University of BRISTOL

Wild Senses

Learning resource for teachers

KEY STAGE 3

Wild Senses

Contents

Introduction

Animals' senses are amazing. Using different senses allows animals to interpret and react to their environment in a particular way. Many senses are highly sensitive and finely tuned; this is due to the adaptation of species in their environment through natural selection. While many animals have the same senses as us, some have senses that we do not have. For example, some animals detect the Earth's magnetic field or see ultraviolet light. Our own senses enable us to see, hear, smell, taste and touch the environment around them. Some people may have a sensory impairment and use their other senses to a greater degree or in different ways.

Our understanding of senses has changed over time: in the past we have tried to put ourselves in the place of animals, often leading to incorrect assumptions and scientific discoveries about how they sense the world. Today, we have a much better understanding of how other animals interpret their world, although there may still be senses we have not yet discovered!

How to use

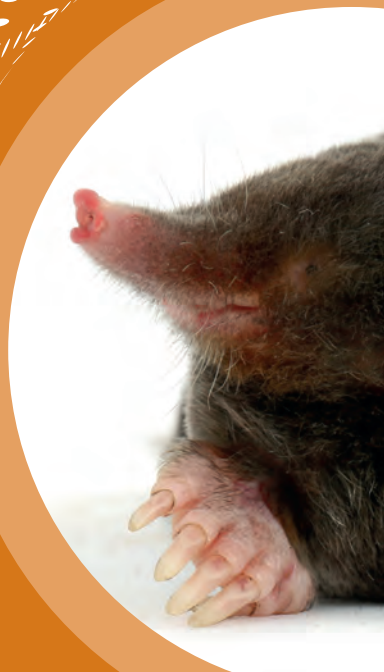
This learning resource provides examples of animals that are well adapted to different environments and how their senses have evolved to deal with the specific conditions they live in. There is also the opportunity to reflect and take action on how some of these animals may need our help to better survive in habitats that they frequently share with humans.

This resource showcases how bats, moles, hedgehogs, deep-sea fish and cave-dwelling animals use their senses. Each subject features a student-friendly page which can be shown on a screen in the classroom. Complimenting each one is a relevant page for teachers and learning providers sharing further details, actions to help and areas of interest to explore.

Learning outcomes of resource

By the end of this resource, learners will:

- Describe how different environments have led to species developing specialised senses to detect and interpret their surroundings;
- Explain how some animals have adapted their senses to particular environments through evolution;
- Explain how our understanding of animals has changed over time as we have gained further evidence of how they live and behave;
- Understand how humans sense the world in different ways to each other;
- Feel empowered to make the environment for these animals more accessible.



Curriculum links

Science:

- Identify how animals and plants are adapted to suit their environment in different ways;
- Recognise that variation in offspring over time can make animals more or less able to survive;
- Describe the interdependence of unfamiliar organisms in a broad range of habitats.

History:

- Understand how knowledge of the past has changed and is informed by a variety of sources and changes over time.

Citizenship:

- Appreciate the diversity of people's sensory needs in their community;
- Explain how knowledge of animals' behaviour and conservation of their habitats can ensure their survival.

Starter activities

- Why do animals have a variety of senses? For example, dogs have a very sensitive nose and alert ears. How do animals use their senses to survive?

- Think of an animal that you know about that uses its senses in a different way to you or has a supersense. Describe and explain why this sense is important for its survival.

- Do you use all of your senses all of the time? Are there situations where you use some senses more than others? Are there times when some senses are more important than others?

- If you could choose one sense that would become a super-sense, which one would you choose and why? What would this enable you to do that you can't already?

Bats

How has our understanding of bat senses changed over time?

1836

"The wings, by their delicate structure and extent, serve as feelers to the animal in guiding its flight in the dark."

Jesse 1836

1944

"Bats can fly through the total darkness of caves without striking the walls...The bats emit a supersonic cry... by means of the echoes of this cry which return to them from any obstacles which lie ahead. Since there is no convenient term available to describe this process of location obstacles by means of echoes, I suggest the word echolocation..."

Griffin 1944

Bats send out ultra-sonic squeaks that bounce off prey, such as moths, back to their sensitive ears. This is known as echolocation.

Skin membranes stretch across long finger bones to form wings and enable active flight.

Bats feed in a variety of ways: some bats feed out in the open on flying beetles while others catch fish, drink blood from other animals or take insects from leaves.

