how nature dresses to impress

SELECTED 2011 THE ROYAL SOCIETY SUMMER SCIENCE EXHIBITION

Why Nature Dresses to Impress

1. Plants need to attract pollinators

Because they can't move, plants use animals to carry pollen from one plant to another. Pollen contains the male gametes, and these need to reach the ovule in a flower, to fertilise the female gamete and make the next generation – a zygote, that grows into an embryo within a seed.

Pollen from a daisy flower

How important this is depends on the plant's breeding system. Some flowers, particularly weeds, can self-fertilise. This gives them flexibility to invade new habitats – they don't need to find a mate. But lots of plants can't – they might even be dioecious (have separate male and female individuals – like holly bushes) or use a biochemical self-incompatibility system to recognise and reject their own pollen to prevent self-fertilisation. These plants are very dependent on animal pollinators.

2. Flowers reward pollinators

To attract pollinators flowers offer a reward – usually sugary nectar, but often extra protein-rich pollen as well. Animals visit flowers to feed, and generally the pollination is accidental (although check out the yucca moth story – where the moth deliberately pollinates the flowers with special mouthparts like tentacles!).

Generally flowers only produce as much reward as they need to. It's expensive to make nectar and pollen. There is also an advantage in encouraging a pollinator to leave after a very short visit – that way your pollen gets carried to more flowers. Remember, there are two components to plant reproductive success – getting your eggs fertilised (the female component) and spreading your pollen around (the male component).

3. Flowers stand out against leaves

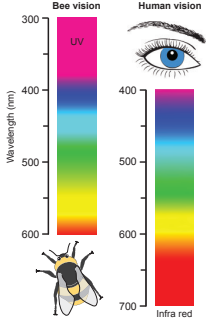
The petals of flowers act as adverts, making it easier for animals to spot rewarding flowers against a green background. These adverts can be based on scent and on colour. Flowers are very rarely green!

This jade vine flower is green – what do you think might pollinate it? Why are some flowers white? What colour do you think would be best to catch the attention of a bee or a hummingbird?

4. Different plants attract different pollinators

Plants attract a number of different kinds of pollinators such as beetles, flies, bees, butterflies, bats, birds, and even lemurs! Plants have specialised in different ways to attract these different pollinators. For example fly-pollinated flowers often smell rotten to attract flies, and moth pollinated flowers are white and open at night. Specialisation to certain pollinators can lead to reproductive isolation from other plants that attract different pollinators. The different colours of flowers reflect the visual systems of the animals they have evolved to attract.

5. Different animals have different visual systems



The range of wavelengths percieved by bees vs humans

Light is made up of lots of different wavelengths. The ones an animal can see depend on its photoreceptors (special cells in the eye, stimulated by light). We have photoreceptors that have maximum sensitivity in the red, the green and the blue wavelengths. Bees have photoreceptors with maximum sensitivity in the green, blue and ultraviolet wavelengths. Many birds can see all the way from red to ultraviolet.

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6. Flower petals contain pigments

Most flowers you see have a colour because they contain a pigment that absorbs lots of wavelengths of light, and only reflects a few. So a red flower contains pigment that absorbs blue and green light, and you see what is left – red

7. Flowers and fruits use structures to produce colour

We have only very recently realised that some flowers also use structural colour. In this case a structure made of transparent material interferes with the reflection of some wavelengths of light, producing a colour. Structural colours are well known in animals (butterflies, rose chafer beetles, peacock feathers) and in artificial systems (the iridescence on a cd). We are working out how different flowers use similar mechanisms to generate colour.

In this experiment we have artificially created iridescent discs in order to explore how bees perceive and respond to iridescent signals.

The iridescent blue colouration of *Pollia condensata* fruits makes them attractive to birds which helps to disperse the seed

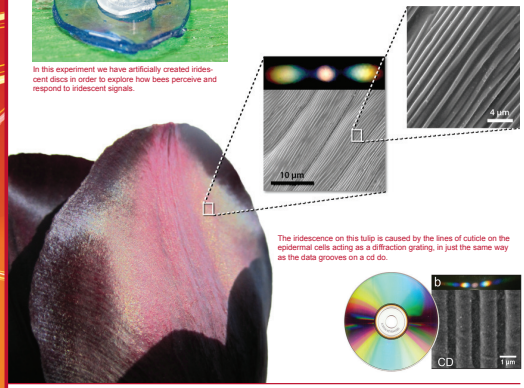
So far we have discovered that quite a few flowers make diffraction gratings (like on a cd) from fine lines of cuticle on their epidermal cells. We are identifying the transcription factors (genes that switch on developmental programmes) that regulate the patterning of the cuticle, and working out what their target genes are.

We have also found that some fruits use multilayer systems to produce colour. These multilayers are made by laying down the cellulose in the cell wall in thin layers. Fruits use colour to attract seed dispersers, like birds.

Want to know more?

http://www.colours.phy.cam.ac.uk/

http://www.plantsci.cam.ac.uk/research/beverleyglover.html



The iridescence on this tulip is caused by the lines of cuticle on the epidermal cells acting as a diffraction grating, in just the same way as the data grooves on a cd do.

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