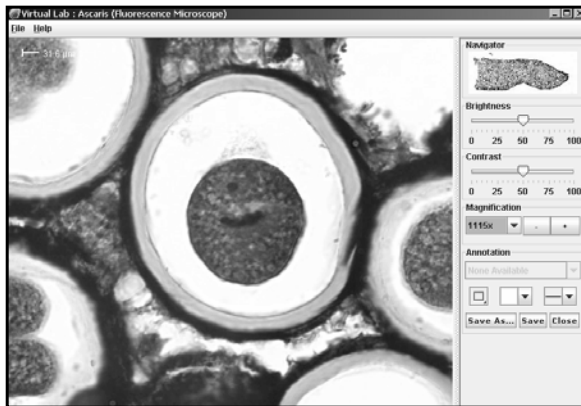


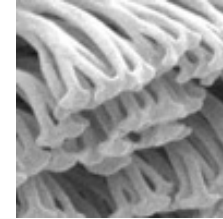
Virtual Lab Specimens for Students from the Perspective of a Scientist

A Selection of Specimens and Discussion Prompts for High School and Middle School:

A Starting Point for Lesson Plans Across a Range of Science Topics



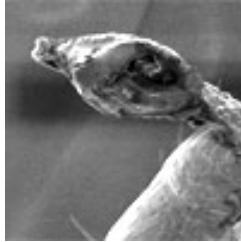
Dr. Iain Duffy
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Gecko Foot

This high-mag sample shows a small section of sticky pad on the underside of a Tokay gecko's front toe. Tokay geckos can adhere to a variety of surfaces by using a unique pad composed of millions of tiny hairs, each *smaller than the wavelength of visible light*. These tiny hairs each have a tiny attraction (van der Waals force) to a surface when in extremely close contact. The combined sum of these attractions would allow a gecko to support hundreds of times its own weight. Images of the Gecko feet were completed with the help of Kellar Autum, Lewis & Clark College, Portland, Oregon.

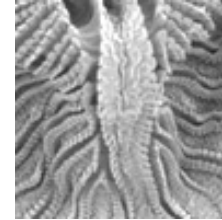
- Why is it better to have many pads and hairs rather than just one large pad?
- Why doesn't gravity pull the gecko down to earth?
- Are there any other animal or insect structures that are stronger than they look?
- Can we learn anything from them? Can we use them?
- Will we ever be able to mimic these structures eg walk up buildings like Spiderman?



Tick

These parasites have little claws on the ends of their arms so that they can hang on to their host. They feed through a barbed hypostome found at the head area, which is like a barbed hypodermic needle.

Ticks are blood-sucking parasites - do we know of any other such creatures?
Why is there such a variety of feeding mechanisms between insects, animals, etc?
Ticks are able to spread diseases to humans - how do they do that?
What diseases can they spread?
What may be the consequence of ticks becoming resistant to pesticides?
Are ticks part of a food web?
What is a "vector"?
What other diseases are spread by vectors?



House Fly

The ventral side of a house fly. This fly has especially spikey looking *setae* (what we call hairs on insects) on its legs. Also, the soft fleshy mouthparts are clean and clearly visible. Most flies regurgitate stomach acids (which dissolve their food) and then suck up the gooey mess. The pattern on the mouthparts here is particularly fascinating.

Common houseflies don't feed on blood - how then do they spread disease?
What diseases do they spread?
Any other organisms that feed by dissolving food and then taking in the soluble end product?
What purpose does stomach acid serve in humans?
If we try to hit a fly it moves before we get to it, why is that?
Flies have "compound eyes" - instead of 2 eyes with a single lens each, they have a bank of lenses [100's or 1000's]. What are the advantages and disadvantages to this?
How do flies manage to hang upside down from a ceiling?
If 5 years ago you hadn't killed those 10 flies, how many offspring would be alive today?



Xyloplax

Xyloplax is a monotypic genus within the Concentricycloidea, an infraclass within the Asterozoa. Details of this new species are to be published in the May 2006 issue of *Invertebrate Biology* by Chris Mah, a scientist specialized in deep-sea starfishes. The ventral (bottom) view shows the tube feet that may be found around the edges of the disc-shaped animal. The patchwork pattern in the middle is due to charging--an undesirable phenomenon that was unavoidable with this particular sample.

This was a new species found in deep ocean.

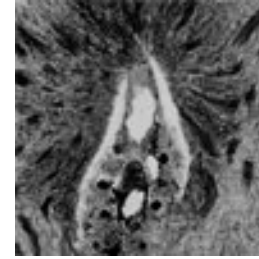
Should we care about what lives thousands of feet down in the oceans?

Is there anything we can learn from these organisms?

New species are being found constantly in the rainforests of South America but at the same time, the rate of deforestation means species are probably becoming extinct before they are discovered. Does this matter? What possible benefits can be got from discovering a new species of animal, plant, etc?

