The race to reproduce' expect tales of sex, violence and underhand tactics...

I was also lucky enough to attend Sue Howarth and Karen Blackmore's (University of Worcester) session on science clubs. **Dissecting owl pellets** is the most fun I've had in ages. As you can see in the photo.

© Sue Howarth

In this edition of Feedback I am pleased to be able to include two opportunities to assist in some animal behaviour research. Nic Charlton from the University of Bristol is involved in a study into robbery of red campion (*Silene dioica*) by a short tongued **bumblebee**, *Bombus terrestris*. The researchers are attempting to understand the patterns of robbery in this wildflower and are looking for people across the British Isles to assist them. Deborah Harvey from Royal Holloway, University of London in monitoring the **rusty red click beetle** (*Elater ferrugineus*) one of the United Kingdom's largest click beetles. Despite its size and dramatic colouring, it is rarely seen and is of conservation concern in this country. Deborah is hoping to determine the distribution of the beetle in the United Kingdom and would like your help to discover whether this elusive beetle really is very rare, or just hasn't been spotted in many locations yet.

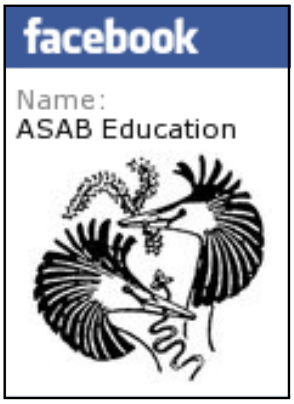
Both these research projects offer marvellous opportunities for lessons and engaging young people. Deborah's study will collect data for mark, release, recapture calculations and Nic's project includes sampling methods. So join in on your own – or get your classes involved as well.

Our **Warning Colours** Poster Competition has a very exciting prize. 2|Entertain have kindly provided two box sets of David Attenborough's Life on Land. Rob has been road-testing these and you can find his verdict on page 16.

Charlotte Evans

The ASAB Education Committee website

can be found at http://asab.nottingham.ac.uk/education/index.php We are in the process of creating an exciting new website which will contain all our resources directly downloadable and more. Meanwhile, if you are after a particular resource that was on the old website please let me know and I'll be able to forward it to you. Please feel free to email me with any ideas or resources you would like to see included on the new website. We are also after a name for our new website, something short, catchy, animally and easy to type.... All ideas gratefully received.



When it comes to instant animal behaviour updates 'ASAB Education' has 87 fans – we need more... So if **Facebook** is your thing, find us and like us. Hopefully we should hit 100 fans by the summer. The more fans we have then we should be able to make our page more interactive. You will discover top animal behaviour news, links to resources, engaging videos and the odd lesson starter. We hope that with your help our page will evolve into an interactive forum for discussion between teachers and animal behaviour scientists.

Dr Dee McCarthy from Hutchesons` Grammar School, who we are lucky enough to have on the ASAB Education Committee, has produced a fabulous resource for the Scottish Higher Biology course. It is a **case study on primate behaviour** and includes resources from Michael Dockery and video footage from the Living links Research Centre at Edinburgh Zoo. Thanks go to Michael Dockery, Professor Andrew Whiten, Dr Mark Bowler and Professor Hannah Buchannan-Smith for their collaboration. The resource should be available from the LTS (Learning and Teaching Scotland) website soon. However, if you would like a sneak preview then please contact me.

You might be aware that ASAB Education Committee runs a **Nestbox scheme**. We have several BoxWatch nestboxes with video cameras. These boxes are available for loan to schools for the nestin-

season each year. If your school would like to be considered for a nestbox and camera next year please contact me at behaviour@cardiff.ac.uk This year's most successful nestbox was Llysfaen Primary School, Cardiff with eight eggs successfully hatching (see the school's video diary on page 5).

ASAB provides **Teacher Researcher Grants** to encourage teachers to produce materials to help in promoting the teaching of animal behaviour in schools and colleges. The Association is prepared to provide grants in 2012 to release teachers for a period of 5 days, plus a small amount for any additional expenses. The successful teacher would work with a university-based member of the education committee where they will develop their idea and test it in their own school or college and in at least one other institution. The aim will be to publish the fruits of their research in an educational journal, or in FEEDBACK (the ASAB education newsletter) or for presentation at an educational conference. The resource would also normally be available on the ASAB education website. The teacher researcher would also have full use of a university library for their research. If you would like to be considered for one of the teacher researcher positions, which can be taken up at any time of the year that is mutually convenient for the teacher, their school or college and the supervisor, then email Charlotte Evans at this address: behaviour@cardiff.ac.uk In your email you will need to attach a short curriculum vitae and, in 200 - 300 words, outline your potential project that will help in the teaching of animal behaviour in schools and colleges. If you have any further questions please do not hesitate to contact me at the same address.

We have recently had a couple of changes to the **ASAB Education Committee** and here is a list of the current members. Dr Rob Thomas, Secretary, (University of Cardiff),Dr Mike Topping (Loretto School, Musselburgh), Dr Lottie Hosie (University of Chester), Dr Sheila Pankhurst (Anglia Ruskin University), Dr Dee Mc-Carthy (Hutchesons` Grammar School, Glasgow), Dr Andy Russell (University of Exeter), Polly Lee (St Monica`s RC Primary School, Flixton) Dr Anna Jolliffe (Wellington School, Somerset) , Evie Bentley (Educational Consultant, Hurstpierpoint) and myself, Charlotte Evans the ASAB Education Officer.

10 Really Good Websites

http://www.living-links.org/

http://www.thenakedscientists.com/

http://www.nhm.ac.uk/nature-online/life/other-invertebrates/walking-with-woodlice/identification.html

http://www.sciencecookiecutters.com/

http://www.thewebbroadcastingcorporation.com/

http://animal.discovery.com/animals/wild-animal-guides.html

http://www.bbsrc.ac.uk/society/schools/keystage3/keystage3-index.aspx

http://www.hedgehogstreet.org/

http://www.sciberbrain.org/Home.aspx

http://www.nationalinsectweek.co.uk/facts.php

NEWS

Llysfaen primary school nestbox report

Please note, due to some school filters it has been necessary to replace the common name of this bird with the scientific one! So for *Cyanistes caeruleus* please read blue t!t...

On the 28th of March we were so excited because that was when we first saw a *Cyanistes caeruleus* in our little bird box. It had blue, white, green and grey feathers and a grey beak. The *Cyanistes caeruleus* had a look around and flew off.

At first the bird box was empty but later we saw little bits of moss scattered in it.

It was the 4th of April when we saw the *Cyanistes caeruleus* again and this time she was holding a piece of grass! It was so exciting... Then the mother bird filled up the bird box and we couldn't see the bottom of it. The nest was mossy and green and it looked really soft.

© Rob Thomas

Year 3 pupils from Lysfaen School setting off on a bird-watching walk to Coed y Felin Woods, after setting up their ASAB video-nestbox in the school grounds

On the 7th of April she was putting soft things like feathers in the nest to make it comfortable.

Four days passed and on the 11th of April the mother bird made a cup in the nest because she was going to lay the eggs in the cup. We watched her all the time she made her nest and it took about two weeks to make and finish. She had been very busy finding things for the nest and the male bird didn't help!
By the 15th of April the mother bird had laid lots of eggs – we were so excited!

By the 16th of April there were six eggs that were white with red spots on them. However, we usually didn't see the eggs because the mother was mostly sitting on them to keep them warm.

On the 4th of May the eggs finally hatched and out popped six chicks with pink skin. We weren't there to see them hatch because it was Easter holidays but Miss Vest saw them.

When we came back to school the baby *Cyanistes caeruleus* were still really small and their eyes weren't open yet. We were extremely happy and very excited. The baby *Cyanistes caeruleus* kept growing and growing. The father bird brought the food for the mother bird because the mother was too busy looking after the chicks. When the baby chicks had grown feathers they began to fly in the bird box. We walked into school on May 16th and found that the birds had all flown away. We were sad but we were glad that the chicks had started to look for their own food.

ANIMAL CAMEO

Fork tailed drongo (*Dicrurus adsimilis*)

© Tom Flower

Fork tailed drongos are small birds, which live throughout southern and eastern Africa in woodland, scrub and grassland habitats. They form breeding pairs which stay together throughout the year and maintain a permanent territory. The pair have 1-3 chicks each year which remain on their parent's territory until the start of the next breeding season. Drongos catch most of their food by hawking small insects from a perch or by flying to ground to collect crickets or lizards. They are also commonly seen following herds of antelope, flocks of birds and even bands of meerkats, and catch small insects disturbed by these groups as they forage.

When following flocks of birds or meerkat bands drongos act as sentries and make true alarm calls at approaching predators such as jackals or hawks which the foraging group respond to by fleeing to cover in bushes or holes to avoid being eaten. However, drongos appear to exploit this relationship, when they see a bird or meerkat with a large food item such as a scorpion or lizard, they make false alarm calls. These cause the individual to drop their food item and flee to cover enabling the drongo to swoop down and collect the food.

This behaviour is an example of deception, the birds and meerkats still respond to the false alarm calls because if they ignored a drongo alarm call they might be eaten by a predator! However, just as in the story, 'The boy who cried wolf', when the drongos make too many false alarm calls, the birds and meerkats stop responding to the drongos false alarm calls. The drongo has another trick up its sleeve to combat this problem; they mimic the alarm calls of other species in the area, including the alarms of the species that they are following. These mimicked false alarm calls cause the birds and meerkats to flee to cover even when the drongos own alarm call do not, enabling the drongo to continue its deception racket.

If the drongos deceptive alarm calls don't do the trick then the drongo can also attack and chase individuals with a food item in an attempt to mug them. In fact stealing food using deceptive alarm calls and mugging are important strategies for drongos particularly during the winter months when they account for 22% of the drongo's food.

The ability to mimic the vocalisations of other animals is actually quite common in birds and some birds like parrots and mynas can even mimic humans. But there have been few examples of how this behaviour benefits individuals. The fork-tailed drongos use of deceptive mimicked alarm calls to steal food is therefore a great example of a function for vocal mimicry.

Five fascinating facts

1. Individual fork tailed drongos have been seen stealing food from 22 different species and one individual mimicked the alarm calls of 27 different species including meerkats.
2. There are 21 species in the drongo family spread across Africa, Asia and Australia. Many of these other species also appear to act as sentries for flocks of birds and steal food.
3. When drongo families meet each other on territory boundaries they engage in aerial dog fights.
4. Drongos chase and attack predators that come into their territory including tawny and marshal eagles, two of the largest birds of prey in Africa.
5. During bush fires drongos commonly fly at the front of the fire storm catching insects that are fleeing the blaze.

