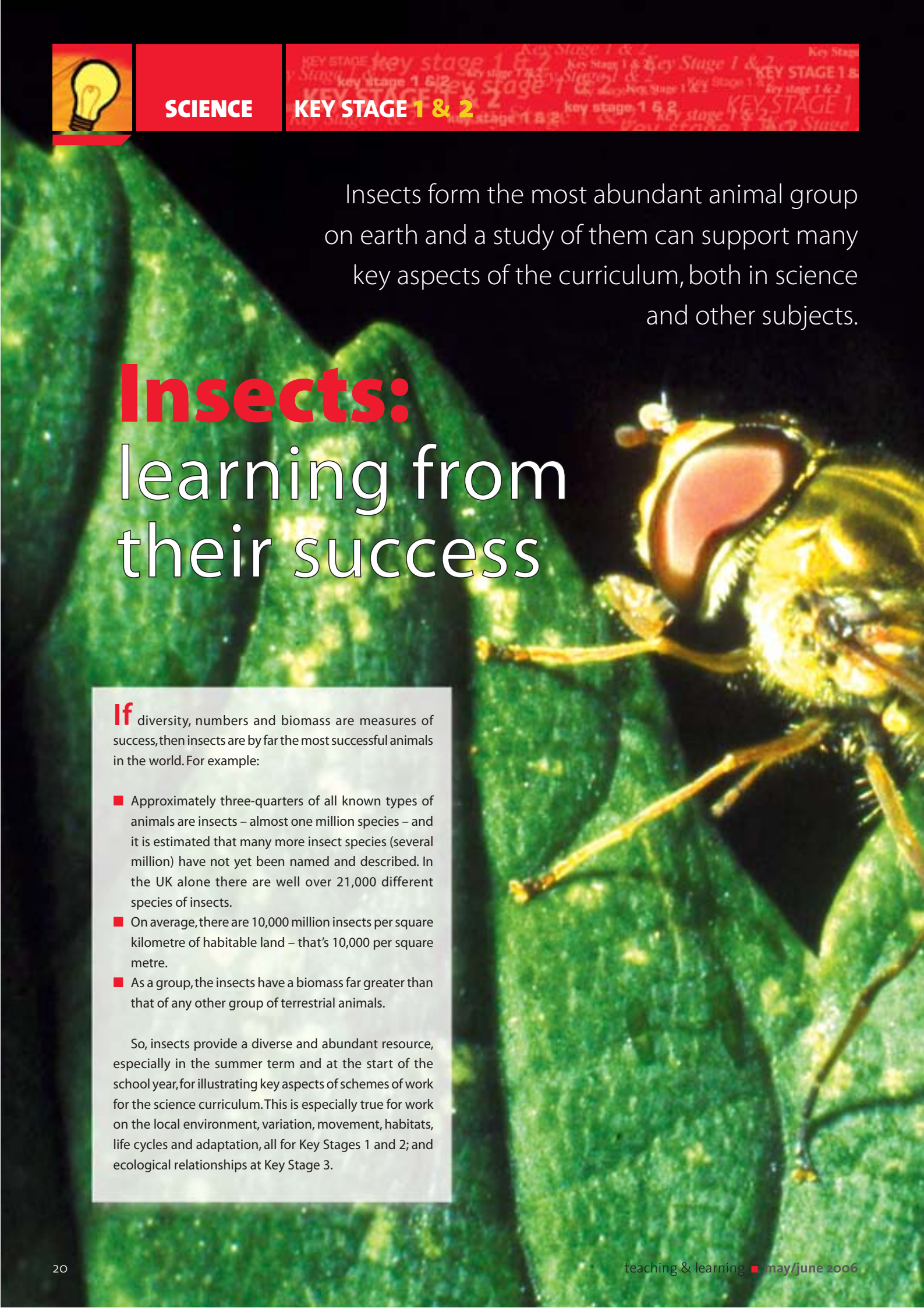
Insects form the most abundant animal group on earth and a study of them can support many key aspects of the curriculum, both in science and other subjects.

Insects: learning from their success



If diversity, numbers and biomass are measures of success, then insects are by far the most successful animals in the world. For example:

- Approximately three-quarters of all known types of animals are insects – almost one million species – and it is estimated that many more insect species (several million) have not yet been named and described. In the UK alone there are well over 21,000 different species of insects.
- On average, there are 10,000 million insects per square kilometre of habitable land – that's 10,000 per square metre.
- As a group, the insects have a biomass far greater than that of any other group of terrestrial animals.

So, insects provide a diverse and abundant resource, especially in the summer term and at the start of the school year, for illustrating key aspects of schemes of work for the science curriculum. This is especially true for work on the local environment, variation, movement, habitats, life cycles and adaptation, all for Key Stages 1 and 2; and ecological relationships at Key Stage 3.

