Allergies

Allergy is an inappropriate, inflammatory, reaction of the body to a normally harmless substance.

It's caused by a part of the body's defence mechanism coming into action in quite the wrong way.

We have a variety of mechanisms to counter harmful bacteria, viruses, & parasites. This defence system is the immune system.

Normally we develop immunity when, say, a particular bacterium is encountered, perhaps in the nose or bloodstream. Certain blood cells – white blood cells – are stimulated by recognising ‘foreign’ or ‘non-self’ substances, on the surface of the bacterium, and are able to react to those substances and, if it's a harmful microbe, hopefully kill or deactivate it. The first time a bacterium, say, is encountered, it takes a little while for the immune system to get going. (Assuming we've survived the first onslaught) next time that bacterium enters the body, we are more prepared, the body’s defences are primed and able to move in quickly. Appropriate antibodies are produced, by a group or clone of white cells, (lymphocytes), rapidly and efficiently, to deal with it. Other cells act in different ways, like regulating the reaction, rallying the troops, or killing off ‘foreign’ cells.

The substance setting off the antibody release is known as an antigen.

An antigen becomes an allergen when an individual’s immune system reacts differently, and inappropriately, to a substance which isn’t a threat to the body. This substance is generally a larger molecule, like a protein, (though a small molecule can be involved). In the case of an allergic reaction, this first encounter with the allergen simply sensitises the system. Next time, it’s ready to bring in the big guns, an inflammatory response instead of immunity.

Antibodies work by fitting on to the antigen in a lock-and-key manner. One antibody will lock on to only one, specific, antigen.

In the case of immunity, the antibody effectively disables the antigen [I think!]

Antibodies (immunoglobulins) come in several basic groups, which I won’t go into. But will just mention Immunoglobulin G, the majority, usually confers immunity, whereas Immunoglobulin E is the main type that gives rise to allergy. Allergic individuals react to particular antigens (allergens) by producing IgE.

In the case of allergy, the ab/ag combination triggers an inflammatory response. Certain cells in the skin, nose etc are stimulated to produce a cascade of inflammatory chemicals including histamine, and other white blood cells come into action. It’s a very quick reaction. There can also be a later allergic reaction taking hours or even days.

The biological function of IgE and this type of reaction seems to be the control of parasites. The inflammation damages, and could kill, or at least isolate, the parasite.

The tendency to become allergic is in one's genetic makeup, but actually developing allergy depends on exposure and other factors. (The tendency to become allergic is called atopy)
Types and causes

The allergic reaction can be in the nose (rhinitis, hay fever), the bronchi (asthma), skin (eczema, urticaria), gut, or many other organs, and manifestations.

Hay fever (seasonal allergic rhinitis) is usually caused by airborne pollen (grass mainly in the UK, also tree, like Birch in Scandinavia, and pollen of various other plants (ragweed is a big problem in the USA). Some seasonal mould spores can also be a cause. Perennial allergic rhinitis is caused by allergens present through the year – like house dust mite, dogs and cats, mould spores in damp houses.

Airborne allergens can also cause asthma, due to constriction and mucus production in the bronchi. Again, this can be seasonal or perennial (or, unfortunately, both)

(Just think – there can be thousands of mould spores, and many hundred grass pollen grains, in a cubic metre of air. We’re breathing them in all the time, and most of us (still) have no problem with this!)

Food allergy is actually not as common as is suggested by the media. The commonest foods to cause problems are: cow's milk, soy, eggs, yeast, wheat, peanuts, tree nuts, fish, and shellfish, not necessarily in that order. In food allergy, tiny amounts can trigger a reaction, which is fast. A specific IgE antibody can be found in the blood. The reaction can take various forms, there can be immediate swelling of the lips or tongue, and gastrointestinal symptoms.

(Food intolerance is different; the mechanism is different. Larger amounts of food are generally needed to produce a reaction, which may occur after several hours. Lactose intolerance, for instance, which produces chronic intestinal problems, is caused by a lack of the enzyme which digests the lactose (a form of sugar) in milk.)

All sorts of symptoms can be produced by food allergy or intolerance – gut or skin problems, or migraine.

An allergic reaction can occur to certain chemicals, latex, insect stings

Why are allergies increasing?

Allergies are increasing in rich countries. This is not just a matter of increased diagnosis, though this has been the case in the past. Asthma has increased more than other forms of allergy. 
Prof Arshad (BBC Horizon programme) estimated:
Incidence of allergy 1950 1% of population
1980s around 10%
2014 25-30%
also quoted: people moving from a developing to a developed industrialised country show an approximately 3-fold increase in allergies after 10 years.
AllergyUK estimates children have a 1 in 5 chance of developing an allergy

(Just to complicate, in some countries inc USA, there’s evidence that hay fever increased faster than this, and that the main increase occurred before the asthma increase. Hay fever incidence in USA quoted as 15% in 1960)

>Air pollutants
We encounter different air pollutants in modern Western living. But relative to 50+ years ago, air in urban areas is much cleaner. We used to endure plenty of soot, smog, sulphur dioxide. Some gases in the atmosphere can increase the bronchial reactivity, in people with asthma, eg nitrogen oxides. However, levels of SO2—an irritant of the airways - are much reduced now.