Incredible sense:

Bats send out ultra-sonic squeaks that reflect off prey back to their sensitive ears. It is known as echolocation. Some bats, such as the brown long-eared bat, have long ears to help them hear and locate the echo. Horseshoe bats have highly textured noses, called nose-leafs, that are thought to help modify the sound being emitted. Bats are not blind: they can see with their tiny eyes, and many will combine their echolocation with sight. Fruit bats do not echolocate and rely on sight for seeing fruit on trees. Whales, dolphins and some shrews also use echolocation to find food.

Conservation:

We can help bats by encouraging more insects into our gardens and school by planting night-scented flowers to attract moths (bat food!) such as honeysuckle, evening primrose and common jasmine. Building a pond and leaving part of your school field or garden to go wild attracts small insects which bats love to eat. You can also put-up bat boxes on trees or buildings.

Q&A Quote:

"When in motion, like clouds, they darken the air, day and night, destroying the ripe fruits of the country, and sometimes settling on animals, or man: they devour fruits, flesh, insects, and drink the juice of the palm tree: their horrid din is heard at night in the forests."

Fitzgerald 1787

Q&A Quote:

"An animal, like the bat, which is half a quadruped and half a bird, and which, upon the whole, is neither one nor the other, must be a monstrous being..."

Buffon 1750

Questions & activities:

In 1787, how did people feel about bats?

In the past, bats were made out to be more of a nuisance. Today, we know far more about them and their benefits to plants, people and the wider environment. For example, bats are important in the pollination of many plant flowers to produce seeds and fruits, including some that we eat. They are brilliant at eating insects and being natural controllers of their populations, protecting people's crops. Fruit-eating bats are also important in dispersing seeds through their faeces, helping plants to grow in new places and regenerate places after trees have been cut down and forests cleared.

- What did people used to think a bat was? Why did they think that? (see quotes).
- How do we classify a bat now? What characteristics does a bat have that make it a mammal?
- Why have people's ideas about bats changed? What scientific enquiry has happened to change people's ideas?
- Think of an animal that you know a bit about but haven't studied in detail, for example a farm animal or a zoo animal. What would you need to do to be able to classify it accurately? How could other groups of scientists help you do this?
- Why are some animals more difficult to classify? For example, penguins are birds yet swim rather than fly; dolphins live in the water like fish, yet they are mammals, and newts are amphibians despite looking like lizards.

Hedgehog

Why has the hedgehog declined when humans love them so much?

Incredible sense:

Hedgehogs are mostly nocturnal. Their noses are particularly sensitive enabling them to find lots of invertebrates as they go foraging around neighbours' gardens, woodlands and hedgerows. An unusual behaviour is their habit of self-annointing: they lick or chew a substance and mix it with their saliva to form a froth which they then spread across their spines. It is not known why they do this although theories include camouflaging their own scent from predators, such as badgers, or deterring parasites such as ticks.

Conservation:

Hedgehogs often top the polls of animals most loved in the UK, despite half the population or more never having seen one in their garden or nearby green spaces. The hedgehog was once a common animal found in gardens, parks, woodlands and the wider countryside; it has been living in the UK for at least half a million years. It has undergone a long historic decline and the latest 'State of Hedgehogs' report online provides the most up to date information.

While thousands of hedgehogs are runover and killed by cars each year, their main cause of decline is due to the disappearance and fragmentation of their habitats. Hedgehogs like things scruffy and untidy and because they travel up to 6 miles in one night, they need connecting pathways between gardens, parks, woodland and scrubland.

Many hedgehogs have nowhere to go and little food to eat as their environment is built on, paved, sprayed and cut up by roads, fences and walls. Despite this, hedgehogs living in urban areas appear to be doing better than those in rural areas.

Why might this be?

(consider connectivity of gardens and parks in towns/cities and intensive farming practices in the countryside).

What you can do to help hedgehogs that live near you.

- Gaps left or made at the bottom of fences between connecting gardens;
- Leaving parts of the garden, school field and shared spaces uncut;
- Avoid using pesticides.

Questions & activities:

Use a map of your local area to give a bird's eye view of all the gardens, roads and houses. Label features that might make a hedgehog's journey around your neighbourhood difficult? Consider roads, uncovered drains, fences and walls.

- What senses does a hedgehog use to find its way around a neighbourhood and forage for food?
- Where might a hedgehog hibernate near your home or school? What environment will it be looking for to sleep in?
- What changes could you make in your school, garden or park to help a hedgehog find food more easily?

