

Rainforest Medicines

This tour will look at the medicinal uses and potential of rainforest plants and animals. It will also explore what the term 'medicine' means to people from different cultures, and who might benefit from the pharmaceutical products based on medicinal species. This tour is most suitable for children at upper primary and secondary levels (also college students and general interest adult groups) but can be adapted according to Key Stage.

Curriculum links

Key Stage 2

Geography - Knowledge and understanding of places

3g) – to recognise how places fit within a wider geographical context (for example, as part of a bigger region or country) and are interdependent (for example, through the supply of goods, movements of people)

Knowledge and understanding of patterns and processes

4b) – recognise some physical and human processes (for example, river erosion, a factory closure) and explain how these can cause changes in places and environments

Knowledge and understanding of environmental change and sustainable development

5b) – recognise how and why people may seek to manage environments sustainably, and to identify opportunities for their own involvement (for example, taking part in a local conservation project)

PHSE & Citizenship - Preparing to play an active role as citizens

2e) – to reflect on spiritual, moral, social, and cultural issues, using imagination to understand other people's experiences

2j) – that resources can be allocated in different ways and that these economic changes affect individuals, communities and the sustainability of the environment

Developing good relationships and respecting the differences between people

4b) – to think about the lives of people living in other places and times, and people with different values and customs

Breadth of opportunities

5a) – take responsibility

5d) – make real choices and decisions

5g) – consider social and moral dilemmas that they come across in life

Key Stage 3

Science (Sc1) - Scientific Enquiry

1c) – the ways in which scientists work today and how they worked in the past, including the roles of experimentation, evidence and creative thought in the development of scientific ideas

(Sc2) Humans as organisms

2n) – how the growth and reproduction of bacteria and the replication of viruses can affect health, and how the body's natural defences may be enhanced by immunisation and medicines

Geography - Breadth of study

6e) – ecosystems - how physical and human processes influence vegetation, including:

i) the characteristics and distribution of one major biome (for example, savannah grassland, tropical rainforest, temperate forest)

ii) how the ecosystems of this biome are related to climate, soil and human activity

6j) – environmental issues, including:

i) how conflicting demands on an environment arise

6k) – resource issues, including:

i) the sources and supply of a resource

ii) the effects on the environment of the use of a resource (for example, resource planning and management, reducing energy use, developing alternative energy sources)

Citizenship - Knowledge and understanding about becoming informed citizens

1i) – the world as a global community, and the political, economic, environmental and social implications of this, and the role of the European Union, the Commonwealth and the United Nations

Key Stage 4

Science (Single/Double) Sc1 - Ideas and evidence in Science

1c) – ways in which scientific work may be affected by the contexts in which it takes place (for example, social, historical, moral and spiritual), and how these contexts may affect whether or not ideas are accepted

1d) – to consider the power and limitations of science in addressing industrial, social and environmental questions, including the kinds of questions science can and cannot answer, uncertainties in scientific knowledge, and the ethical issues involved

Citizenship - Knowledge and understanding about becoming informed citizens

1j) – the wider issues and challenges of global interdependence and responsibility, including sustainable development and Local Agenda 21

Tour notes

1. Cocoa tree (*Theobroma cacao*)

The cocoa tree, from South America, produces over 150 different chemicals in its leaves, fruit, seeds and bark. Medicinal use of the cocoa plant dates back thousands of years to the Olmec, Mayan and Aztec civilisations. Anxiety, fever, fatigue and coughs were all treated with preparations made from parts of the cocoa plant.

Many plant remedies tasted very bitter (and still do!) so chocolate paste was used to help the medicine go down. Its medicinal use in Europe can be traced to roughly 500 years ago when it was first brought over from the Americas, and was used to treat, amongst other things, anaemia, emaciation, kidney stones and cuts and burns.

Today, cocoa trees are grown in tropical countries all over the world and recent research has confirmed that chocolate can be very beneficial to health and well-being. Chocolate is rich in polyphenols, the same anti-oxidants found in red wine, which have been shown to help protect against heart disease, as well as improving our immune system and affording protection against cancer. The darker the chocolate the more anti-oxidants it contains. The saturated fats found in cocoa beans, unlike saturated animal fats, can also help lower total blood cholesterol, and actually raise good cholesterol levels.

All good news for chocolate lovers!

2. Avocado (*Persea Americana*)

Originally from Mexico, the avocado was cultivated across Central and South America before the arrival of Europeans. It is now grown throughout the tropics and subtropics. Avocado is high in tannins (which makes it bitter if cooked), vitamins, and healthy, calorie-rich oils. The skin and unripe fruit are said to be toxic.

The antibiotic properties of its skin are exploited to treat dysentery, while the leaves are chewed as a remedy against gum disease. New shoots are boiled to treat coughs in Cuba, and in Mexican traditional markets the fruit is sold as a remedy for intestinal worms.