>Day to day chemical exposure
A possible contributory factor, some chemicals increase bronchial reactivity, and some can sensitise, but it’s not clear whether they can actually initiate an allergic condition.

>Dietary changes
We are eating foods we are not biologically adapted to, we're eating allergens eg peanuts – is this high load of novel foods affecting out immune system?

The evidence doesn’t seem to stack up; some cultures eat higher amounts of potentially allergenic foods but don’t show big increase in allergy

Lack of nutrients such as Vitamin D have been proposed as a cause, but the evidence is inconclusive.

>Indoor sedentary lifestyle
In West, people spend c 85-90% of their time indoors (BBC Horizon programme). Exposure to indoor allergens eg house dust mite has vastly increased, with warm sealed houses & soft furnishings & carpets. But asthma has increased in countries with hardly any dust mites , eg Sweden, and there’s evidence that in Netherlands, dust mites are decreasing while asthma is increasing (Dr F Spieksma). Evidence about exposure to cats & dogs is inconclusive. The increase in allergy is seen in countries with very different types of housing, climate and traditions of domestic pet ownership.

There is some, but not very convincing, correlation of asthma incidence with obesity.

Also some evidence that decreased amounts of physical activity can worsen asthma, but not cause it.

>Lack of parasites
Immunoglobulin E helps in fighting parasitic infection, like gut worms. Some parasites can live quite symbiotically with us, causing minimal adverse effects. In rich Western countries we have very few or none. Possibly the production of IgE is actually regulated by parasites, so without them can be set off by wrong stimulus.

>Viral infections
These can affect the immune system and can promote or increase an allergic tendency. Virus infections are more common [I think] in richer developed countries

>Hygiene hypothesis
Allergies have been increasing in ‘developed’ Western countries. Populations moving from poor to rich countries, or from poor rural to cities, show increase in allergy.

Strachan (BMJ 1989) in the UK showed a strong (inverse) relationship between hay fever and family size and position in household, ie number of older siblings, independent of social class. The idea was that infections were acquired from older siblings, transmitted through less than hygienic contact with them, and from the mother also being infected by the other siblings, and that these infections acquired in early childhood protected against the development of allergy.

He suggested that higher personal cleanliness and smaller family size have, together, reduced the cross-infection in young families.

The immune system, it is postulated, is adapted to fight infections and needs the stimulus of such infections in order to function normally.
Since then it has been shown that common childhood infections don’t protect against allergy, some making allergic disorders worse. Children living in very run-down conditions in inner cities in USA, where cleanliness is going to be poor and over-crowding making cross-infections inevitable, have high rates of allergy and very high prevalence of asthma. And in Africa, it has been shown that children moving into cities experience more asthma but also more infections.

We in the developed world have for many decades been obsessed with cleanliness and the killing of ‘germs’. Anti bacterial cleaning products are the norm. Vaccinations and antibiotics have greatly reduced bacterial, and many viral, infections. Children living on traditional farms, exposed to farm animals, have lower rates of allergy. Children, and adults, spend far less time outside in the ‘natural’ (and inevitably not super-clean) environment.

The balance of probability swings towards the idea that microbes, or the lack of them, have an effect on the development of allergy, and that early childhood is a crucial time for this effect.

> Familiar micro-organisms
We all harbour around $10^{14}$ bacteria and other organisms in our gut (Prof Graham Rook, UCL, a BBC program). The great majority of these are beneficial. Skin also carries microbes.

Diversity of gut bacteria seems to be important. A remote tribe in Tanzania (quote from the BBC Horizon programme) has a high diversity, and only 1 in 1500 of them with an allergy. Allergic individuals generally have low diversity [though one might question cause & effect here?] Antibiotics kill beneficial & harmless bacteria as well as harmful ones. It seems that the more courses of antibiotic received, especially in the first year of life, the greater the risk of developing allergies and eczema.

Even birth is important. Babies born naturally get smothered with particular bacteria (esp Lactobacilli) in the process. Those born by caesarean section (25% in UK) are colonised more by skin and other environmental bacteria, and are 52% more likely to become allergic.

The current theory is that we are adapted to cope with a particular range of microbes (and parasitic worms) to which we would have been historically exposed. This range of microbes in the gut, on the skin & in the environment have, in turn, in a way programmed the immune system, helping it mature and respond to pathogens and not to harmless substances. We have evolved (over thousands, probably millions of years) to anticipate these organisms and need to encounter them, from family and from the natural environment (Prof Rook again). The most important window is the first year of life (including birth). This regulatory system can break down in modern societies as we’re not much exposed to the traditional microbes, and we haven’t had any time to evolve to cope, so sometimes our immune systems go into overdrive.

[Different cultures will historically been exposed to different ranges of microorganisms??]

Maybe we – particularly young children - should spend much more time in the outdoor, semi-natural environment; we would then bring microbes indoors with the potential to expose young infants to these too? Get out more!

Maybe we should just accept the increase in allergies as just a side effect of improved health and wellbeing and infant survival?