Tom Flower
University of Cambridge

ANIMAL CAMEO

© Giulia Cutuli

Hermann's tortoise (*Testudo hermanni*)

Hermann's tortoise is an endangered species of tortoise which can be found throughout southern Europe. There are two principal subspecies: The western population (*T. h. hermanni*) is found in eastern Spain, southern France, the Balearic Islands, Corsica, Sardinia, Sicily and south and central Italy (Tuscany). The eastern population (*T. h. boettgeri*) is found in Serbia, Kosovo, Macedonia, Romania, Bulgaria, Albania and Greece.

Living in Mediterranean areas, characterized by a temperate climate, with mild winters and dry summers, Hermann's tortoise favourite habitats are densely wooded hillsides and coarsely vegetated slopes. Like all other tortoises, Hermann's tortoise is mainly vegetarian, but sometimes its diet may include small invertebrates like worms and snails.

© Giulia Cutuli

Winter months (from November to March) are spent in hibernation. Some weeks before hibernation begins, the Hermann's tortoise stops eating and reduces it's activity. Then they dig a shelter and spend the winter underground. During this period the tortoise's heart and breathing rate drop noticeably. In the very hot and dry conditions of mid-summer much of the day is spent in retreat. Maximum activity occurs in the early morning or in late afternoon.

Hermann`s tortoise has two reproductive seasons a year, males and females mate in late spring-early summer and in September. The typical courtship display of a Hermann's tortoise is not very subtle. The male bites and smells the female, bobs his head, rams, runs after and moves around the female. Sometimes, during courtship and mounting the male can seriously hurt the female. Each female can mate with more than one male in a single reproductive season and the young are often sired by two or three different males. In addition to this, females are able to store viable sperm in their oviduct for many years!

Females lay eggs two or three times a year, during the summer, and have a total clutch size of 5 - 12 eggs. The offspring hatch after 60 days of incubation under the ground and their sex is determined by environmental temperature (< 31.5 °C produces males; > 31.5 °C produces females).

Despite its tough appearance, the Hermann's tortoise is seriously endangered and under threat of extinction. Its natural habitat is threatened by fires, urbanization and intensive agriculture and its populations are subjected to over-exploitation and capture for trading purposes.

Five fascinating facts

1. Tortoises are particularly long-lived animals, and are believed to live for 70 - 100 years.
2. During hibernation, when the body temperature is about 5° C, the heart rate drops to only 4 beats a minute.
3. Tortoise females, after oviposition, hide their eggs (in a hole in the ground) and then abandon them. However, the hatchlings are able to feed and provide for themselves just a few hours after birth.
4. Tortoises have a good sense of smell and have excellent sight but their hearing is very poor, though they can detect ground and air vibrations.
5. Tortoises are non-social animals, and they rarely meet in their natural habitat; however, they do show weak territoriality over foraging, nesting and shelter sites.

Giulia Cutuli
University of Florence, Italy

Banded mongoose – *Mungos mungo*

© Jennifer Sanderson

The banded mongoose (*Mungos mungo*) is a highly social carnivorous mammal that is found widely across the African savannah. They are opportunistic foragers and will eat anything they can find, ranging from snakes, frogs and birds down to millipedes, termites and dung beetles. Banded mongooses are close cousins of meerkats (*Suricatta suricata*) and share many characteristics of social living, such as alloparental care and group vigilance. However, unlike meerkats who have a dominant breeding pair, all mature individuals within a banded mongoose pack are able to breed.

Like in many social species, banded mongoose females come into oestrous simultaneously. This provokes some extreme behaviour from the males of the group: older, more dominant males become mate guards of oestrous females, each following his partner closely all day, aggressively guarding her against sneaky matings with subordinate younger males. After about two months all the females will give birth together, producing a large litter that the whole pack will help to care for.

Banded mongoose pups stay hidden in the den for the first month of their lives and each day one or more adults stay behind to look after them and guard them against attack from predators and rival groups. These babysitters forego all foraging opportunities for a whole morning or afternoon which leads to significant weight loss and can affect their chances of breeding, as reproductive success is highly dependent on body size. Therefore most babysitters are young males who are not yet able to breed and so are least affected by this weight-loss. After emerging from the den the young mongooses then compete for access to adult *escorts*. Each pup will then spend the next six weeks of its life closely following its escort who will feed it and protect it from danger whilst it learns to fend for itself.

Five fascinating facts

1. Banded mongooses are highly cooperative, living in groups of 8 – 30. All individuals will help to look after pups even if none of them are their own.
2. Within a pack of banded mongooses there are *super-helpers* who will care for pups by babysitting or escorting up to five times more than the average mongoose.
3. If a pack of banded mongooses gets too big some members will become highly aggressive towards others to evict them from the group. These evictees will then disperse to form coalitions with evictees from other packs and find their own territory.
4. Some packs of banded mongooses have developed mutualistic relationships with warthogs, cleaning the ticks and fleas from the warthogs and gaining a tasty meal for themselves in the process.
5. Banded mongooses show an unusually high degree of birth synchrony, with up to 10 females giving birth on exactly the same day. This appears to be advantageous, as pups are at risk of infanticide if their mother gives birth before other females, and are less able to compete for food if their mother gives birth after.

ANIMAL CAMEO

Life as a banded mongoose is fraught with danger; the group is constantly on guard looking out for predators such as eagles, leopards and pythons. If a banded mongoose spots one of these predators it will give a loud alarm call warning the group of imminent danger. However, the biggest danger to banded mongooses is ... attack from other banded mongooses! They are highly territorial and if two packs meet they can fight for several hours. These fights are so vicious that they often result in death, especially for young pups that can easily get lost or left behind in the midst of the battle. It is this intense competition between groups that may have lead to the evolution of cooperation within banded mongoose packs.

© Jennifer Sanderson

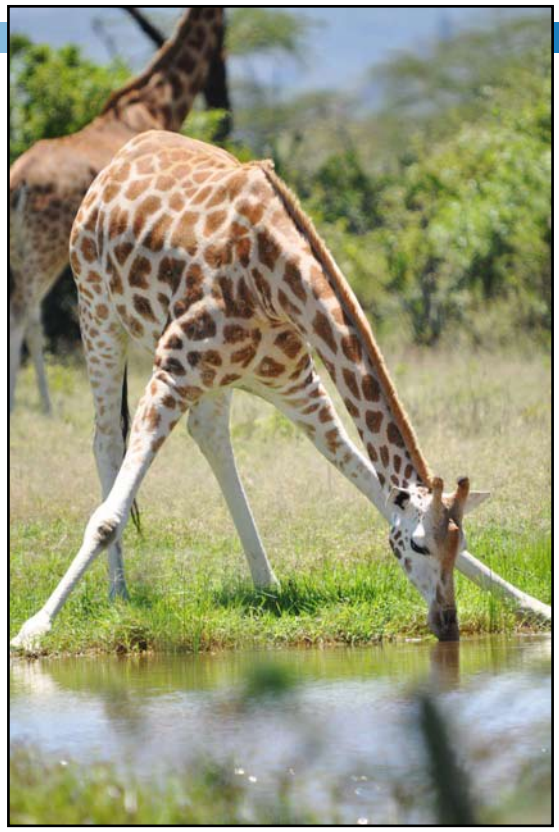
Banded mongooses are highly communicative and have several distinct calls that they use to keep the whole group well-informed. For example, if a banded mongoose becomes lost from the group it will make loud *lost calls* to let the others know where it is, whilst a mongoose who finds something interesting will make *excitement calls* to draw the attention of the rest of the group. Banded mongooses are also very smelly; they have an anal gland that they use to smear their scent over latrine sites and over-mark the faeces of other group members. In fact they will also seize any opportunity to make themselves even smellier by rolling in the faeces of larger animals, such as elephants and buffaloes.

© Jennifer Sanderson

© Jennifer Sanderson

Jennifer L. Sanderson
University of Exeter

Animal Cameo: The giraffe, *Giraffa camelopardalis*



© Zoe Muller

The giraffe is a truly unique animal, the tallest living land mammal (up to 18 feet tall) and one of Africa's most charismatic creatures. They live across Africa in areas of open savannah and woodland, spending as much as twenty hours a day feeding on a wide variety of trees and shrubs, the most common being the *Acacia* species. The closest living relative of the giraffe is the Okapi, a secretive hoofed mammal found in the forests of the Democratic Republic of Congo.

The giraffe's long neck is thought to have arisen through sexual selection, whereby males gained an advantage through having long necks to engage in 'necking' competitions with other males. Another theory is that the giraffe's neck evolved to allow it to browse leaves on higher trees, thus carving out its own ecological niche and avoiding competition with other herbivores.

Five fascinating facts

1. A group of giraffe is called a "tower of giraffe".
2. A giraffe heart is the size of a beach ball and weighs 14Kg. Its feet measure 12 inches across – the size of a dinner plate!
3. Giraffe give birth standing up - the fall and impact on the ground functions to kick-start the calf's lungs and heart.
4. A giraffe sleeps for 1 – 12 minutes at a time. They can sleep lightly standing up, but for REM sleep they must be lying down and have their head rested on their flank.
5. Despite their long neck, giraffe have the same number of neck vertebrae that all mammals do (including us) – seven.

Giraffe also have a unique circulatory system which has adapted to suit their large frame and ensure effective regulation of blood pressure in their long necks and legs. When a giraffe lowers it head to drink, its elasticated blood vessels expand and contract accordingly to ensure the animal's blood pressure maintains constant so that it doesn't pass out!

In the wild, increasing agriculture, human settlement and widespread habitat loss have contributed to a steady decline of giraffe populations in the last fifty years. There are currently nine recognised subspecies of giraffe in Africa, two of which are classified as Endangered; the West African giraffe *Giraffa camelopardalis peralta* with an estimated 200 individuals left in the wild, and the Rothschild's giraffe *Giraffa camelopardalis rothschildi* with less than 670 individuals left in the wild.

Giraffe have an interesting social structure known as a 'fission-fusion' society which is characterised by frequent changes of associates, with males adopting a roaming strategy to search for widely distributed female groups. It was previously thought that these associations are random and transient, with weak inter-individual associations and no lasting bonds. However recent research is beginning to suggest otherwise with evidence of a matrilineal social structure whereby females maintain strong inter-individual associations and bonds while males show greater dispersal. Studies on captive giraffe have shown that giraffe show a strong preference to associate with related individuals over non-related individuals and that this preference is stronger in females than males.