Avocado oil is 'hypoallergenic' (suitable for sensitive skin) and commonly used in face creams and soaps. It has also been shown to protect against ultraviolet rays, and even have anti-ageing effects. Avocados contain a compound called lutein (also found in green vegetables), which helps to protect against prostate cancer and eye disease.

3. Rosy periwinkle (*Catharanthus roseus*)

Originally from the dry tropical forests of Madagascar, this plant yields two of the most important anti-cancer drugs—vincristine and vinblastine—in use today. Since the development of these medicines, the chance of surviving childhood leukaemia has risen from 10% to 95%.

Traditional Malagasy healers used the rosy periwinkle for treating diabetes, which initially brought the plant to the attention of western scientists. In their labs, it was by chance that they looked at the blood cell count of animals treated with the extracts of the periwinkle. There they found startling effects on white blood cells, which were reduced—exactly the action required for treating leukaemia.

While these medicines have proved very profitable for global drug companies, virtually none of the profits from their sale have found their way back to Madagascar, one of the poorest countries in the world. Recent international agreements—such as the Convention on Biological Diversity—have tried to ensure that more profits from the commercial development of animal and plant species return to the countries of origin. Some pharmaceutical companies are trying to redress this imbalance by working closely with ethnobotanists and indigenous healers and sharing profits more equitably.

4. Wild yam (*Dioscorea* spp.)

The wild yam, North & Central America, has greatly influenced the social and medical traditions of millions of people around the world. Diosgenin, extracted from the rhizome (underground stem) and roots of the yam, forms the basis of the modern birth control pill. Since the 1930s, a variety of human sex hormones have been produced. In this country, it is commonly taken as a supplement for menopausal women.

Traditionally, women in Central America used this plant for a similar purpose, taking plant extracts daily to prevent pregnancy. In India today, traditional Ayurvedic healers use *Dioscorea* species to treat impotence and infertility. In China they are used to treat liver conditions and aid digestion. Yam extracts have also been found to reduce inflammation and pain, and relax stiff muscles, and are therefore useful in treating arthritis and rheumatism. Recent studies in Texas have shown that they can also help alleviate symptoms of chronic fatigue syndrome.

Diosgenin is a saponin, a plant steroid which protects plants from attack by slugs and snails, insects and microbes. In many cultures across the world it is used to stun and catch fish, and saponins are one of the most commonly used fish poisons.

5. Golden trumpet (*Allamanda cathartica*)

All parts of the golden trumpet are poisonous and, if ingested in sufficient quantities, may produce symptoms of vomiting or diarrhoea.

As the scientific name suggests, however, the plant also has certain 'cathartic' or healing properties. In Surinam traditional medicine, the flowers are used as a laxative, while the roots are used to treat jaundice, an enlarged spleen and complications with malaria. The plant has also been discovered to have antibiotic properties.

6. Angel's trumpet (*Brugmansia* spp.)

Brugmansias are also known as tree daturas, and belong to the potato family. Found naturalised across the world, their trumpet flowers exude a beautiful and narcotic scent, particularly at night. Both *Brugmansia* and the closely related *Datura* are revered in many cultures.

Brugmansias have a long history of use by shamans in South America, and are highly respected plants, used with caution. They are valued for their power to induce visionary dreams and to reveal causes of disease and misfortune. In the Amazon various species are used either alone or as an additive to 'Ayahuasca', an important visionary brew.

All species of *Brugmansia* contain powerful alkaloids, which in sufficient quantities can kill. There is an extremely fine line between medicinal and lethal doses. The alkaloids are scopolamine (found in the highest concentration), hyoscyamine and atropine, which stimulate the central nervous system whilst simultaneously depressing the peripheral nerves. Scopolamine is responsible for the magical visionary or hallucinatory effects of *Brugmansia*.

Until recently *Datura* cigarettes were prescribed to asthma sufferers as an anti-spasmodic which relaxes the respiratory muscles. *Daturas* also suppress glandular secretion and therefore the amount of mucous secreted by the lungs. The anti-spasmodic qualities are useful in treating patients with Parkinson's disease.

The wide use of *Brugmansias* and *Daturas* as an aphrodisiac led to their reputation being sullied in Europe. In Mexico, however, Santo Tolache is the patron saint of *Datura*.

7. Goeldi's monkey (*Callimico goeldii*)

Monkeys, apes and primitive primates (such as lemurs) are regularly used in research to gain an insight into how lifestyle, disease and medication might affect humans. For example, a study in 2002, concluded that feeding soy formula milk to babies may indeed have an effect on their development, after it was found that levels of testosterone in developing male marmosets were significantly decreased if they were reared on soy formula milk. Other examples include research into malaria, HIV and testing of vaccines and drugs. If a drug shows undesirable effects then it would not be further tested in humans.

Although the large majority of animals used in testing are now captive-bred, some special exceptions are made and wild caught animals are still used. Until the late 1980s plant researchers in the rainforests of Peru still observed hundreds of monkeys, from different species, being caught and transported from the wild.