Hedgehog

Mole

How does a mole use its range of senses underground?

Tiny eyes that detect light and darkness helping moles to spot breaks in their tunnels and to travel across land.

Short velvety fur helping mole to move backwards and forwards in a tunnel.

Super-sensitive nose for feeling its food such as earthworms.

Sharp, insectivorous teeth for biting and paralysing prey, keeping them alive in a food store. They are thought to be one of the world's fastest eaters – they can eat a worm or insect in 120 milliseconds. Its brain decides in 8 milliseconds whether a prey is edible or not.

Shovel-like front feet to quickly dig tunnels.

Incredible sense:

The mole is incredibly well suited to life underground. While all moles have sensitive noses, the star-nosed mole, from North America, has 22 fleshy tentacles around the tip of its nose helping it feel for any small creatures close by. Underground there is less oxygen to breathe – a mole's blood is specially adapted to absorb all the oxygen that is available. The star-nosed mole favours marshes and wetter areas where they swim and forage for invertebrates.

Historical context:

Looking back at historical documents the senses of the mole were well recognised. However, how might some of these quotes be misinterpreting or making assumptions about a moles' senses, or comparing too closely with human senses, emotions and/or anatomy?

Historical Quote:

"It has, besides, a delicate sense of touch; a skin as soft as velvet; a very fine ear; and small hands, with five fingers, very different from the extremities of other quadrupeds, and nearly similar to the human hand.**"**

Rafinesque 1832

Historical Quote:

"Blind, awkward and shapeless, condemned to a life of incessant toil in subterranean darkness... this animal, so apparently helpless and miserable, be shown to possess as numerous and efficient means of happiness as any of the more obviously favoured species.**"**

Bell 1837 on the European mole

Conservation:

There are thought to be over 41 million moles in the UK! They are difficult to study so we don't know the exact figure.

Moles are excellent at keeping the soil well drained and aerated, benefiting the plants growing there. By keeping our gardens and school grounds free of pesticides and herbicides – chemicals that are used to kill bugs and unwanted plants – the soil can be rich and healthy supporting lots of worms, beetles and slugs for moles to eat and keeping plants healthy too.

Questions & activities:

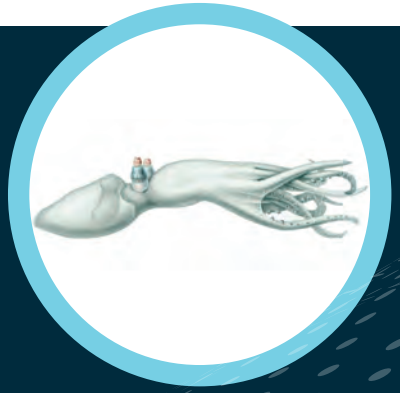
- What features does a mole's nose have that means the animal is well adapted for living underground?
- List three ways in which moles are adapted to their environment underground and describe why they are important for its survival.
- During evolution, what advantages did moles with a very good sense of smell have over moles without a good sense of smell?
- Explain how natural selection would have led to moles having shovel-like feet. Explain how these adaptations help them survive.

Star-nosed mole

Mole

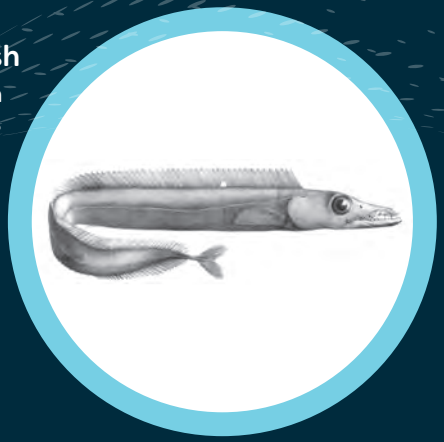
Deep Sea

What sensory adaptations enable animals in the open ocean and deep sea to survive?



Telescope Octopus

An octopus with tubular eyes on stalks!



Black Scabbardfish

A deep sea fish with huge eyes and fang-like teeth.

Eyeless or vent shrimp

One of the most abundant animals living at hydrothermal deep sea vents along the Mid-Atlantic Ridge. They have light-sensing organs on their backs.

Sabre-toothed dragonfish

"These luminous fishes are well equipped for life with long feelers, excellent eyes, lines of brilliant lights and needle-sharp fangs of great length..."