ANIMAL CAMEO

© Zoe Muller

Historically, female giraffe are thought to have weak bonds with their calves, but current research in Kenya is finding that calves in fact show strong levels of association with their mothers and other calves of similar ages. The research will track the lives of such calves to see if these bonds are maintained over time and how they differ between males and females. Preliminary social network analysis of a wild giraffe population has also shown the highly interconnected nature of the population and research is currently ongoing to further determine the nature of relationships between wild giraffe and the interconnectedness of their herds. This latest research is leading scientists to review the social organisation of giraffe and we are beginning to realise that giraffe social society is much more complex than we first realised.

© Zoe Muller

Zoe Muller
University of Bristol

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* student rate includes students, retired members and those not in paid employment.

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SURVEYS

When bees exploit plants: Nectar robbery

Nicholas Charlton, University of Bristol, Nic.Charlton@bristol.ac.uk

©Nicholas Charlton

The amazing variety and beauty of flowers we see in our gardens is partly due to the relationship between plants and their pollinators. Through millions of years of evolution, insects have adapted to use flowers and plants have adapted to use insects. By producing a sugary reward in the form of nectar, plants attract insects to their flowers and use those insects to carry their pollen. The plants benefit from having their pollen spread over greater distances and with much more accuracy than if transported by wind. The insects benefit by gaining a source of high energy food in the form of nectar. This relationship can then be considered a mutual one, with both groups gaining an advantage from the interaction.

In every mutualism, however, there may be opportunities to take advantage of the situation. Normally there is 'give and take', but sometimes one half of the relationship may just 'take'. For example, there are several orchid species with non-rewarding flowers which do not produce any nectar, but the pollinators still respond to these flowers without gaining any reward. The non-rewarding orchids 'cheat' the insects by not wasting energy on producing nectar, but still benefit from pollination.

There is another example of a 'cheater' taking advantage of the situation, but with the roles reversed. Some species of bees have learnt to steal nectar from flowers without pollinating them. To do this, the bee will make a hole in the flower near to the source of the nectar. This makes it possible for bees with short tongues to reach nectar in long flowers which would normally be too deep to reach. The bee will then use the hole to extract the sugary reward without going near the stigmas and stamens. This behaviour is described as nectar robbery. You may have seen bumble bees doing this in your garden as it has been observed on several different types of plants, including red campion (*Silene dioica*), bleeding heart (*Dicentra spectabilis*), *Fuchsia*, and common yellow toadflax (*Linaria vulgaris*). Even Charles Darwin observed robbery of broad bean flowers and mentions robbery of azalea and honeysuckle flowers. Examples of species of nectar robber include the bumble bees *Bombus terrestris*, *B. jonellus* (both found in Europe), and *B. occidentalis,* and the carpenter bee, *Xylocopa*

californica (both found in North America). Looking for evidence of robbery is quite simple. If flowers have been robbed, they will usually have a neat circular or semi-circular hole near their base, close to where the nectar is produced. Once holes have been made by the robbers, other insects may also use them. For example, honeybees and ants have been seen using holes made by bumble bees.

Directly damaging the flowering parts of a plant would appear to be detrimental to the plant and in some situations nectar robbery may reduce the numbers of seeds produced. Robbery also reduces the amount of nectar in flowers which can make the flowers less attractive to true pollinators, which in turn may reduce pollination of those flowers. But the holes made by robbery can encourage other insects to feed from flowers which would otherwise be inaccessible, encouraging a greater diversity of insects.

Although there have been many studies on nectar robbery, there have been few in the British Isles. I am currently involved in a study into robbery of red campion (*Silene dioica*) by a short tongued bumblebee, *Bombus terrestris*. At the University of Bristol we are attempting to understand the patterns of robbery in this wildflower and are looking for people across the British Isles to assist us. This summer I am trying to gain a picture of what levels of robbery are like across the country and I would like volunteers to collect and send information. If you feel you would like to take part in active research and help with the collection of data on nectar robbery see the instructions below.

Plants have lived with insects for millions of years, but in some cases the insects have learnt to exploit the plants they visit by robbing nectar. So look out for signs of robbery on wildflowers or in your garden. And if you see a bumble bee making a hole in a flower, you may be witnessing nectar robbery first hand and catching them in the act.

Nicholas Charlton
University of Bristol

Instructions
The equipment required is a pen and paper, and it only takes a few minutes to record the data per patch of red campion. Each patch of red campion counts as a single record. You need to be able to recognise red campion and be able to see flowers close up to look for signs of robbery. The main flowering season for red campion is during May and June, but can continue into July.

1. Find a patch of red campion flowers and count the number of open flowers as accurately as you can. Record this as 'number in patch'. For very large or long patches, an estimate to the nearest 50 is sufficient. Ignore small patches of less than 30 flowers.

2. Choose any 30 open flowers, ideally choose flowers that are spread across the patch, and check for signs of robbery. Record the number of robbed and unrobbed flowers. e.g. 25 robbed 5 unrobbed. This gives a measure of the level of robbery and 0 robbed flowers still counts as a record.

3. From the list below, choose a habitat which best describes where the patch is found, selecting from:
   - Woodland
   - Woodland edge
   - Hedgerow or verge
   - Grassland
   - Other, please describe

4 Please state the location of where the patch was recorded, e.g. A postcode, grid reference or address, and the date you checked the flowers..

5. (Optional) List any other common flowers close to the red campion. Only open flowers, and only if you know them.

Please email results to Nic.Charlton@bristol.ac.uk
Additionally, if you see any bees in the act of robbing, please send details of the species and the location. Photos are also welcome.

Survey of nectar robbing of red campion

Instructions:

1. Patch of *at least* **30 red campion flowers**
2. Record **location**
3. Record the **habitat** where the patch was located
4. Estimate the **number of flowers** in patch
5. **Select 30** open flowers, ideally from across the patch
6. Record **number of robbed flowers** out of 30
7. Record **other flowers** close to the patch

Red campion flower showing distinctive nectar robbing hole

(photo by J Memmott)

Your name/s		
Date		
Location (address, postcode or grid reference)		
Habitat type: (Tick which one)	Woodland	
	Woodland edge	
	Hedgerow/Verge	
	Grassland/Scrub	
	Other (specify):	
Total number of flowers in patch (to the nearest 50)		
Number of robbed flowers (out of 30)		
Other plants in flower within a few metres of red campion patch		

Please e-mail results to:

Nic.Charlton@bristol.ac.uk

Survey for Nicholas Charlton, School of Biological Sciences, University of Bristol, Woodland road, Bristol, BS8 1UG

SURVEYS

Monitoring the rusty red click beetle *(Elater ferrugineus)*

Deborah Harvey, Royal Holloway, University of London

Deep in the centre of many large old trees is a community of saproxylic insects, silently feeding on the rotting wood and remains of abandoned birds' nests. These creatures are a vital component of the woodland ecosystem: nature's recyclers. Today many of these creatures seem to becoming scarce in the United Kingdom as their habitats are destroyed by forest management techniques. Monitoring them will enable us to accurately gauge their numbers and determine the conservation effort needed for them to survive.

One such insect is the rusty red click beetle, *Elater ferrugineus*. At approximately 20mm long, and brick red in colour, it is one of the United Kingdom's largest click beetles, yet, despite its size and dramatic colouring, it is rarely seen and has conservation status in this country.

©Deborah Harvey

Like other click beetles, the beetle gets its name from the audible click it produces when it is attacked, threatened or overturned. The click is produced by a peg on the thorax pushing against its abdomen until the peg is suddenly released, spinning the beetle into the air at a height of up to 30cm. *Elater ferrugineus* has a life cycle of up to 6 years, with the larval stage spent in rotting wood where it feeds mainly on wood mould and the remains of birds' nests, supplemented with occasional larvae and eggs of other beetle species. In the May of its last year it pupates and emerges to fly as a beetle from late July to early August of the same year.

In the last few years, using the chemicals that are given off by endangered insects to monitor them has been growing in popularity, and one of the greatest success stories in this area is the rusty red click! The chemicals used are the sex pheromones that the beetles use to attract their mates.

Last year, by using a lure supplied by the Swedish scientists that perfected the techniques, Professor Mattias Larsson and Dr Glen Svensson, and trapping in just three areas in and around Surrey, I managed to find over 100 rusty red click beetles (more than have ever been recorded in this country) in just 2 weeks.

This year I am hoping to extend the monitoring scheme across England, Wales and Scotland to determine the complete distribution of the beetle and would like your help to discover whether this elusive beetle really is very rare, or just hasn't been spotted.

Monitoring will take place throughout July and involves capture mark release trapping. No beetles will be harmed or killed the process and all will be released to allow them to mate, although they will also be able to mate in the traps.

The trapping will comprise putting up a trap in an area where there are old trees, preferably, but not necessarily, in a woodland with deciduous trees. The trap and lure will be supplied with instructions for assembly.

©Deborah Harvey

The traps will need to be checked once a day; in the evening or early morning is best. The beetles should be removed from the trap, and, if possible, their total length measured. This can be achieved by gently holding the beetle against a ruler and measuring the entire length of the body, from tip of head to base of abdomen. It should then be marked on the wing cases with a marker pen, such as a Crayola metallic marker (which will be supplied) and released at a distance of approximately 25m from the trap. The beetles are fairly lively and therefore a holding container will be needed to put them in after they have been marked.

It is also a good idea to count them before the trap is opened in case any escape! Any other beetles trapped should be noted- particularly any other click beetles or chafers. Where possible a photo with scale of a coin should be taken of any unfamiliar beetles.

If you feel you may be able to help please email me at deborahjharvey@btopenworld.com

REVIEW

David Attenborough's Life on Land DVD Encyclopaedia

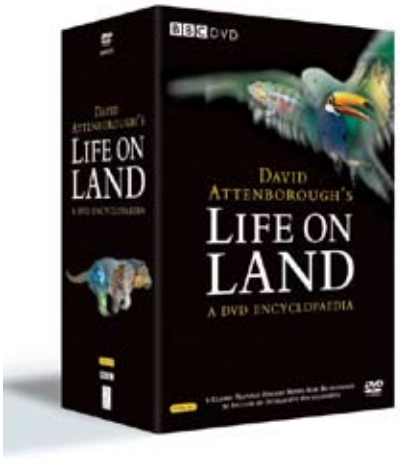
Ask any keen biology student what their ideal job would be, and they will instinctively reply "oh, I'd like to be the next David Attenborough".

