# CommNet
## Nanotechnology

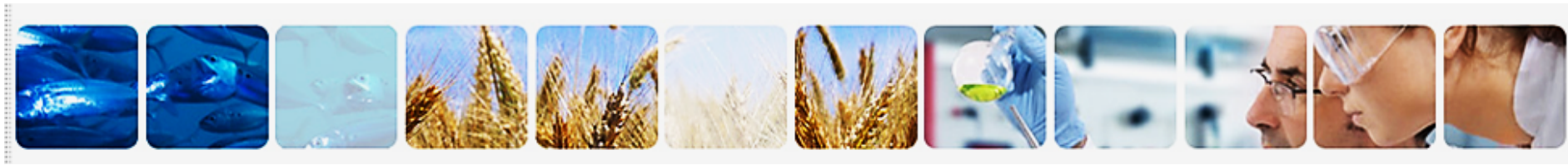**Objectives:**

To define nanotechnology.

To understand the basic scientific principles of nanotechnology.
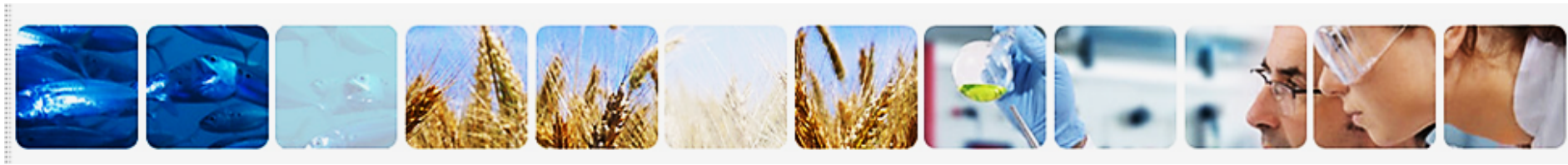
# What is nanotechnology?

Nanotechnology is the ability to create and manipulate atoms and molecules on the smallest of scales. 'Nano' comes from the Greek word for dwarf.

A **nanometer (nm)** is one-billionth of a metre, smaller than the wavelength of visible light and a hundred-thousandth the width of a human hair.

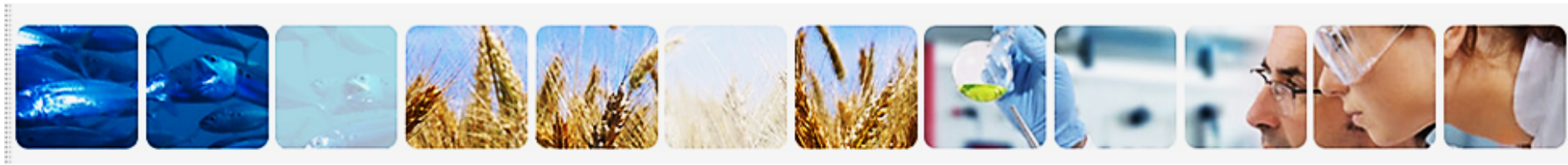Nanotechnology deals with anything measuring between 1 and 100 nm.

There are a number of products available that are already benefiting from nanotechnology.

Using sunscreen as an example, many of them contain nanoparticles of zinc oxide or titanium oxide. Older sunscreen formulas use larger particles, which is what gives most sunscreens their whitish color.

Smaller particles are less visible, so when the sunscreen is rubbed into the skin, it doesn't leave a whitish tinge.
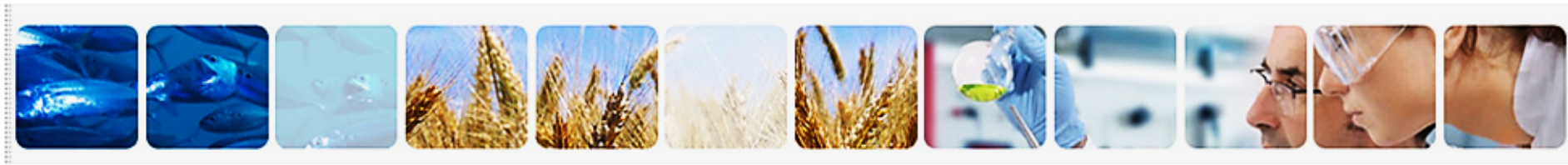
Others include:

- mobile phone touch screens;
- cosmetics;
- tennis rackets;
- bicycles;
- fabric;
- computer technology.

Nanotechnology offers a wide range of opportunities for the development of innovative products and applications for food packaging.