Beebe 1932

Zooplankton

The microscopic animals living in the sea. Many are the young or larvae of crabs, shrimps and other sea life.

Phytoplankton

The microscopic plants living in the sea.

Lanternfish

These small fish produce a weak blue, green or yellow light known as bioluminescence. It is thought to be used to group together in shoals, for courtship and as camouflage.

Incredible sense:

Small animals living in the open ocean and deep sea have evolved a range of adaptations to their senses to survive – some are featured on the student page. In the extreme depths of the sea, it is completely dark, and some animals produce their own light and have huge eyes suited to seeing in low light conditions. The light may be used to attract prey, in courtship or to stay in shoals.

Historical context:

Because of the lack of exploration of the deep sea until recently many creatures have remained a mystery. Here are some early observations.

Historical fact:

In 1931, William Beebe, along with Otis Barton, set the record for the deepest dive at that time into the sea near Bermuda. They travelled 435 metres in a metal craft, spotting lots of strange and mysterious creatures down there.

*Davy's Jones' Locker = a metaphor for the bottom of the sea.

Historical Quote:

"Only when I saw them at greater depths in the searchlight did I recognize them. Of all the many thousands of these fish which I have netted, I never saw one alive until now. The lanternfish (Myctophids) came close to the glass and were easy to call by name. Instead of only having half a dozen scales left, like those caught in the nets, these fish were ablaze with their full armor of iridescence. Twice I caught the flash of their light organs, but only for an instance."

Willam Beebe (1934), 'A first round-trip to *Davy Jones's Locker' from Half Mile Down

Conservation:

Fish numbers are reducing in size due to nations around the world overfishing their populations. Sustainable fishing ensures fish populations can keep laying eggs and growing so they don't decline or disappear. In Britain, many supermarkets show which fish have been sustainably caught with a blue Marine Stewardship (MSC) label. The Good Fish Guide – available online – showcases which fish should be avoided, due to low numbers, and which can be eaten if they have an MSC label.

We can help sea life by using materials that are compostable and decompose quickly, and recycling, reducing and reusing our plastic. Plants, small fish and larger sea creatures like dolphins have all been found to have plastic inside their bodies. One lanternfish was found with over 80 pieces of plastic chips in its stomach. By reducing our plastic and using paper or cotton, picking up litter, we can ensure plastic we use does not end up in rivers that flow into the sea.

Questions & activities:

- Use the pictures and information to draw some food chains showing which organisms eat each other and how energy is transmitted up the chain. Then combine your food chains to make them into a food web.
- Find out about the lanternfish's predators and what it eats.
- Discover more about the black scabbardfish, an important prize fish eaten on the island of Madeira and in Portugal. What would happen to the food web in the sea if humans overfished black scabbardfish? Discuss the effect on other populations within the ecosystem.
- What happens when humans let too many nutrients, such as nitrogen and phosphorous, leach into the sea from land? Too many phytoplankton, microscopic plants grow – particularly ones that thrive in nutrient-rich waters. They block the light and use up all the oxygen. What effect does this have on other animals and plants living in the sea?

Caves

A lost sense or a supersense?