Yes, Sir David Attenborough, OM, CH, CVO, CBE, FRS, FZS, FSA and National Treasure, officially had The Best Biology Job In The World! The wildlife documentaries made over Attenborough's long and enviable career are a fantastic resource for anyone involved in teaching about animal behaviour. The quality of both the footage and the scientifically accurate narration make an Attenborough video clip the next best thing to taking a class of GCSE students hot-air ballooning over the Serengeti savannah, to watch a pride of lions bring down a wildebeest in a coordinated attack, or leading a class of 6th formers silently through the rainforests of NE Australia to listen to a superb lyrebird mimicking the sound of a forester's chainsaw.

For years, video clips from the Attenborough back-catalogue have been widely used to support teaching in schools, colleges and universities, to illustrate all kinds of behavioural interactions, from communication to camouflage, territory defence to tool-use. However, a big problem for busy teachers and lecturers has always been how to find the most appropriate video clip from a stack of DVDs, without having to sit through the entire oeuvre the evening before the lesson (as distractingly enjoyable as that may be!). This is where the BBC's new Life on Land DVD Encyclopaedia comes in...

To win a copy of the DVD Encyclopaedia for your own school, why not enter our poster competition!

The DVD Encyclopaedia brings together the edited highlights of the last 20 years of Attenborough documentaries comprising six series encompassing all of life on land, namely; Life in the Undergrowth, The Private Life of Plants, Life in Cold Blood, The Life of Birds, The Life of Mammals and The First Eden. Thirty-four hours-worth of highlights(!) are edited onto 15 disks, and come with an extensive index to enable teachers to find the clip they need as quickly and easily as possible.



In addition, to the General Index listing all of the species and topics (which is useful to teachers from primary to university level), a particularly important resource is a keyword index for Primary Schools, and an equivalent keyword index for Secondary School use. These keyword indices list topics and sub-topics that each have a series of clips linked to specific Exam Board Schemes of Work. A brief description is given of each clip so that you can assess its suitability by reading the index, before deciding whether to access it on the DVD.

For example, to find a video sequence showing "learning behaviour" suitable for secondary school students studying for the OCR 21st Century Scheme of Work, I might select a 10-minute clip of "Orang-utans showing a variety of learning behaviours such as tool use and imitating human activities". It then takes just a few seconds to start viewing the clip on Disc 13, Episode 10, Chapters 1-3.

I know from experience at university level that students love these sequences, some of which are among the very best wildlife footage ever shot. The use of videos can never replace getting out into the field and seeing animals in the flesh, but this DVD encyclopaedia gets you as close to the action as its possible to get without leaving the classroom!

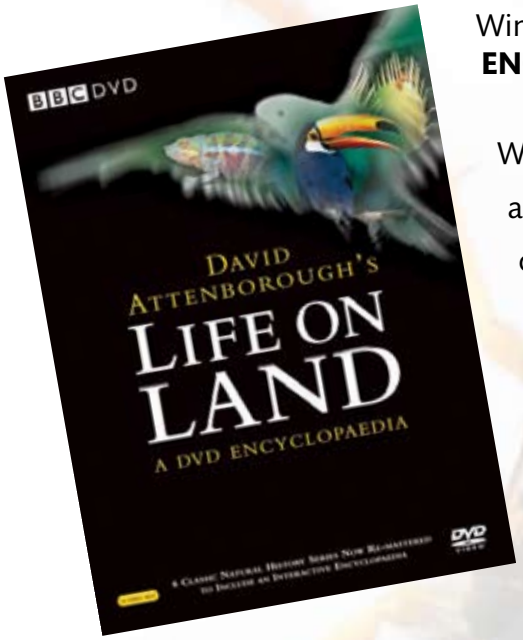
The challenge in compiling this encyclopaedia must have been not what to include, but what to leave out. Attenborough connoisseurs will all have their favourite clips, and choosing your own top-10 is as fun as choosing your own Desert Island Disks. Come to think of it, compiling this encyclopaedia was possibly the Second Best Biology Job in the World!

Ten out of ten to Sharmila Choudhury and the BBC / 2-Entertain team for this excellent idea. I will be looking forward to hearing of a follow-up box-set on "Life Under Water" with which to enthral my marine biology students...

Rob Thomas
ASAB Education Secretary &
Lecturer in Animal Communication & Sensory Ecology, Cardiff University

POSTER COMPETITION

Warning Colours



Win a copy of **DAVID ATTENBOROUGH'S LIFE ON LAND ENCYCLOPAEDIA** for your school.

Warning colours are often found in nature, scientists call these colours aposematic. These colours usually mean '**Watch out I'm poisonous**' or '**I taste horrid**'. So, the purpose of warning colours is to put off potential predators. Some animals have warning colours when they are not really poisonous – these animals are called mimics because they can deter predators without actually producing any venom.

Find pictures of animals which have warning colours and produce a poster to illustrate this amazing adaptation.

Competition Guidelines

There are two age categories for this competition: Primary or Secondary – please highlight which category you are entering.

Print your name, age category, class and school on the reverse of your poster.

Your poster should be A4 size.

Post your entries by the 30th of September to: Dr. Rob Thomas, Cardiff School of Biosciences, Museum Avenue, Cardiff CF103AX. Or email them to behaviour@cardiff.ac.uk

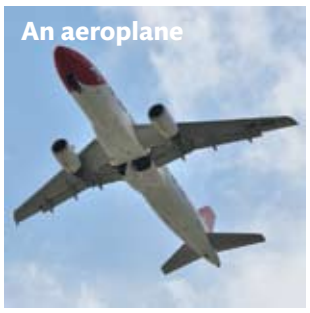
Please note that all posters will be non-returnable.

The winning posters will be displayed in an upcoming issue of Feedback.

If you have any queries please contact Charlotte: behaviour@cardiff.ac.uk

KEY STAGE 1 - ANIMALS

Look at these pictures of living things and things that are not alive:



1. **Which ones have hair?** Draw a circle around them.

2. **Which ones can fly?** Write the answer here

. . . . . .

3. **Two things are not alive** - cross them out.

4. Draw a circle around the things that all animals need.

Food	Toys	Shelter
Water	Trees	Crisps

Chimpanzee Challenge

See if you can find the answers to these questions:

Where do Chimps live?

How long do they live for?

What do Chimps eat?

['Suggested' answers - page 36]

KEY STAGE 2 - ANIMALS


© Mick Hoult


© Charlotte Evans


© Charlotte Evans

Here are some photographs of farmyard animals


© Charlotte Evans

1. Circle the animals which are birds?

2. Tick all the things birds have:

legs	**feathers**	**hair**
beak	**wings**	**teeth**
fins	**scales**	**talons**

3. Cats prey on other animals. What is another scientific word for a hunter?.....

4. Can you name three animals that might be prey for a cat?

....

5. Cats are carnivores. What are sheep?.....

6. Sheep and Cats are similar - they are both mammals. Write down two similarities between the sheep and the cat.

.....

.....

7. Fill in the food chain below using these words:

Sheep
Grass
Humans

..... → ..... → .....

KEY STAGE 2 - ANIMALS

8. See if you can find eleven animal related words in this word search.

p	r	e	d	a	t	o	r	s	h	y	f
g	f	e	w	w	a	m	t	r	a	g	e
h	l	o	b	e	l	n	u	e	s	s	a
n	g	m	i	d	o	i	o	p	w	z	t
m	r	n	r	f	n	v	p	t	q	c	h
a	w	b	d	r	s	o	v	i	a	n	e
m	a	b	s	t	h	r	x	l	s	u	r
m	o	a	j	p	r	e	y	e	p	f	s
a	m	p	h	i	b	i	a	n	h	i	q
l	o	r	a	o	u	a	a	c	o	s	a
s	j	e	s	l	p	s	e	d	l	h	p
v	n	d	h	a	b	i	t	a	t	m	o

['Suggested' answers - page 36]

KEY STAGE 3 - BIOLOGY

Woodlice are crustaceans – this is the same group of animals as lobsters and crabs. They have a hard, segmented exoskeleton and fourteen jointed limbs. One type of woodlice can roll into a ball as a defensive mechanism. Woodlice are found in rotting damp leaves, under dead tree bark, in cracks in walls where they feed on dead and dying plant material. Woodlice are important nutrient recyclers.

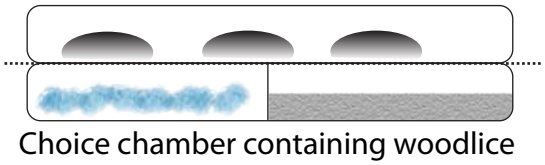
1. In what conditions are most woodlice found?

. . . . . .

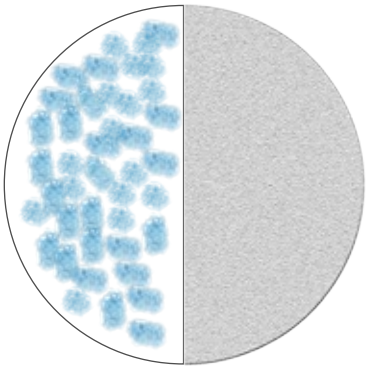
2. What other common names are used for woodlice?

. . . . . .

In a class experiment each group of students placed 10 woodlice through the central hole of a choice chamber – set up as shown below:



Choice chamber containing woodlice



Section containing damp cotton wool - provides a damp environment

Section containing calcium chloride crystals - remove water vapour from the air

After ten minutes the students counted the number of woodlice on each side of the choice chamber. The results of the class experiment are shown on the next page:

KEY STAGE 3 - BIOLOGY

Table to show results of the woodlouse behaviour experiment

Group number	Number of woodlice in the damp side	Number of woodlice in the dry side
1	10	0
2	10	0
3	9	1
4	8	2
5	10	0
6	10	0
7	9	1
8	10	0
9	10	0
10	9	1
Total		
Mean result		

3. Complete the table by calculating the total and mean results.

4. Draw a graph to show the results.

5. What is your conclusion to this experiment?

. . . . . .

6. What advantages do you think woodlice find in their favourite conditions?

. . . . . .

7. Why do you think the woodlice were introduced into the middle of the choice chamber?

. . . . . .

8. This experiment was repeated using a choice chamber divided into a dark half and a light half. What is your prediction? Which half will the woodlice prefer and why?

. . . . . .

. . . . . .