Observing insects in the local environment *(Science Unit 2B)*

Globally, insects are found in virtually all terrestrial environments, from deserts to rainforests and from tundra to savannah, and they are also abundant in freshwater, from seasonal brooks to major rivers and from stagnant puddles to huge lakes. Most importantly, in terms of impact on humans and as resources for teaching, insects are common in environments dominated by man's activities, in both rural and urban areas. They can easily be found and observed by children in their local environment: on the school field; in a nearby pond; in the garden; on road verges; in hedgerows and fields; in garden sheds; and even inside the classroom and their own homes.

In order to explore just how common and widespread insects are in the local environment, choose two or three (preferably more) contrasting places for an insect hunt, e.g. long grass at the edge of the school field; dead leaves or weeds in a corner of the playground; flowers or vegetables in the school garden; or an old wall in the sun.

On a warm summer's day, some large insects such as butterflies and bumblebees are easily seen in flight, but many more small insects can also be seen flying in the air against a plain dark background such as a wooden fence. If you have bushes or small trees in the school grounds, hold a plain, pale-coloured umbrella upside down under a branch and tap the branch smartly with a stick. Dislodged insects will fall into the umbrella (you will find more insects on a native bush or tree species rather than an imported ornamental one).

If you have a school garden, use a trowel or spade to look for the insects that live and move underground among the soil and roots. Pond-dipping with a net and collecting-tray will reveal that many other insects live underwater.

Variation among insects – a cornucopia of species *(Science Unit 2C)*

Insects display a huge variety of forms and have more different species than all other animals combined, but (as with all organisms) the similarities and differences between species allow us to sort them into a hierarchy of groups, from the major orders down to individual species. Most of the insects that your class will see in their local environment will belong to one of six main types:

- Butterflies and moths (Lepidoptera), with two pairs of wings covered with coloured scales;
- Beetles (Coleoptera), with hard wing-cases in place of their fore-wings;
- Ants, wasps and bees (Hymenoptera), with a very narrow 'waist' in the middle of their bodies;
- True flies (Diptera), with only one pair of wings, the fore-wings;
- Dragonflies and damselflies (Odonata), with shiny membranous wings and large eyes (and aquatic predatory nymphs);
- True bugs (Hemiptera), with mouthparts specialised for piercing and sucking fluids.

After distinguishing these main groups, encourage your class to look at the variety of insects belonging to different subgroups within them, e.g. between ants and bees in the Hymenoptera; between ladybirds and cockchafers in the Coleoptera; and between aphids and shieldbugs in the Hemiptera. Closely-related species are sometimes easily distinguished, especially when they are boldly coloured and patterned, e.g. the red admiral butterfly, with scarlet stripes and white spots on its black wings, compared with the painted lady butterfly, with black and white markings on its brownish-orange wings. More often, related species are so similar that they are difficult to separate without specialist knowledge, e.g. the various species of drone-flies commonly seen hovering at flowers.

How do insects move and grow? *(Science Unit 4A)*

Most animal species and other arthropods (e.g. crustaceans and spiders) have a jointed exoskeleton. The principle of movement by contraction and relaxation of muscles is similar to that of the vertebrate body, but the muscles are inside the skeleton, which is also the body surface. Since a tube has more rigidity than a rod of the same weight and material, the insect skeleton has surprising strength for its weight. (You should ignore the incorrect assertion in the Scheme of Work for Science, Unit 4A, that the invertebrate body is characterised by '*its lack of rigidity*' compared with the human body.) Your class can see examples of the effectiveness of the insect exoskeleton for movement by:

- looking at butterflies, bees and dragonflies in flight;
- disturbing a black ant nest to see the adult workers carrying the large pupal cocoons to safety;
- watching the precision hovering of a drone fly at a flower;
- trying to see the actual jump of a grasshopper;
- attempting to swat a house fly with their hands.

Unlike bone and cartilage, the hard chitinised plates of an insect's exoskeleton cannot grow, which is why a developing insect undergoes a series of moults to shed successive cuticles as it increases in size.

Habitats and insects – generalists and specialists *(Science Unit 4B)*

Insects are found in most terrestrial and freshwater habitats, including those created by man, but many species are specialists associated with particular plants or microclimatic conditions. They are therefore very suitable subjects for a comparison of habitats and animal communities within the local environment of a school. Available habitats will vary with location, but within your school grounds or in the immediate locality you should be able to identify several distinctive and contrasting habitats (such as those suggested earlier, in the section on local environment).

In each habitat, your class should observe or collect insects, note the main types and their abundance, and possibly identify some of the common species (e.g. butterflies, bees and ladybirds). The children should be asked to suggest why the observed insects were found in each habitat and what they were doing there. In particular, they should think about what the insects feed on and their position in a food chain: are they generalists, feeding on many different things and found in several habitats, or specialists, feeding on just one food source and only found in one or two of the habitats?