Nanotechnology and nanomaterials are a natural part of food processing and conventional foods, because the characteristic properties of many foods rely on nanometer sized components (such as nanoemulsions and foams).
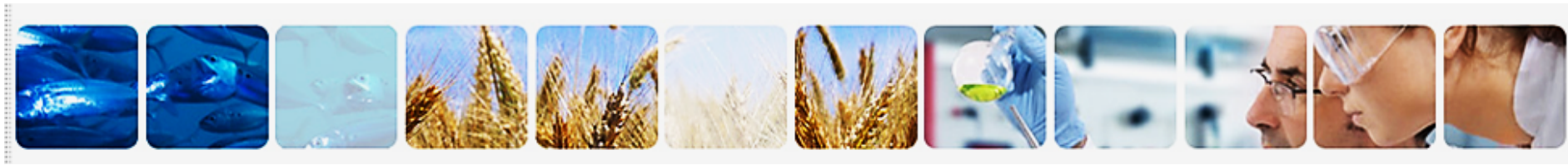
## 'Nano' foods now

All foods contain nanoparticles.
Examples of foods that contain
nanoparticles include milk and meat.

Milk contains caseins, a form of milk
protein present at the nanoscale.
Meat is made up of protein filaments that
are much less than 100nm thin.

The organisation and change to the
structures of these affects the texture
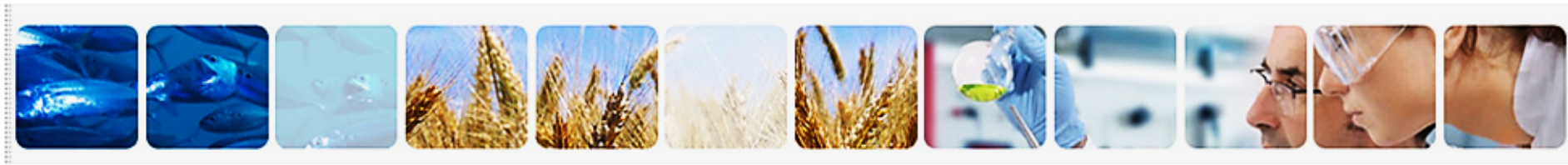and properties of the milk or meat.

**Uses for nanotechnology in food**

Nanotechnologies are being developed all the time.
Here are some examples that are being used:

- nanocarrier systems for delivery of nutrients and supplements;

- organic nano-sized additives for food, supplements and animal feed;

- food packaging applications e.g. plastic polymers containing or coated with nanomaterials for improved mechanical or functional properties;

- nanocoatings on food contact surfaces for barrier or antimicrobial properties;

- nano-sized agrochemicals (a chemical used in agriculture, such as a pesticide or a fertilizer.);
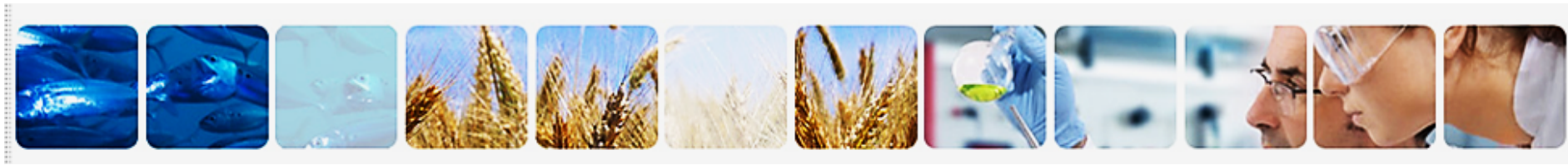
- nanosensors for food labelling.

**Food examples**

Nanoparticles are being used to deliver vitamins or other nutrients in food and drinks without affecting the taste or appearance. These nanoparticles encapsulate the nutrients and carry them through the stomach into the bloodstream.

Nanoparticle emulsions are being used in ice cream and various spreads to improve the texture and uniformity.
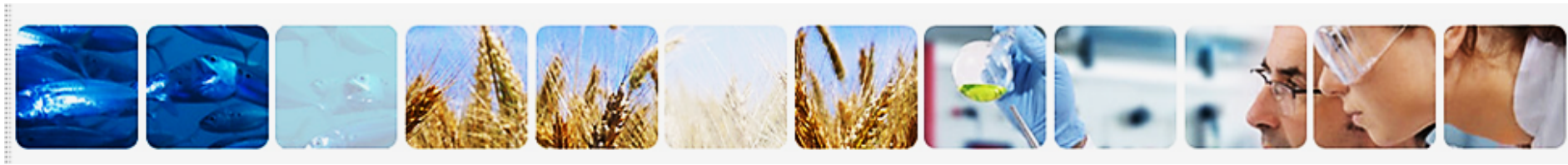
**Food examples**

New developments in nanoscience and nanotechnology will allow more control and have the potential of increased benefits. These include:

- healthier foods (e.g. lower fat, lower salt) with desirable sensory properties;
- ingredients with improved properties;
- potential for removal of certain additives without loss of stability;
- smart-aids for processing foods to remove allergens such as peanut protein.
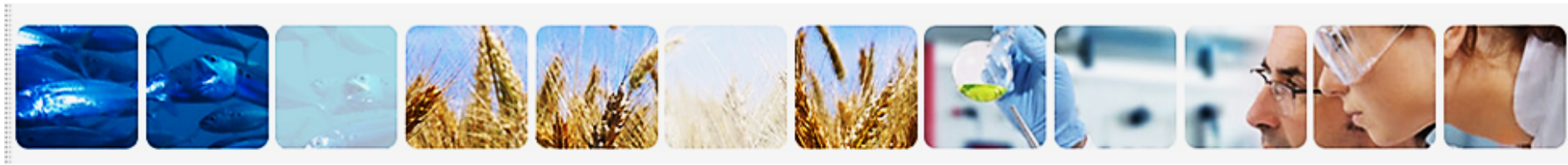
**Packaging examples**

Researches have produced smart packages that can tell
consumers about the freshness of milk or meat.
When oxidation occurs in the package, nanoparticles
indicates the colour change and the consumer can see if
the product is fresh or not.