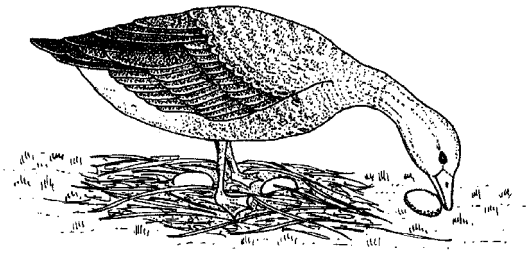
. . . . . .

['Suggested' answers - page 36]

GCSE BIOLOGY

Foundation tier

A. Instinctive behaviour in greylag geese



The drawing shows a greylag goose incubating her eggs. One egg has rolled out of the nest as she moved. This is her first clutch of eggs but as soon as she sees the egg she stands up, stretches out her neck and slowly draws the egg back into the nest. All greylag geese retrieve eggs in the same way.

1. Using only the information in the paragraph, suggest how you can tell that rolling an egg back into the nest is instinctive behaviour. ①

2. Lorenz and Tinbergen identified 4 characteristics of instinctive behaviour. Give **TWO** of these characteristics. ②

3. All greylag geese perform this egg retrieval behaviour in exactly the same way when an egg rolls out of the nest. What term describes this behaviour?

i) a response
ii) a stimulus
iii) a releaser
iv) a fixed action pattern
v) learning. ①

B. Learned behaviour in beef heifers

Animals have the ability to learn. For example, song birds generally improve the quality of their song over time. There are many forms of learning and one form of learning is habituation.

4. Give a definition of learning. ①

5. Habituation is the decline in the response of an animal to a specific stimulus over time, when that stimulus is repeatedly given to the animal.

   Give an example of an animal showing habituation, but not the example mentioned in question 6. ①

Recent research involving beef heifers studied how they might respond to two sound stimuli. Scientists believe that noise is a potential source of stress for animals and so they decided to test the response of heifers to two noises, viz. the sound of humans shouting (as they moved farm animals about) and the sound of metal clanging against metal (such as a metal gate being closed). The table below (Table 1) shows the mean heart rate of the heifers during the two experimental treatments (voices and clanging).

GCSE BIOLOGY

Table 1 Average heart rate response in beef heifers during noise treatments (human voices and clanging metal sounds) of 1 minute duration over the five days of the trial.

Day of trial	Treatment	Heart rate during treatment (beats per minute)
Day 1	Voices	100.5
	Clanging	82.2
Day 2	Voices	
	Clanging	86.7
Day 3	Voices	90.0
	Clanging	76.9
Day 4	Voices	84.0
	Clanging	76.0
Day 5	Voices	86.2
	Clanging	74.4

6. i) The heart rate response to the human voice on day 2 was 8.3 beats per minute lower than on day 1. What was the average heart rate of the heifers in response to the sound of human voices on day 2? ①

ii) By how much had the average heart rate fallen over the five days for both the response to human voices and to clanging sounds? ②

iii) How can you tell the heifers showed habituation to the noises? ①

iv) How could farmers use these data to reduce stress in beef heifers to both sources of sound? ②

C. Feeding behaviours

Some animals, such as foxes, are described as generalist feeders and some animals are described as specialist feeders.

7. Give a definition of what a generalist feeder is. ①

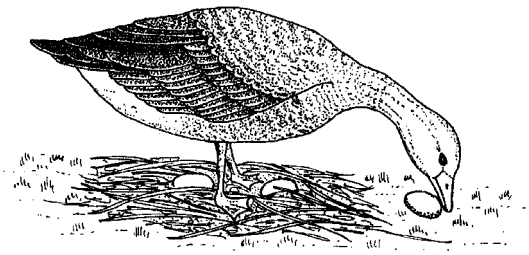
8. Give **ONE** example of an animal that is a specialist feeder. ①

9. Some carnivores hunt in packs, such as African wild dogs. Give **ONE** advantage and **ONE** disadvantage to animals of hunting in packs. ②

GCSE BIOLOGY

Higher tier

A. Instinctive behaviour in greylag geese



The drawing shows a greylag goose incubating her eggs. One egg has rolled out of the nest as she moved. This is her first clutch of eggs but as soon as she sees the egg she stands up, stretches out her neck and slowly draws the egg back into the nest. All greylag geese retrieve eggs in exactly the same way. This is an example of instinctive behaviour.

1. Give a definition of instinctive behaviour. ①

2. Lorenz and Tinbergen identified 4 characteristics of instinctive behaviour. Give **TWO** of these characteristics. ②

3. All greylag geese perform this egg retrieval behaviour in exactly the same way when an egg rolls out of the nest. What term describes this behaviour?

i) a response
ii) a stimulus
iii) a releaser
iv) a fixed action pattern
v) learning. ①

4. Outline what a releaser is. ①

B. Learned behaviour in beef heifers

Animals have the ability to learn. For example, song birds generally improve the quality of their song over time. There are many forms of learning and one form of learning is habituation.

5. Habituation is the decline in the response of an animal to a specific stimulus over time, when that stimulus is repeatedly given to the animal.

   Give an example of an animal showing habituation, but not the example mentioned in question 6. ①

6. Recent research involving beef heifers studied how they might respond to two sound stimuli. Scientists believe that noise is a potential source of stress for animals and so they decided to test the response of heifers to two noises, viz. the sound of humans shouting (as they moved farm animals about) and the sound of metal clanging against metal (such as a metal gate being closed). The table below (Table 1) shows the mean heart rate of the heifers during the two experimental treatments (voices and clanging).

GCSE BIOLOGY

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Day of trial	Treatment	Heart rate during treatment (beats per minute)
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Day 3	Voices	90.0
	Clanging	76.9
Day 4	Voices	84.0
	Clanging	76.0
Day 5	Voices	86.2
	Clanging	74.4

i) How can you tell the heifers showed habituation to the noises? ①

ii) How could farmers use these data to reduce stress in beef heifers to both sources of sound? ②

iii) Why do you think that the response to human voices was greater than it was to the clanging sounds. ①

C. Feeding behaviour

Some animals, such as foxes, are described as generalist feeders and some animals are described as specialist feeders.

7. Give a definition of what a generalist feeder is. ①

8. Give **ONE** example of an animal that is a specialist feeder. ①

9. Some carnivores hunt in packs, such as African wild dogs. Give **ONE** advantage and **ONE** disadvantage to animals of hunting in packs. ②

10. Carnivores often target weaker prey animals when they are hunting. Give **ONE** advantage and **ONE** disadvantage to carnivores of taking weaker prey animals. ②

['Suggested' answers - page 36]

AS/A2 BIOLOGY

Food availability and predation – song sparrows, Melospiza melodia

The amount of food that chicks receive from their parents will obviously affect their survival chances. This might be because extra food can change the behaviour of adult birds and the nestlings. Research has shown that giving birds extra food may reduce the chance of a parent or the chicks being taken by a predator at the nest. For example, if food is readily available the parents would spend less time looking for it and be able to spend more time watching for predators or defending the nest from predators. A recent study* of song sparrows (see Figure 1) set out to determine if giving these birds extra food reduced predation at the nest.

© Mick Hoult

Figure 1 A song sparrow

In this study the scientists provided additional food for pairs of song sparrows, to see if putting food in nesting territories had an effect on predation. The research was carried out in Canada in 2003. The scientists studied song sparrow territories at 14 sites, and pairs of sites were identified with closely matched vegetation. One territory of each pair received extra food, the other did not. Did the two types of territory experience different rates of predation?

* Duncan Rastogi, A., Zanette, L. & Clinchy, M. 2006. Food availability affects diurnal nest predation and adult antipredator behaviour in song sparrows, Melospiza melodia. Animal Behaviour, 72, 933 – 940.]

1. Song sparrows build open cup nests, either on the ground or in bushes.
   i) What is an open cup nest? ①
   ii) Give **ONE** advantage and **ONE** disadvantage to a bird that builds a nest on the ground. ②

2. The scientists monitored 75 nesting territories at 14 sites. They selected pairs of sites that were matched for vegetation type. Why did they match the sites for vegetation? ①

3. At each pair of sites, one was provided with extra food (`fed` territory) whilst the other received no extra food (`unfed` territory). What was the independent variable in this study? ①

4. The food provided in the feeders was millet seed and high protein pellets, which the scientists provided ad libitum. What does ad libitum mean? ①

5. In the research report the scientists noted that "feeder watches confirmed that each target pair of birds used the feeder" provided in their territory. Why was it important to confirm this? ①

AS/A2 BIOLOGY

6. Each nest had a data logger, and a sensor in the base of the nest recorded the nest temperature every two minutes. Another sensor measured the air temperature close to the nest every 30 minutes.
   i) What is a data logger? ①
ii) The scientists used the temperature data to sample the behaviour of the female at the nest. For example, the mean time the female spent incubating, the mean time spent away from the nest, etc.. Why did they feel they could use this information in this way? ①

7. Microphones were also placed beside each nest so that the begging calls of the nestlings could be recorded. Why did the scientists do this? Underline below the best answer.

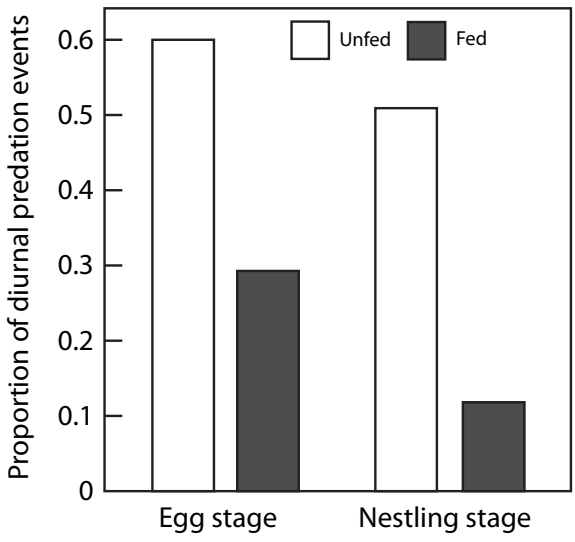
   i) The scientists might hear a predator catch a female at the nest.
   ii) To hear if the nest was in a noisy site.
   iii) It would be interesting information to have.
   iv) To record the sounds of other animals in the area.
   v) To determine if providing food in a territory affected chick begging behaviour. 1

8. The researchers categorized the times of predation as being either diurnal (happening during the day), nocturnal (happening at night) or crepuscular. What does crepuscular mean? Underline below the answer you think is correct. ①

   a) happening at midday;
   b) happening at midnight;
   c) happening at night when the street lights were on;
   d) happening between the time the researchers went to sleep and when they awoke;
   e) happening in the time just before and after sunrise and sunset.