8. Annatto/Lipstick tree (*Bixa orellana*)

The crushed seeds of annatto make a dye used to colour food from Cheddar cheese to rice, and to make cosmetics including lipstick. Its use can be traced back to the Mayans where it was used for body paint and for dyeing fabric. In Suriname, the dye was used to paint tribesmen's bodies before magical rituals.

For centuries, rainforest peoples throughout Central and South America have also used the annatto tree as a broad spectrum medicine. People in Paraguay use it to repel biting insects, while indigenous people in Peru use it to make a love potion.

Annatto has been extensively investigated for its medicinal properties and research backs up the traditional uses of annatto. Colombians have long used extracts from the leaf and bark to treat snakebites and a study in 2000 confirmed this effect in mice. Oil extracted from the plant contains carotenoids (plant pigments), one of which, Bixin, has been found to protect against UV and also has anti-oxidant properties, opening up possible new applications. However, there have been reported cases of death due to anaphylactic shock in people allergic to Bixin.

9. Pineapple (*Ananas comosus*)

Pineapples originally came from Brazil but have been widely cultivated throughout the tropics for over 500 years. Apart from its use as food, the pineapple has long been used as a medicinal plant in several native cultures to treat diverse ailments - from jaundice to warts. In the Choco regions of Colombia and Ecuador, children are treated with the young buds for respiratory problems.

The active chemical in pineapples is bromelain, a digestive enzyme extracted from the stem and fruit. Commercially this is taken from the waste products after processing. Bromelain has an anti-inflammatory effect so it helps to reduce swelling, pain and tenderness. It is often used after surgery, to reduce inflammation in injuries and to treat deep burns and wounds. It is also thought to improve absorption of antibiotics, generally help the immune system and be effective against intestinal parasites, some of which cause severe diseases in humans.

Bromelain is also used in certain cosmetics. However, too much can damage the skin, so people who regularly handle fresh pineapple flesh must wear gloves for protection.

10. Millipede

An aspect of animal behaviour which has only recently become a serious study is the phenomenon of animals healing themselves with natural substances. One such example, exhibited by primates on different continents, is the use of millipedes to eradicate skin pests. This behaviour is most noticeable in the wet season when skin pests are most prevalent.

Capuchin monkeys in Venezuela and lemurs in Madagascar have all been observed rolling and biting millipedes in order to release their defensive toxins, then rubbing themselves all over with them. Some even suck the millipedes, causing a narcotic effect. The capuchins even make it a social event, and share them amongst group members. Scientists have shown that the chemicals released by millipedes do indeed repel insects and have anti-microbial properties. These primates fight off unwanted guests while receiving a natural high in the process.

11. Trumpet tree (*Cecropia peltata*)

Cecropias or embauba are widely used in traditional medicine throughout Central and South America. Virtually every part of this tree is used in medicinal applications – the bark, roots, sap, leaves and fruit. Embauba is used to treat a diversity of ailments, from respiratory illnesses to high blood pressure and rheumatism. Applied to the skin, the latex can treat warts and ulcers, and the leaves can be used as a painkiller. A medicine to treat bronchitis and snakebites in Trinidad is used as a cure for diabetes and hypertension in Guatemala. Each country has differing uses for extracts of this plant.

The traditional medicinal uses of embauba have still to be fully investigated scientifically, but research in the US has led to two recently patented active compounds from the plant: a glycoside called ambain (which stimulates the heart) and an alkaloid called cecropin (which has diuretic properties). Embauba may also be useful for treating obesity, as well as bacterial infections and cancer. It is regularly used throughout the world by herbalists for treatment of respiratory disorders and diabetes, but people with heart disorders or diabetes should seek professional help before taking embauba products.

12. Poison dart frog (*Dendrobates auratus*)

Indigenous people in Colombia tip their hunting darts with the extract from the skin of poison dart frogs. The toxins which ooze from their skin contain numerous chemicals. Over the past decade scientists in the US have discovered 500 new compounds, some of which are being studied for potential medicinal use. One such compound, developed into a painkiller, is 'ABT-594', which is 200 times stronger than morphine but is not shown to be addictive. The compounds—'pumiliotoxins' or skin toxins—typically come from the frogs' diet of alkaloid-containing insects, such as ants.

Recently researchers in Australia have discovered a group of frogs that actually make their own unique poisons—a rare feat for frogs—in addition to those which they get from their diet. Scientists are now working on these novel alkaloids in the hope of finding new breakthrough medicines.

The toxins from *Dendrobates auratus* (Green and Black poison frog) are being studied for their potential use in treating heart attacks.

After the tour

After your guided tour you will be able to take the children around the greenhouses in small groups. This is a good opportunity to complete worksheets, or to spend time looking in more depth at some of the plants and animals. Look out for the 'Rainforest Medicines' logo on interpretation in the houses, which indicates a plant or animal with a medicinal story.



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