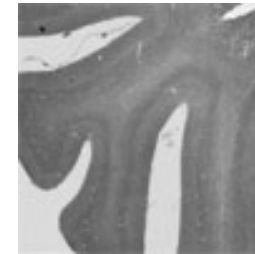
Why should we care about the loss of trees in some other part of the world?

Man, through selective breeding [dogs, cats, livestock] and cloning, has made new forms of animals and plants. Is this acceptable? What are the benefits, what are the disadvantages?



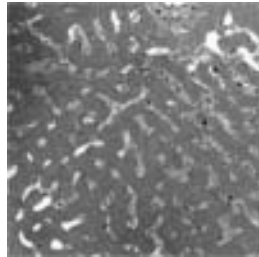
Kidney Injected

"The kidneys are bean-shaped excretory organs in vertebrates. Part of the urinary system, the kidneys filter wastes (especially urea) from the blood and excrete them, along with water, as urine. The medical field that studies the kidneys and diseases affecting the kidney is called nephrology." (credit: wikipedia) [Read more about the kidney at Wikipedia.](#)



Chinchilla Cerebellum

"The cerebellum (Latin: "little brain") is a region of the brain that plays an important role in the integration of sensory perception and motor output. Many neural pathways link the cerebellum with the motor cortex "which sends information to the muscles causing them to move " and the spinocerebellar tract "which provides feedback on the position of the body in space." (Credit: Wikipedia) [Read more about the cerebellum at Wikipedia.](#)



Dog Liver

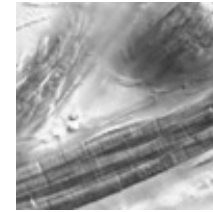
"The liver is an organ in vertebrates, including humans. It plays a major role in metabolism and has a number of functions in the body including detoxification, glycogen storage and plasma protein synthesis. It also produces bile, which is important for digestion." (credit: Wikipedia)
[Read more about the liver at Wikipedia.](#)

Liver cells differ from brain cells, they both differ from kidney cells. As, for example, in humans, all cells have the same DNA then these cells differ due to the making of different proteins. Why cant our body just make all of the same type of cell? Why do we need different kinds of cells and different organs?

Do all of these cells come from different cells to start with or from one type of cell? How does it know to make these different types of cells? Can we use this starting cell for anything?

Does a dog liver differ from a human liver in structure and/or function?

Does it need to be different?



Microbial Mat

Microbial Mats are of interest to scientists because they are representatives of the oldest life on Earth. These thick layers of microbes would grow almost anywhere on Earth, but the evolution of plants started a competition for resources and as animals appeared they consumed the mats as food. With the proliferation of plants and animals now, the best place to find naturally occurring microbial mats are environments so extreme that plants and animals aren't around. Billions of years ago, microbial mats produced stromatolites, our oldest records of life on Earth. Be sure to check out our stromatolite samples as well. (Credit: NASA) [Read more about these mats at the NASA website.](#)

Stromatolites are a form of fossil record of microbes, such as cyanobacteria.

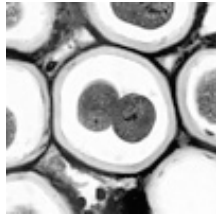
Are there fossil records of viruses?

Cyanobacteria [a bacteria - prokaryote] and plants [a eukaryote] are both green due to chlorophyll. Are these two organisms [different cell types] then related?

If chlorophyll is involved in photosynthesis - what is photosynthesis?, why is it important?, where does this place these organisms in a food web?

Photosynthesis converts energy from sunlight into sugars. If energy cannot be created or destroyed then where does the energy go, and in what form, from the sun and then up through the food web?

Animals such as mammoths, are normally only seen in fossilized form. Is it possible to take DNA from a frozen animal, such as a mammoth, and create a new one? What might be the advantages and disadvantages to such an act?



Ascaris

Ascaris is a type of parasite, and is one of the largest and most common type found in humans. This sample shows various phases of mitosis as well. Mitosis is the process of producing two daughter cells by nuclear division plus cytokinesis.

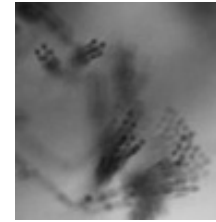
Mitosis is part of the cell cycle and eventually leads to 2 cells from one. What happens when something goes wrong with the cell cycle?

Another form of cell division, meiosis, leads to the formation of gametes. Ascaris can produce up to 200,000 eggs per day.

Why do some organisms produce 1 egg and some produce thousands?

Why are parasites found in certain parts of the world and not others?

Why cant we just give a tablet or a vaccine to rid these people of this parasite?