9. Figure 2 shows the proportion of song sparrows taken at the nest when the chicks were at the egg stage or at the nestling stage during the day. Give **TWO** observations you can make from the graph. ②

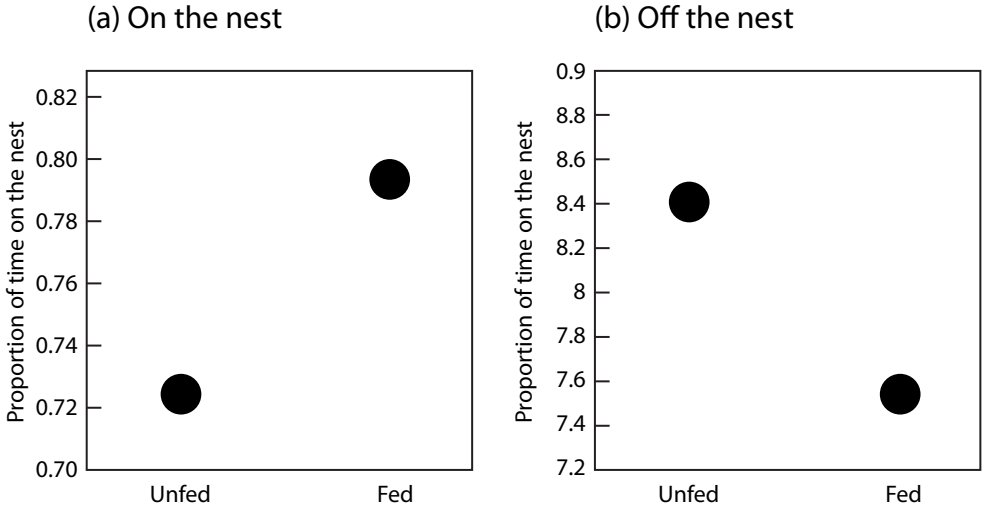
Figure 2
Proportion of song sparrow nests that were preyed upon during the day (i.e. diurnal predation events/ (diurnal + nocturnal predation events). White bars – control territories with no extra food: black bars – experimental territories with extra food provided. The predation event was noted as being either at the egg stage or the nestling stage (i.e. after hatching but before the chicks left the nest).



AS/A2 BIOLOGY

10. Figure 3 shows the proportion of time that females spent on the nest (a) and off the nest (b). Suggest how both these two variables are affected by food availability. ②

Figure 3 Behaviour of the females during incubation at the control and experimental territories: a) proportion of time female spent on the nest; b) proportion of time female spent off the nest. Values are means.



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[We thank Elsevier Press for permission to use Figure 1 page 936 and Figure 2 (a and c) page 937 from the article by Duncan Rastogi et al. in Animal Behaviour, 2006, 72, 933 – 940.]

['Suggested' answers - page 37]

ADVANCED HIGHER BIOLOGY

A. Animal learning

The behaviours shown by animals, especially young animals, change as they acquire the necessary skills to perhaps open a nut or a shell. Learning new behaviours is very important for youngsters.

1. Give a definition of learning. ①

2. One form of learning is imprinting.

   i) Give a definition of imprinting ①
   ii) Briefly outline **ONE** example of imprinting that you are familiar with. ②

3. Habituation is another form of learning. Underline below the best definition of habituation.

i) The repetition of the same sequence of behaviour;
ii) how a young animal learns to direct a response to one other animal, usually a parent;
iii) the decline in the response of an animal to a specific stimulus over time;
iv) the ability of an animal to respond to a particular situation which it experiences for the first time;
v) unlearned behaviour.

4. Recent research involving beef heifers studied how they might respond to two sound stimuli. Scientists believe that noise is a potential source of stress for animals and so they decided to test the response of heifers to two noises, viz. the sound of humans shouting (as they moved farm animals about on a farm) and the sound of metal clanging against metal (like a metal gate being closed). The table below (Table 1) shows the mean heart rate of the heifers during the two experimental treatments (voices and clanging).

Table 1 Average heart rate response in beef heifers during noise treatments (human voices and clanging metal sounds) of 1 minute duration over the five days of the trial.

Day of trial	**Treatment**	**Heart rate during treatment (beats per minute).**
Day 1	Voices	100.5
	Clanging	82.2
Day 2	Voices	92.2
	Clanging	86.7
Day 3	Voices	90.0
	Clanging	76.9
Day 4	Voices	84.0
	Clanging	76.0
Day 5	Voices	86.2
	Clanging	74.4

ADVANCED HIGHER BIOLOGY

i) How can you tell the heifers showed habituation to both sounds? ①
ii) Suggest **ONE** reason why the heart rate of the heifers was always greater when human voices were heard than when gates were clanged. ①
iii) Heart rate monitors were used to measure the heart rate of the animals. Give ONE advantage to using this equipment for this purpose. ①
iv) How could farmers, or farm workers, use these findings to reduce stress from both these sound sources in beef heifers on a farm? ②

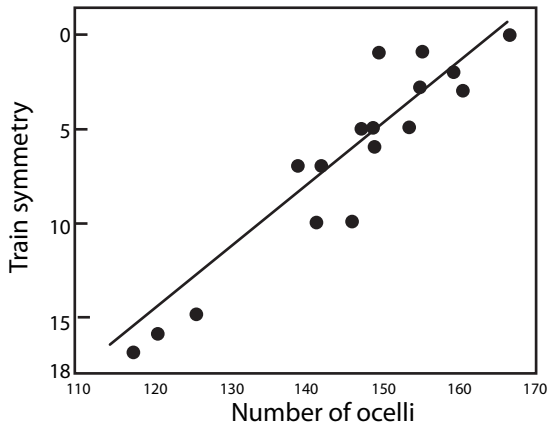
B. Courtship behaviour in animals

Courtship is behaviour that precedes the sexual act between a female and a male animal of the same species. In some animals, male-male rivalry is seen in which males fight to control mating opportunities.

1. Name **ONE** species in which males engage in male-male rivalry. ①
2. For the named species, outline the nature of the contests. ②

3. In some species, peafowl for example, females make the choice of male to mate with. In one study into female choice in peafowl, the scientists measured the number of eye-spots (ocelli) on the peacock`s train (tail) when he opened it up to display to females. The researchers also measured how symmetrical the tail was by counting how many ocelli were on either side of the mid-line of the tail: a score of 0 indicated perfect symmetry and as the number increases the less symmetrical the tail is. Their data are illustrated in Figure 1.

Figure 1 The relationship between train symmetry and the number of ocelli per train.



© Mick Hoult

i) What type of graph is illustrated in Figure 1? ①
ii) What type of correlation is evident in the graph? ①
iii) Write down the nature of the relationship between the two variables. ①
iv) Suggest **ONE** reason why females might select a male to mate with who has a symmetrical distribution of eye spots in his tail. ①

ADVANCED HIGHER BIOLOGY

C. Predator-prey relationships

Cheetahs are a major predator of Thomson`s gazelles in the Serengeti National Park in Tanzania. Recent research* has shown a positive correlation between the abundance of prey and the percentage of prey in the diet. However, additional factors also influence the motivation of cheetahs to hunt, for example, the presence of cheetah cubs and the presence of lions. The results allowed the scientists to produce a graph to show the probability of cheetahs hunting when they have or don`t have cubs and the abundance of lions in the area, see Figure 2.

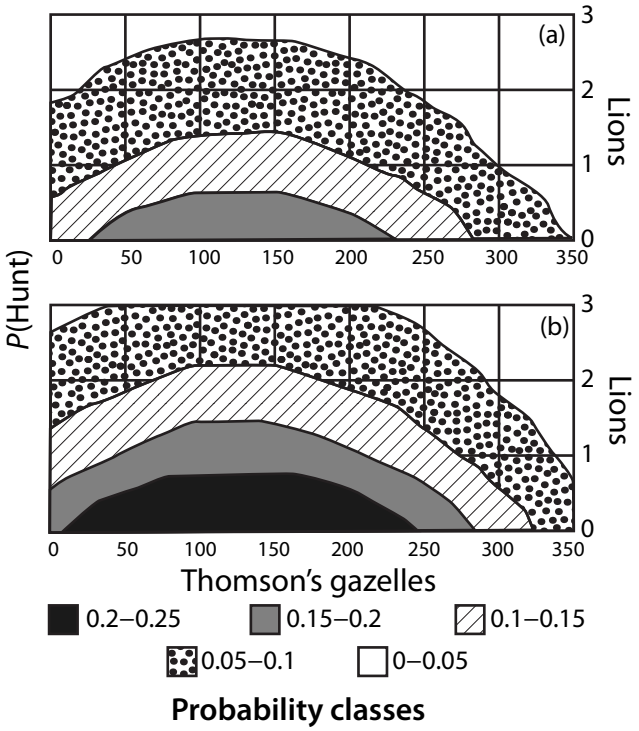


Figure 2 Graph to show the probability P(hunt) of a cheetah (a) with cubs and (b) without cubs as a function of the abundance of Thomson`s gazelle and lions.

Probability classes
0.2 - 0.25 is a fairly high probability (1 in 4) but 0.0 - 0.05 is extremely small (less than 1 in 20)

Between which numbers of prey are cheetahs more likely to hunt? ①
2. How does the presence of cubs influence the probability of hunting? ①
3. What effect does the presence of lions have on probability of cheetahs hunting? ②
4. Suggest **TWO** dangers to cheetahs from the presence of lions? ②

* Cooper, A. B., Pettorelli, N. & Durant, S. M. 2007. Large carnivore menus: factors affecting hunting decisions by cheetahs in the Serengeti. Animal Behaviour, 73, 651 – 659.

['Suggested' answers - page 37]

AS/A2 PSYCHOLOGY

1. Attractiveness of humans

The attractiveness of males will clearly influence mate choice in females. As well as the relative attraction of potential mates, humans are also influenced by the relative attraction of themselves. So exposure to others who are more attractive than themselves may decrease self-ratings, whilst exposure to those who are less attractive than themselves may increase self-ratings.

In a recent study*, 65 heterosexual human females were given photos of females (20 attractive and 20 unattractive) and asked to rate them for facial and physical attractiveness and were also asked to provide self-ratings of facial and physical attractiveness. The photos were taken from a freely accessible internet site. The researchers found that, in human females, exposure to attractive females decreased self-ratings of attractiveness and exposure to unattractive females increased self-ratings of attractiveness.

