



## Seven Wonders of the Microbe World

### *Nitrogen Fixation*

#### **COMM**

Microbes are the oldest form of life on earth. They first appeared on earth about 3.5 billion years ago – and are critically important in sustaining our life on earth today.

Microbes generate at least half of the oxygen we breathe – but in 1885, the Dutch microbiologist, Martinus Beijerinck discovered another critical function they performed – fixing Nitrogen

#### **CHARLES**

Nitrogen fixing bacteria are absolutely essential for life because they fix nitrogen, one of the key elements, one of the key building blocks of all our cells and all our biochemistry.

All animals and plants on the earth depend upon it, but also human beings. The only way that we can get nitrogen is through the food that we eat that was originally fixed by the bacteria.

#### **COMM**

Although around 80 per cent of the earth's atmosphere is made of Nitrogen it's too stable for most plants and animals to break it down – but that's where the microbes come in.

Bacteria in the soil fix the Nitrogen – that means they combine it with oxygen or hydrogen into compounds that plants can make use of.

Some nitrogen fixing microbes have even developed a symbiotic relationship with certain plants, like peas and beans.

#### **TOM**

So nitrogen enters the food chain as a result of microbes taking it from the air and converting it into more accessible compounds such as ammonia, which plants can then take up.

#### **CHARLES**

These nitrogen-fixing bacteria often live in the roots of legumes like bean plants. And the bean plants are very clever - they send out hairs from their roots to trap these bacteria in and the bacteria essentially take up residence in the roots of these plants.

#### **TOM**

These bacteria are incorporated into root nodules and in these special protective houses bacteria work anaerobically to fix nitrogen into ammonia using a special enzyme called nitrogenase which combines hydrogen and nitrogen.

#### **COMM**

In 1909, the German Fritz Haber discovered how to 'fix' nitrogen chemically to create ammonia, leading to the production of inorganic fertilizers on an industrial scale. One third of the world's population is now sustained by crops grown using artificial fertilizers – but inorganic fertilizers can be bad for the environment.

#### **CHARLES**

Plants that contain nitrogen fixing bacteria can often grow in much poorer soils than other plants, so they're extremely useful for farmers. The farmers can grow nitrogen fixing plants, the bacteria will fix the nitrogen and then they can come along with a plough, churn those plants into the soil and thereby enrich the soil with nitrogen. This is one way in which nitrogen fixing bacteria are so essential for our agriculture.

**COMM**

Crop rotation uses the symbiotic relationship between plants and microbes to fertilize the soil naturally. It's been practiced since ancient people began to farm. Historic rotation methods are mentioned in Roman literature, and referred to by several civilizations in Asia. Today this ancient technique has become the cornerstone of modern organic farming.

**CHARLES**

So what do these nitrogen fixing bacteria teach us? They teach us that human beings not only require microbes, they're not only useful for us – we actually depend upon them for our survival.