Penicillium

Penicillium is a fungal genus whose different species have such varied uses as making cheese and producing antibiotics. Commonly known as "bread mold" because it is typically the blue-green mold that shows up on old bread. (Background information courtesy of Wikipedia)



Rhizopus

A Rhizopus is a filamentous fungus found in soil, decaying fruit and vegetables, animal feces, and old bread. It is the cause of some serious, and often fatal, infections in humans and animals. They reproduce by sporulation, or the production of spores.



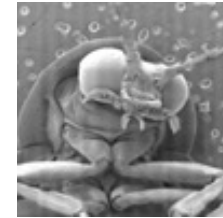
Yeast

Saccharomycetes is a class in the kingdom of fungi, and includes budding yeasts. These sugar-eating yeasts are of great importance to industry, and are central in the production of ethyl alcohol and many bread products.

All of these are fungi and yet sometimes they are good for us and sometimes they are not.

What causes members of the fungi to behave differently?

Some fungi, such as yeast, are single celled and microscopic. Just recently they discovered the largest known single organism ever found and it was a multi-cellular fungus [like a large underground mushroom]. Why are two very different organisms such as those, a member of the same group of organisms?



Firefly

The firefly, part of the family Lampyridae, are actually beetles not flies, as their name would imply. Fireflies glow to attract other fireflies and are usually about 0.75 inches (2 cm) long. More information about fireflies can be found at [BackyardNature](#).

Why does the firefly glow?

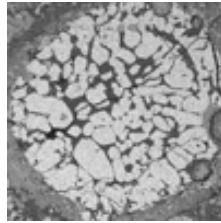
How does the firefly glow?

Any other animals, etc that can glow?

Any other known physical adaptations in animals, insects, etc?

What are their purpose?

Do humans copy animal adaptations?



Meteorite (EDS)

Meteorites are pieces of rock that fall to Earth from space. This meteorite came from an asteroid. It is made of dust that formed 4.6 billion years ago, when the planets were just beginning to form. At that time, the Solar System was a cloud of dust and gas that circled in a disk around the newly-formed Sun. Some pieces of dust were flash-heated and melted, and then cooled to form solid beads - the circular objects in the image. These beads are cemented together with fine-grained dust that did not melt. Meteorites like this one, which are called chondrites, tell us about how the Solar System formed.

Did meteorites bring lifeforms to earth?

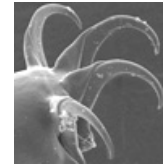
What sort of lifeforms could survive a meteor journey through space?

What may be the consequence of bringing a virus or bacteria to earth from another planet?

Could meteorites have caused a change in the earths atmosphere and hence, the earths temperature? What would be the consequence of this?

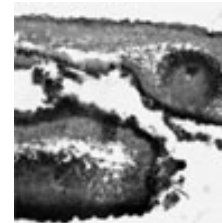
How might the earth have been formed? Was it too a meteorite? How may life have started on earth? How did earth and its lifeforms change over time? [<http://www.lifethoughtime.com/>]

[There are websites with the earths temperature going back to the early 1800's. A good exercise is to break into 1's or 2's and divide the timescale up by the amount of groups - get students to plot the temperature for a certain timescale eg 10-20 years. When you look at them individually you don't see a pattern but when you piece them together on a wall you can see the change in global temperature over a longer period.]



Tardigrade (Sagittal View)

The animals of the phylum tardigrada or water bears are microscopic (0.2-0.5 mm) aquatic animals that are commonly found in the interstitial moisture trapped among the leaves of mosses and the thali of lichens. Water bears have well developed muscles, a ventral nervous system, a complete digestive system, and separate sexes but they lack circulatory and respiratory systems. Tardigrades are famous for being able to survive the most extreme conditions on the planet by slipping into cryptobiosis, a state of desiccation and returning to active life months and years later. About a thousand species are recognized today, mostly by the shape and structure of their body, mouth parts, and claws. These specimens were collected in Utah from a moss growing on a stone wall around a yard. Sample courtesy of William R. Miller, Baker University, William.Miller@BakerU.edu



Lichen

Lichen is made up of green algae or cyanobacteria (blue algae) and filamentous fungi. Since they take on the external shape of the fungi, they are grouped with them. Lichen is made up of various layers: upper layer is made up of fungi, just underneath this layer resides cyanobacteria, another layer consists of algae embedded in fungi, and the last layer is made of fungi. Lichen reproduces asexually.

Lichens are formed from a fungus and a blue-green algae or a cyanobacteria - what role does either play? Why do they need each other?

Are bacteria known in other symbiotic relationships?

Tardigrades can survive extreme conditions - what other adaptations are known for survival in extreme conditions?

Can lifeforms such as bacteria and fungi survive in all extremes of temperatures?

Tardigrade + fungus + algae/cyanobacteria = basic ecosystem - what are ecosystems?

Are humans part of an ecosystem?