* Little, A. C. & Mannion, H. 2006. Viewing attractive or unattractive same-sex individuals changes self-rated attractiveness and face preferences in women. Animal Behaviour, 72, 981 – 987.

a) Give **ONE** reason why the researchers used photographs from an online database in their investigation. ①

b) Researchers always try to avoid using a biased sample in any investigation. What is a biased sample? ①

c) How does the sample size relate to the `power` of a statistical test? Underline which suggestion below is most likely to be the correct explanation. ①

i) Large sample sizes make no difference to the power of a test.
ii) The power of a test increases with an increase in sample size.
iii) The power of a test decreases with an increase in sample size.
iv) A small sample size means working out the test value is easier.

d) The researchers used 65 females in the study (aged 16 – 45 years, $\bar{x} \pm SD = 23.5 \pm 5.6$ years). Explain what $\bar{x}$ and SD are. ②

e) Outline how $\bar{x}$ and SD relate to the shape of a normal distribution curve. ②

f) Draw a diagram to show a normal distribution curve. Locate on the diagram the position of the mean and the area within ± 1 SD of the mean. ②

g) The researchers calculated a correlation coefficient to examine the nature and strength of the correlation between facial and body attractiveness. Outline what a correlation coefficient is. ②

h) The correlation coefficient resulting from the analysis was: $r_{63} = 0.48$, $P < 0.001$. Explain what r_{63} and $P < 0.001$ mean. ②

AS/A2 PSYCHOLOGY

2. Display and food preference

Male bowerbirds (for an example see Figure 1) collect coloured items in their habitat to use in decorating their bower. The bower is only produced to attract a female bowerbird: after mating, the female leaves to lay eggs and rear the young herself. A recent suggestion claims that food colour preferences could drive males to look for items of certain colours to use in decorating their bowers. If so, there would be an expected positive correlation between food colour and decoration colour. Research reported in 2006* tested this in satin bowerbirds, *Ptilonorhynchus violaceus*.

Figure 1 A male satin bowerbird

©Dr. G. Borgia

The researchers carried out the study on a natural population of bowerbirds in the field in Australia. They used Kellogs Fruit Loops cereal for food (in 6 different colours, viz. red, yellow, orange, green, blue and violet) and 6 different coloured plastic squares (with sides of 2.5 cm) for decorative items (in red, yellow, orange, green, blue and violet). The scientists gave the birds opportunities to utilize each and recorded their colour choices.

* Borgia, G. & Keagy, J. 2006. An inverse relationship between decoration and food colour preferences in satin bowerbirds does not support the sensory drive hypothesis. Animal Behaviour, 72, 1125 – 1133.

a) The researchers tested the hypothesis that there would be a positive correlation between the order of the colour preferences of objects used by male birds in their display and the order of the food colour preference of females. Would the hypothesis be a directional or a non-directional hypothesis? ①

b) The research was carried out in the field using a natural population of satin bowerbirds in Australia. Give **ONE** advantage and **ONE** disadvantage of carrying out an investigation in the field. ②

c) To assess the food colour preferences of the birds the researchers used one type of cereal but of 6 different colours (red, orange, yellow, green, blue, violet). Why did they use the same type of cereal? ①

AS/A2 PSYCHOLOGY

d) What influence or effect might have occurred if the researchers used 6 different cereals? Underline below the best answer. ①

e) Pilot studies were first carried out in order to see if humans and satin bowerbirds were able to detect differences in taste between the different colours of the cereal.

i) ceiling effect;

ii) floor effect;

iii) confounding influence;

iv) order effect;

v) no influence.

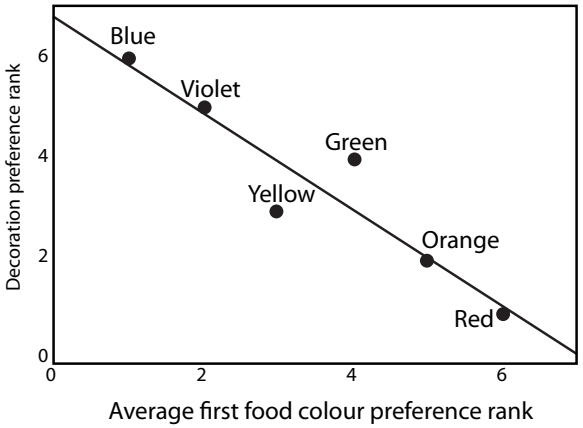
i) What is a pilot study? ①

ii) Give **ONE** reason why did the researchers thought it was important to carry out pilot studies first? ①

f) To test whether the birds showed a colour preference when selecting objects to decorate their bowers, the researchers used 6 different colour plastic squares (red, orange, yellow, green, blue, violet). Outline why the scientists chose colours that were approximately similar to the colours of the cereal? ①

g) The researchers scored colour preferences of birds for cereals and plastic squares on a scale from 1 – 6 (6 being the most frequently chosen colour and 1 the least frequently chosen colour). Figure 2 shows the relationship between the colour preference for bower decoration and colour preferences for food.

Figure 2



i) What type of graph is illustrated in Figure 2? ①
ii) What type of relationship is evident in the graph? ①
iii) Describe the nature of the relationship. ①
iv) Does the graph support the hypothesis that was tested? Explain your answer. ②

[We thank Elsevier Press for permission to use Figure 1 page 1128 from the article by Borgia, G. and Keagy, J. in Animal Behaviour, 2006, 72, 1125 – 1133.]

['Suggested' answers - page 37]

SUGGESTED ANSWERS

KEY STAGE 1 - ANIMALS

1. A boy, a chimpanzee, a bat, a teddy bear

2. An aeroplane, a blackbird

3. An aeroplane, a teddy bear

4. Food, water, shelter

Chimpanzee Challenge

Chimps can live up to 50 years old in the wild and have been known to reach 60 years old in captivity. Chimps can be found in 21 African countries. Chimpanzees are omnivores, meaning they eat a wide variety of foods that includes fruits, nuts, seeds, and insects. Chimps occasionally hunt and eat meat.

KEY STAGE 2 - ANIMALS

1. Doves, chickens

2. Birds have legs, beak, feathers, wings, scales, teeth and talons

3. Predator

4. Mice, shrews, rats, voles, birds, rabbits, fish

5. Herbivores

6. Covered in hair, young feed on milk, maintain a constant body temperature

7. Grass – sheep – humans

8.

p	r	e	d	a	t	o	r			f
					a	m		r		e
			b		l	n		e		a
			i		o	i		p		t
m			r		n	v		t		h
a			d		s	o		i		e
m			s			r		l		r
m				p	r	e	y	e	f	s
a	m	p	h	i	b	i	a	n	i	
l									s	
s									h	
			h	a	b	i	t	a	t	

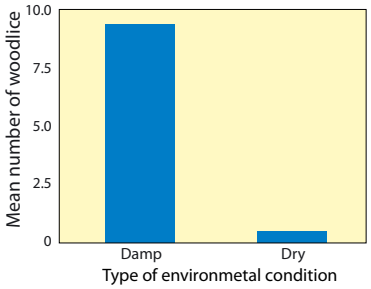
KEY STAGE 3

1. Damp and dark.

2. Cheesy bug and pill bugs amongst others!

3. Damp, dry – Totals 95,5 Mean – 9.5,0.5

4.



5. Woodlice prefer damp conditions to dry conditions.

6. Avoid drying out (desiccation), find rotting material to eat, find mates...

7. In the middle means that the practical is unbiased. You can introduce them via the other holes and this ensures that they don't follow each other.

8. The woodlice will prefer the dark side as this is most similar to their natural environment. Here they can avoid predators and remain damp...

GCSE BIOLOGY

Foundation tier

A. Instinctive behaviour in greylag geese

1. the behaviour happened with the female`s first clutch – the paragraph indicates that all geese perform the behaviour in the same way

2. behaviour should be stereotyped – should be characteristic of a particular species – should be seen in an animal reared in isolation – should appear fully developed in animals that have had no opportunity to practise the behaviour

3. iv) a fixed action pattern

B. Learned behaviour in beef heifers

4. a relatively permanent change in behaviour which results from experience

5. for example, put a snail on a table and as soon as it begins to move tap the table sharply in front of the snail – the snail withdraws into its shell but when this sequence is repeated the snail spends less time withdrawn and moves on more quickly - see the example of the heartbeats of a calf when a dog appears in the ASAB DVD *Stimulus Response*

6. i) 92.2 beats/minute

ii) voices – 14.3 beats/minute, clanging 7.8 beats/minute

iii) heart rate under both treatments showed a decline over the trials – the heart rates declined when the same stimulus was repeatedly presented, which is the criterion for habituation

iv) they could reduce the frequency or loudness of shouting when close to the animals – they could put some form of cover (say, rubber) on the bolts of a gate so that when it engages the gatepost the clanging sound is muffled

C. Feeding behaviour

7. an animal that has a wide variety of foods in its diet

8. koala bear which feeds almost exclusively on eucalyptus leaves – giant panda which feeds almost exclusively on bamboo

9. *adv* – can take bigger prey so more food is available, it increases the chance of one member of the group catching food if they hunt as a group

disadv – food is shared amongst many, animals 'lower' in the dominance hierarchy may lose out to 'higher' animals

Higher tier

A. Instinctive behaviour in greylag geese

1. behaviour that is carried out in its complete form when it is needed, in response to a specific signal, and requires no practice

2. behaviour should be stereotyped – should be characteristic of a particular species – should be seen in an animal reared in isolation – should appear fully developed in animals that have had no opportunity to practise the behaviour

3. iv) a fixed action pattern

4. the stimulus that produces the sequence of behaviour in a fixed action pattern (also called a sign stimulus)

B. Learned behaviour in beef heifers

5. for example, put a snail on a table and as soon as it begins to move tap the table sharply in front of the snail – the snail withdraws into its shell but when this sequence is repeated the snail spends less time withdrawn and moves on more quickly - see the example of the heartbeats of a calf when a dog appears in the ASAB DVD *Stimulus Response*

6. i) heart rate under both treatments showed a decline over the trials – the heart rates declined when the same stimulus was repeatedly presented, which is the criterion for habituation

ii) they could reduce the frequency or loudness of shouting when close to the animals – they could put some form of cover (say, rubber) on the bolts of a gate so that when it engages the gatepost the sound is muffled

iii) to a heifer, a human is potentially more of a threat than a gate so its heart rate is higher when it hears human voices – the heifers might have had a stressful experience before which they associated with the loud voices of humans