Insect life cycles – moulting and metamorphosis *(Science Unit 5B)*

Through the process of moulting of the exoskeleton, the growing insect changes form as it develops from egg to adult. In some groups, such as earwigs, the young nymphs are recognisably similar to the adults, though they lack the wings that will only become fully developed in the adult stage. Many groups, however, such as butterflies and beetles, have a complete metamorphosis during a pupal stage between the larva (adapted for feeding and growth) and the adult (equipped for reproduction and dispersal). In many species, the immature nymphs or larvae not only differ in appearance and behaviour from their adults but also live in a different place.

Because most insects have seasonal life-cycles, it is rare to be able to see more than one stage of an insect species at the same time, and you would be very fortunate indeed to see an adult damselfly emerging from its last nymphal skin or a butterfly from its pupa. You will therefore need to use other resources (books or internet sites) to demonstrate to your class the connection between caterpillars and their adult butterflies, or between the underwater nymphs of dragonflies and their flying adults.

Adaptation in insects – their ecological success *(Science Unit 6A)*

The subject of adaptation and interdependence provides an opportunity to bring together in Year 6 what has been learned earlier in KS1-2 about variation, habitats, body structure, movement, growth and life-cycles, in order to understand how animals are interrelated to each other and are adapted to survive in their environments. By varied adaptation of a body structure based on a segmented jointed exoskeleton and by the development of diverse life-cycles, insects have become the most successful group of animals on land and in fresh water.

Insects in other curriculum subjects

Insects are also relevant to the teaching of other curriculum subjects:

- **Geography**: Environmental links to biodiversity are especially evident in insects. Insects are key biological indicators of water pollution. Insect pests and disease vectors have a major impact on man's use of the land for agriculture and tourism.
- **Art & design**: Insects have often been used in art, either symbolically (e.g. scarab beetles as symbols of resurrection in ancient Egypt, or honeybees representing industry in European art) or for their own aesthetic appeal (especially butterflies and moths).
- **Design & technology**: Silk from the cocoons of silkworm moths has long been valued as a luxury textile, and has a high tensile strength. Structural materials based on the design of the linked hexagonal cells of the honeycomb are resistant to compaction yet lightweight, and have been used in construction and insulation.

End-of-year projects

The final weeks of the summer term provide an opportunity for integrative project work outside the classroom. During National Insect Week (19–25 June 2006), your class can participate in the DfES Growing Schools Project, looking at insects (as pollinators, pests, predators and parasites) on broad bean plants in the school garden, or you could take your class pond-dipping or stream-dipping to look at variation, habitats, food webs and water pollution in your nearest freshwater habitat. Further information and resources for these activities, plus an all-age prize quiz, can be found at www.nationalinsectweek.co.uk. The website also provides details of all the NIW events happening in your area during that week.

Resources

- DfES Standards Site at www.standards.dfes.gov.uk for Schemes of Work
- NIW 2006 site at www.nationalinsectweek.co.uk for Insect Index, Educational Resource Pack, 'Growing Schools' project, Ladybird Survey links, Pond-Dipping, listings of local events in National Insect Week, and further information
- The Coleopterist at www.coleopterist.org.uk for an extensive gallery of beetle photographs
- *Minibeasts: An Identification Guide* by Peter Smithers with illustrations by John Walters (2004), published by John Walters, ISBN 0-9540256-2-8
- *The Freshwater Name Trail: A Key to the Invertebrates of Ponds and Streams* by Richard Orton, Anne Bebbington & John Bebbington (1996), published by Field Studies Council: laminated fold-out chart
- Ponds and Streams (2004), interactive CD-ROM from Spiny Software, home user version £19.99, school single-user version £39.99, school full site licence £60.00 (suitable for KS2)
- Butterflies, Bugs and Beasties (2001), interactive CD-ROM from Spiny Software, home user version £19.99, school single-user version £39.99, school full site licence £60.00 (supports KS1–2)

Chris Haines
Co-ordinator, National Insect Week 2006

National Insect Week is organized by the Royal Entomological Society (RES) with entomological partners Buglife (The Invertebrate Conservation Trust), the Amateur Entomologists' Society, and the British Dragonfly Society, and the inputs of many other national and local entomological groups. The RES supports insect science through its scientific journals and handbooks, and by providing a forum for disseminating entomological knowledge. For further information visit www.royensoc.co.uk

AMAZING FACTS ABOUT INSECTS

1. Insects have much more impact on the planet than vertebrates. In tropical forests, insects eat 12-15% of all the leaves, compared to just 2-3% eaten by vertebrates. Insects also eat 15-20% of all crops grown for human food.
2. Termites devised air-conditioning millions of years ago: their huge mounds are complex ventilation systems for the underground nests of their colonies.
3. A swarm of desert locusts contains up to 50 billion individuals, each eating its own weight of food in a day, so one swarm can eat 75-100,000 tonnes a day – four times the daily consumption of the human population of London.
4. There are at least 20,000 different species of bee in the world: about the same as the number of species of all types of fish.