Mexican blind cavefish

No eyes

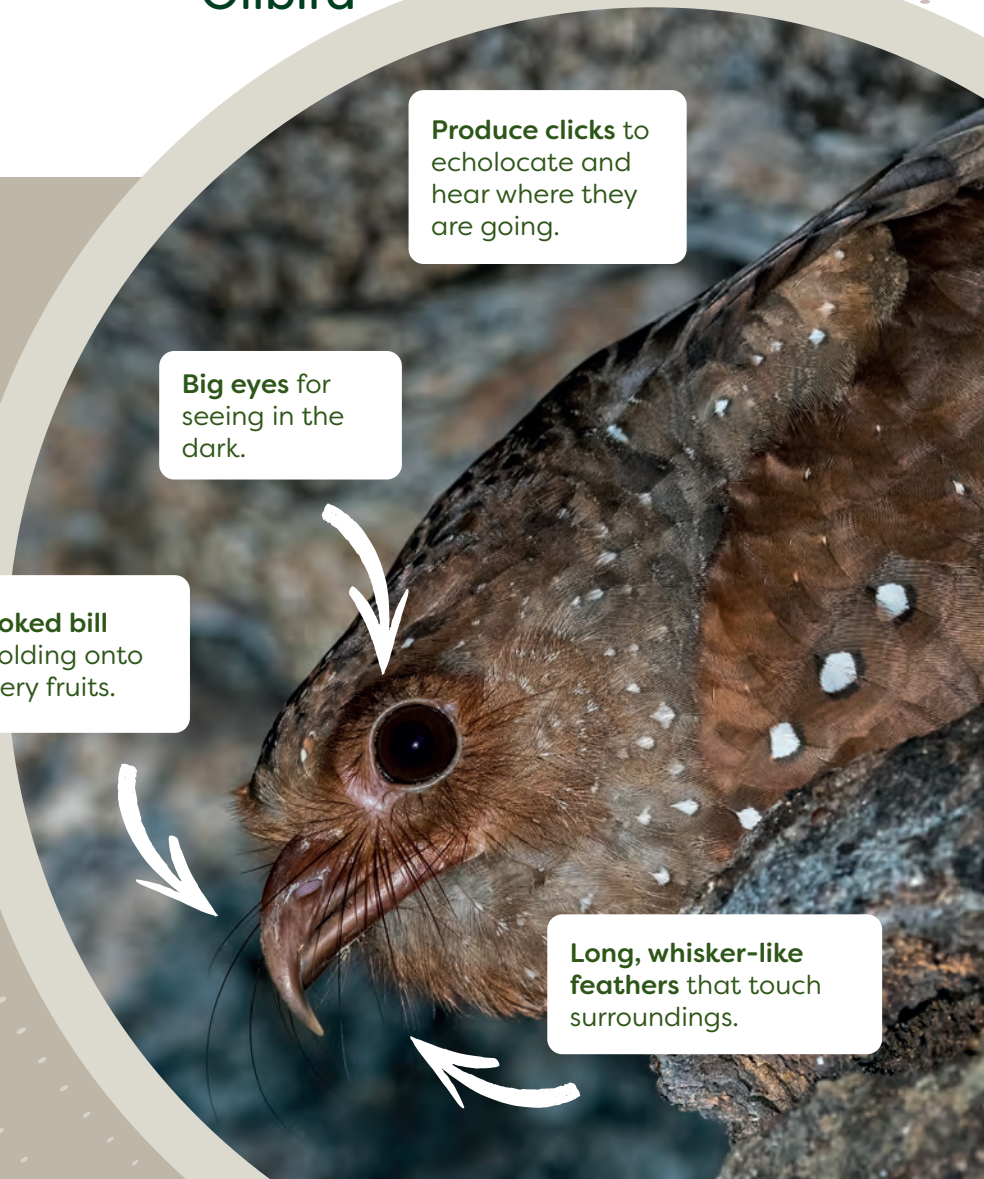
More sensitive lateral line: fish have a sensory line running along the body to sense vibrations in the water.

Large fins to swim more efficiently and use less energy.

Mouths suited to scavenging on plant and animal remains swept into caves by water.

Scales that streamline the body.

Oilbird



Produce clicks to echolocate and hear where they are going.

Big eyes for seeing in the dark.

A hooked bill for holding onto slippery fruits.

Long, whisker-like feathers that touch surroundings.

Incredible sense:

Both cavefish and oilbirds live in dark caves. However, they have adapted to the darkness differently. For example, while the oilbird's eyes have evolved to be larger to use what little light there is effectively, the cavefish has lost its eyes and relies on its other senses instead.

There are 29 varieties of the Mexican blind cavefish, and river-swimming forms of this species do have eyes and see. They diverged around 20,000 years ago. They often share the water with other eyeless animals such as shrimps. Other blind cavefish species include the Somalian cavefish and the Tinaja cavefish.

Historical context:

Historically two types of cavefish have been documented in Mammoth Cave in Kentucky, USA and generated much curiosity.

Historical Quote:

"In this river are the eyeless fish; there are two kinds of them, neither having the least resemblance of a place for an eye, for, of course, they have no need for eyes. The solitariness of such a scene can scarcely be conceived."

John Wilson, A Visit to the Mammoth Cave of Kentucky (Edinburgh, 1849)

Historical Quote:

"The blind fish is now become tolerably rare from its having been so frequently fished out of the Lethe stream, as the subterranean river of the Mammoth Cave is called."

The Subterranean World, Hartwig 1870

Conservation:

Both cavefish and oilbirds are prone to disturbance through recreational cave activities, deforestation, increased access to caves and water pollution events. Conservation efforts include protecting cave entrances from disturbance, protecting the land through which the water runs into caves, increasing education of these animals so they receive greater protection and, for oilbirds, the creation of artificial nesting ledges.