C. Feeding behaviour

7. an animal that has a wide variety of foods in its diet

8. koala bear which feeds almost exclusively on eucalyptus leaves – giant panda which

feeds almost exclusively on bamboo

9. *adv* – can take bigger prey so more food is available, it increases the chance of one member of the group catching food if they hunt as a group

disadv – food is shared amongst many, animals lower in the dominance hierarchy may lose out to higher animals

10. *adv* – weak prey don`t have the stamina of fitter animals so it is easier to catch them, weaker animals don`t fight back very effectively

disadv – they may be smaller animals and so provide less food, they may be diseased and this may affect the predators

SUGGESTED ANSWERS

AS/A2 BIOLOGY

1. i) a nest that is open to the sky – a nest that does not have a concealed entrance

ii) *adv*: easy to find a potential site for a nest – very little danger to the nestlings if they jostle around in the nest –chicks can retreat into cover if a predator attacks

disadv: there are probably more potential predators for ground nesting birds – the nest, incubating parent, eggs and nestlings need to be well-camouflaged – large animals, such as cows/sheep, might tread on the eggs/nestlings

2. so that they would be able to determine that if differences in predation risk were found it was not due to the type of vegetation at the pair of sites

3. the additional food, put out in half of the territories

4. the birds were provided with an unlimited amount of food

5. if the birds had not used the feeders then the researchers could not infer that differences in predation risk were due to the provision of additional food

6. i) an electronic device with a built in (or linked) sensor that records data over time, such as temperature – they are often linked to a computer which allows data storage and manipulation

ii) because if the female was absent from the nest the temperature of the nest and contents would quickly drop and this would be a means of identifying how much time the female spent away from the nest and when she stopped incubating the eggs

7. v) to determine if providing food in a territory affected chick begging behaviour

8. e) the time just before and after sunrise and sunset

9. the proportion of territories preyed upon during the day was much greater at the egg stage for the `unfed` territories - the proportion of territories preyed upon during the day was more similar for the `unfed` territories than the 'fed' territories – predation risk was always higher at the `unfed` than the `fed` territories during both stages of chick development

10. a) the proportion of time the female is on the nest is significantly greater at both the 'fed' sites because her body acts to camouflage the eggs from avian predators and some predators may not attack the nest if the parent is present – if the female is on the nest then the time for incubation is shorter and eggs hatch more quickly

b) if the female has to spend more time away from the nest, as they do if they are in an `unfed` territory (nearly one extra minute), then this gives predators a greater opportunity to spot the eggs/nestlings – in the same way, if the female is on the nest then the time for incubation is shorter and eggs hatch more quickly

SCOTTISH ADVANCED HIGHER

A. Animal learning

1. a relatively permanent change in the behaviour of an organism resulting from its experience

2. i) the attachment of young chicks, goslings, etc. to their mother which develops soon after they are mobile, occurs quickly and is difficult to reverse

ii) Lorenz - Goslings

3. iii) the decline in the response of an animal to a specific stimulus over time;

4. i) their mean heart rate to both sound signal sources declined over time – the mean heart rate declined by 24.3 beats/min over the 5 days for voices and by 7.8 beats/min for clanging sounds

ii) the heifers may have associated more stressful/unpleasant consequences with the sound of human voices (being loaded onto trailers or lorries for example) than to gates being closed - they may have experienced a stockman with a loud voice who not very caring/sympathetic to them

iii) the monitors can record automatically the heart beat over a period of time – a monitor is fixed or strapped to the heifer`s body so it is not an invasive technique – the monitors are fairly small so carrying it is not a burden for a heifer

iv) farmers/workers could reduce the frequency or loudness of shouting when close to the animals – they could put some form of cover (say, rubber) on the bolts of a gate so that when it engages the gatepost the sound is muffled

B. Courtship behaviour in animals

1. red deer, gladiator frogs, elephant seals

2. see the student response

3. i) scattergraph

ii) a positive correlation

iii) as the number of ocelli/train increases, the symmetry of the train increases

iv) symmetry may suggest overall health and fitness of males so a male with a symmetric pattern of eye spots would be an attractive mate – it may suggest that their offspring may also have high train symmetry and so would be successful in attracting females when they are ready to mate

C. Predator-prey relationships

1. 100 – 150 gazelles

2. the presence of cubs increases the probability of hunting – this increased probability occurs whether or not lions are present

3. the presence of lions makes it less likely that cheetah will hunt – if a cheetah has cubs, however, the probability of it hunting Thomson`s gazelles increases, even with lions present, since the cubs need meat regularly beyond the suckling stage

4. lions may steal the kills of cheetahs – lions are competitors for cheetah prey – lions may kill cheetahs – lions may detect and kill cheetah cubs

AS/A2 PSYCHOLOGY

1. Attractiveness of humans

a) the photos were in the public domain – there was a large sample of photos that could be used and as a consequence they could use 20 attractive ones and 20 unattractive ones for which people could agree fell unequivocally in those two categories

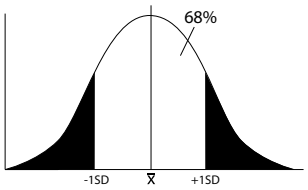
b) one in which members of a group are under or over-represented

c) ii) The power of a test increases with an increase in sample size.

d) X is the mean of the measures/values obtained in the study – SD is the standard deviation of these measures, a measure of how dispersed the individual values are around the mean

e) the mean and standard deviation describe the shape of the curve, so for the same mean value, a small standard deviation will produce a narrower curve with a sharp peak, whereas a larger standard deviation value will produce a flatter but broader curve - these two values identify sections of the curve, usually ± 1, ± 2 and ± 3 standard deviation values around the mean

f)



g) a measure of the strength of the correlation or association between two variables – coefficients measure how strong a relationship is and lie within the range – 1.0 to + 1.0

h) r_{63} is the value of the correlation coefficient (0.48) for the relevant degrees of freedom, which in this case is df = N – 2 = 65 – 2 = 63

P < 0.001 is the probability (confidence) level associated with the test statistic, and here is less than one in a thousand

2. Display and food preference

a) a directional hypothesis

b) *adv*: ecological validity of the findings – more likely to see `natural` behaviour shown

disadv: limited control of variables – may be limited in using certain pieces of equipment

c) they wanted only one variable to change, i.e. colour – to ensure the birds were only responding to one feature, the colour of the food

d) iii) confounding influence

e) i) a preliminary investigation conducted before the main investigation

ii) to test any equipment they hoped to use in their study – to see if their chosen method of study was appropriate

f) if they hadn`t chosen colours of food and plastic that were very similar then the birds could have been responding to some other feature of the food or plastic, say, texture

g) i) scattergraph

ii) a negative correlation or relationship between the two variables

iii) the most frequently chosen colour for bower decoration was the least frequently chosen food colour so bower colour preferences and food colour preferences are different

iv) no, because the FCD hypothesis predicted a positive relationship between the variables whereas the graph indicates a negative relationship

List of ASAB educational resources

Below is a list of the current ASAB educational resources. Prices include postage and packing. For all ASAB resources make cheques payable to `ASAB` and send with this order form to: Charlotte Evans, Hendre Isaf, Crafnant Road, Trefiw, Conwy LL27 0JZ Phone - 01492 642103

Videos/DVDs/CDs

Stimulus Response DVD - £5 - GCSE/A Level (The teaching notes for **Stimulus Response** - £1)
Vigilance Behaviour in Barnacle Geese - £5 -A Level/undergraduates [£3 for video]
Let`s Ask the Animals - £5 - for Key Stage 2. [£3 for video]
The North Atlantic Gannet: video for resource pack - £5
Parental behaviour of burying beetles: DVD - £2
Parental behaviour of blue tits: CD-Rom including video footage - £2
Parental behaviour in nuthatches: DVD - £2
Foraging behaviour in bumblebees: CD - £2
Changes in plumage in Canada goose goslings: DVD - £2
Feed the birds: DVD - £2
Behaviour of brine shrimps: DVD - £2
Leaf-cutting ants: DVD - £2

Books

..... copies of **Animal Behaviour: GCSE** ..... copies of **Animal Behaviour: A Level**
both books written by *Michael Dockery and Michael Reiss* - £1

Posters

A2 poster **When is a moth not a moth?** - *Michael Dockery* - £1 - (includes four worksheets for Key Stage 2 pupils)
A2 poster **Birds` Nests** – *Anne Woodfield*. Copies of the poster are £1 each.
Laminated version of the A2 poster **Birds` Nests** – *Anne Woodfield*. Copies are £3 each.

Resource Packs

***Finding Food** (KS2) - *Michael Dockery*
***Observational studies of ringtailed lemurs in zoos** (A Level) - *Mary White [DVD available on loan from Michael Dockery]*
The North Atlantic Gannet: observing and recording selected behaviours (A Level)- *Carole MacLaren* (video above £5)
***The Birds and the Bees** – (A Level) *Jan Morton and Amanda Eggert*
Parental behaviour of burying beetles – (A Level) – *Melanie Gibbs* (DVD above £2)
Parental behaviour of blue tits – (KS2) – *Michael Dockery and Tor Yip* – (CD above £2)
Parental behaviour in nuthatches - (GCSE and A Level) - *Michael Dockery, Graham Read, Alex Graham and Guy Meachin (DVD £2)*
Foraging behaviour in bumblebees – (A Level) – *Patricia Stewart* - (CD above £2)
Environmental Enrichment – *Frances Steel* – the CD (with film footage) - £2
***Birds' Nests** – (KS1) – *Anne Woodfield* - (poster above)
***Patterns of Life: Moths, Adaptation and Predators** – (GCSE) – *Laurence Cook and Michael Dockery*
***Animals on the move** (KS2) – *Michael Dockery*
***Showing off - the art of communication** - (GCSE) - *Nicola Marples, Mick Hoult and Michael Dockery*
Changes in plumage in Canada goose goslings: - (GCSE/A Level) - *Les May* (DVD £2)
***How to avoid being eaten** (GCSE/A level) - *Michael Dockery, Laurence Cook, Nicola Edmonds and Julie Meneely*
Feed the birds (KS3) – *Ann Skinner* (DVD £2)
***Mini-animals** (KS1/KS2) – *Anne Woodfield, Michael Dockery and Mick Hoult*
Behaviour of brine shrimps (KS2) – *Tor Yip et.al.* (DVD £2)
Investigations into the behaviour of ants - (A Level) - *Liz Evesham*
Do leaf-cutting ants prefer to cut flower petals of a certain colour? - (A level) - *Richard Bottrill* - DVD - £2