

The Science behind the “Noses are Red” show:

Introduction:

The “Noses are Red” show is about allergies and the biological causes behind them. In order to explain allergies you need to understand a certain amount about the immune system and that is why the show begins with an introduction to the immune system.

The science of Immunology is extremely complicated with a huge amount of terminology and has had to be simplified for the show. For example there are many different types of white blood cells, which have different roles in the immune response, but in the show we only show one role of white blood cells, that is producing antibodies. There are also 5 different types of antibodies, but the one most involved in the allergic response is called IgE.

The body’s defences against infection:

In the show we talk about germs, this can be thought of as a general term for any microscopic organism that can make you ill, there are 4 types; bacteria, viruses, fungi and protozoa.

Bacteria –

Single-celled microorganisms, which can live inside or outside the body. Some cause sickness, but others are harmless.

e.g. Streptococcus causes sore throats.

Viruses –

Viruses cannot survive outside of a living cell. They hijack the cell’s reproductive machinery and use it to make copies of themselves.

e.g. Influenza, HIV.

Fungi –

Fungi is a multicellular organism and most types are harmless, but we can get certain fungal infections like athlete’s foot.

Protozoa –

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Protozoa are single-celled organisms, some of which eat bacteria. A lot of them live in water and they can cause various unpleasant diseases, such as Malaria.

Probably the two that are most relevant to our audiences are Bacteria and Viruses.

The first activity in the show involves feeling different items in the feely box and talking about how these items help to protect our bodies against infection. Our bodies need to try and prevent germs getting inside the body. The mouth and throat and digestive system is not considered to be inside the body because it is open to the outside world, the same applies to the respiratory system.

See: <http://uhaweb.hartford.edu/BUGL/immune.htm>

Skin:

Our bodies are covered in skin, which is a physical barrier to germs getting inside the body. Any openings in the skin are obviously risky points where germs could potentially get into the body, such as cuts in the skin, but also natural openings such as the mouth and nose.

Hair:

Hair is used as a barrier to protect some of the risky points, for example the eyelashes, hairs in your nose, hairs in your ears. They all trap dust and dirt, which may contain germs. Also hairs on your arms and legs etc... are also important. Hair follicles secrete sebum, which contains lactic acid, which can inhibit the growth of certain bacteria and fungi. That's why you are most susceptible to fungal infection on areas of your body that have no hair, like athlete's foot on the soles of your feet.

Watery stuff:

In the show we mention watery stuff that the body produces. This covers tears, sweat and saliva, all of which contain an enzyme called lysozyme which can kill certain types of bacteria.

Gooey stuff:

This represents mucus (English spelling may sometimes be Mucous). Mucus lines the gastrointestinal and respiratory tracts and traps germs. Mucus is also a protective layer – e.g. protecting your stomach lining from the strong acid in the stomach.

More about mucus at:

<http://arbl.cvmbs.colostate.edu/hbooks/molecules/mucins.html>

These types of immunity are sometimes called the INNATE IMMUNE SYSTEM because they are non-specific.

After the feely box part of the show we move on to the fact that we all get ill sometimes so the germs must, on occasion, get through our defences into our bodies. This is when our ADAPTIVE IMMUNE SYSTEM comes into play. This is more specific and consists of many different types of blood cell and a ridiculous number of chemical mediators with funny names like Tumour Necrosis Factor etc... Don't worry too much about all these different names because very few people would know all of them.

Because of the complexity of this I have simplified the action of White Blood Cells to explain allergies.

White Blood Cells & Antibodies

Certain types of WBCs called B cells produce antibodies, which are Y-shaped molecules. The two tips of the Y have a very specific 3-D structure. This structure allows the antibody to "lock on" to molecules that have a complimentary 3-D structure. The molecule that they lock on to is called the antigen.

Each B cell produces a different type of antibody, which will be specific for a different antigen. For example a certain B cell may produce an antibody that sticks to a molecule on the surface of the measles virus.

When a child gets measles they are exposed to that antigen and so that type of B cell multiplies and produces a colony of B cells all producing the same antibody. Some of these cells will remain in the body as memory cells. That person now has extra cells producing an antibody specific to the measles virus, so they are immune to measles. The same effect can be produced by injecting a child with a pure measles antigen (without the measles virus attached). This is how vaccination works.

There are literally millions of different antibodies produced by the body specific to all sorts of different things, some of these antibodies may be specific to an antigen on the surface of pollen or dust mites.

Some people when exposed to pollen (or any other allergy causing substance) may get sensitised to the pollen, which means they develop colonies of B cells producing the antibodies against pollen. This means that once they are sensitised every time the pollen season comes round their

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immune system will illicit a reaction to the pollen. No-one really knows why some people are more prone to react in this way than others.

Mast Cells

Mast cells are a type of white blood cells, they are most often in the skin, especially lining the inside of the nose and around the eyes. They are covered in antibodies themselves and can stick to germs and other things that get into the body including pollen. When they stick they degranulate (they explode!!), and release their contents into the blood. They are full of granules of histamine and other chemical mediators. Histamine causes an inflammatory response (in the show this is simplified, by saying that histamine “calls in the reinforcements” which is true, but not quite the full picture). It is the inflammation around the nose and eyes that causes the redness and itching associated with hayfever. This is also what causes rashes on the skin in various contact allergies.

Treatments

Allergies are most often treated with antihistamines, which can be tablets or syrup. Children under 12 are not supposed to take the antihistamine tablets, but can take the syrup.

Steroids are another treatment for allergies, steroid creams can be applied to eczema and steroid nasal sprays are good for Hayfever. These are general suppressors of the immune system, so they stop an allergy by suppressing the immune response. Obviously you don't want to completely suppress your whole immune system, so these only have a local action, which is why you rub the cream directly onto the affected area or spray the nasal spray right up your nose, where the immune response is happening.

General allergy and treatment:

<http://www.claritynallergy.co.uk/index-vote.html>

What does Histamine do?

<http://www.bio.davidson.edu/courses/Immunology/Students/spring2000/lamar/mfirp.htm>

General intro to what is an allergy?

<http://www.hoptechno.com/book46.htm>

What are germs?

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<http://kidshealth.org/kid/talk/qa/germs.html>

What makes you sneeze?

<http://kidshealth.org/kid/talk/qa/sneeze.html>

How your immune system works:

<http://science.howstuffworks.com/immune-system.htm>

Very good overview of the allergic response:

<http://health.howstuffworks.com/allergy.htm>