Questions & activities:

- Describe how the blind cavefish moves around? The cavefish has lost its sight to save energy in the dark – what other adaptations does it have to survive?
- Describe some ways in which the oilbird has adapted to hunt for food and move around.
- Compare and contrast the cavefish with the oilbird using your own Venn diagram. What is the same about their senses and what is different? How do they both manage to survive?

Cavefish and oilbird: more adaptations to share with your class:

- Cavefish binge eat to survive months without food (by storing food as fat);
- Cavefish lack a swim bladder enabling them to feed more easily on the bottom of a cave pool;
- Oilbirds have the most sensitive eyes of any vertebrate;
- Oilbirds use their eyes and sense of smell for detecting their food (fruits).

Other senses

Different animals are able to sense the world in different ways, enabling them to find food or escape predators in ways that are suited to the environment they live in.

Choose one of these senses and imagine you have it:

What extra powers would it give you, how would you sense the world differently, and how would you use that to build up a picture of the world around you?

- **Fish**, such as the elephant-nose fish, can detect the electric fields given off by other animals as well as generate their own electricity to stun their prey.
- **Birds and insects** are able to see ultraviolet light. Flowers have lines or 'guides' on their petals only visible in the UV range. They encourage pollinators, such as bees, into their flowers to drink their nectar and pollinate.
- **Birds and bees** can detect the earth's magnetic field, helping them to find their way.

- **Bumble bees** have smelly feet which tell them if a bee has already visited a flower or not (and whether to bother visiting or not).
- **Some snakes** can detect infrared or body heat with special holes known as pit organs on their faces; this helps them to find prey such as small mammals.
- **Spiders** use their sense touch to detect potential food on their webs using hairs on their legs.
- **Catfish** have long whiskers or barbels covered in tastebuds which detect chemicals (and therefore food) in the water.
- **Some humans** are super-sense smellers and tasters and may test new foods for supermarkets.

Plenary

Use prior learning from this resource to encourage learners to consider the following questions:

- **How do different animals use their senses to build up a picture of the world around them?** Describe what different animals do to find their way around. Why are all these ways so different? For example, if you are a mole and you cannot see, how do you know where you are going? (consider pressure on skin and touch using nose).
- **How do different animals find food in different ways?** Why have these differences evolved?
- **Imagine you are out at breaktime and you are a bumblebee:** how would you see the playground differently if you can see ultraviolet and the magnetic field? Look up how cameras detect ultraviolet light on flowers.
- **Discuss** how comparing our own sensory interpretation can lead to the wrong idea and impression of how animals sense their world.

Humans use their senses to interpret the world and adapt if they have a sensory impairment or disability:

Some people have sensory impairments where one or more senses may be impaired or lost altogether. Sensory impairments can mean their senses don't work as well or work differently. For example, they may have a narrow field of vision, be colour blind or not be able to hear very high pitch sounds.

- **How do people adapt if they have a visual sensory impairment?** For example, they may have glasses, they may use a stick/cane and/or have a guide dog.

- **Sounds travel as vibrations through solids, liquids and gases.** Our ears detect these vibrations, and we interpret them as sound. If someone has a hearing impairment, how do they use their sense of touch to communicate or sense vibrations that sounds make? For example, dancers feel the vibrations through their bodies while those who are unable to see and hear may use tactile signing, feeling another persons' signing hands.

- **How do we improve our senses for particular situations, such as seeing something up close or hearing something more easily?** For example, we may use microscopes, stethoscopes, x-rays, infrared scope/night vision goggles, cupping ears to hear bird sounds.

- **How might new buildings, road layouts and towns be transformed if we consider people with sensory impairments and how people use their senses in different ways?**

Some examples include:

- Silent traffic crossing lights and a spinning cone on underside of pedestrian crossing to indicate green light.
- Textured paving that distinguishes a path from other obstacles or dangers.
- Voiceover on buses/trains to indicate stops.
- Turning off music in communal areas of workplaces or shopping centres.
- Designing buildings with large windows to allow for natural illumination. Natural light is much better for vision – for everyone.
- City planners to pay attention to acoustics and to design spaces where people can see each other and moving vehicles easily (long sight-lines).

Wild Senses

School of History

Wild Senses, KS3 Teaching resource

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