Incorporation of nanoparticles in packaging can increase
the barrier to oxygen and slow down degradation of
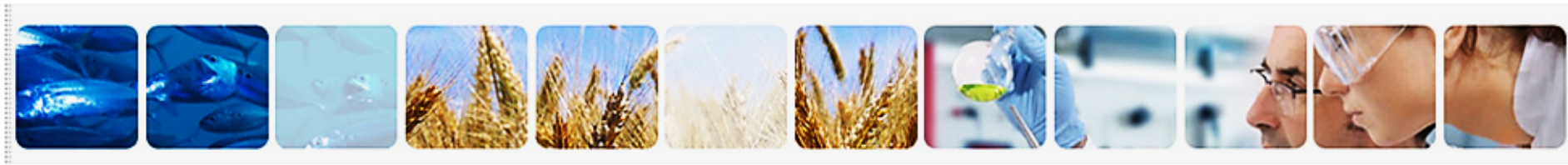food
during storage.

**Packaging examples**

Bottles made with nanocomposites minimise the leakage of carbon dioxide out of the bottle.

This increases the shelf life of fizzy drinks without having to use heavier glass bottles or more expensive cans.

Food storage bins have silver nanoparticles embedded in the plastic. The silver nanoparticles kill bacteria from any food previously stored in the bins, minimising harmful bacteria.

# Nano in nature

Gecko feet are covered with nano-size hairs that use intermolecular forces, allowing the lizards to stick firmly to surfaces.

By replicating this scientists have developed an adhesive that can seal wounds or patch a hole caused by a stomach ulcer. The adhesive is elastic, waterproof and made of material that breaks down as the injury heals.

SEVENTH FRAMEWORK PROGRAMME

The contribution of nanoscience research in agriculture and food will be in the following areas:

- food safety and biosecurity;
- material science;
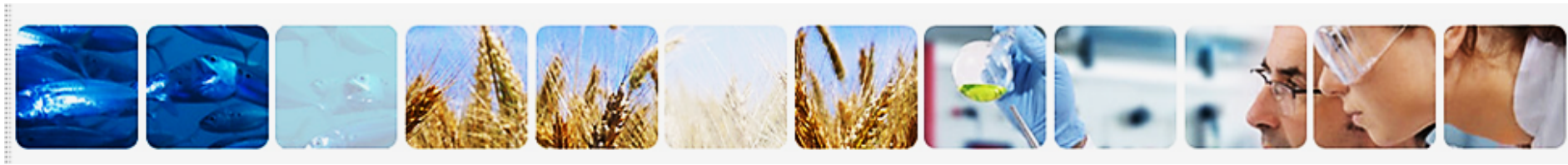- food processing and product development.

# Applications of nanotechnology

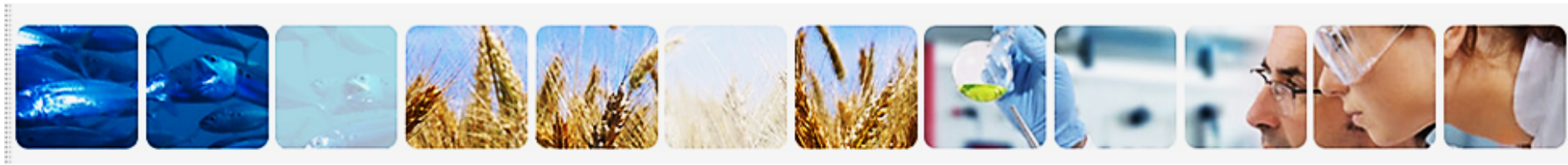| Agriculture | Processing | Products | Nutrition |
|---|---|---|---|
| New pesticides | Microencapsulation of flavours/aromas | UV protection | Neutraceuticals |
| Genetic engineering | Gelation agents | Antimicrobials | Nutrient delivery |
| Identity preservation | Nano emulsions | Condition and abuse monitors | Mineral/vitamin fortification |
| Sensors to measure soil conditions | Anti-caking | High barrier plastics | Drinking water purification |
| | Sanitation of equipment | Security/anti counterfeiting | Sensory characteristics of supplements |
| | | Contaminant sensors | |

**The future of nanotechnology**

Research is being carried out to develop nanocapsules containing nutrients that would be released when nanosensors detect a deficiency in your body.

Nanomaterials are being developed to improve the taste, colour, and texture of foods. For example "interactive" foods are being developed that would allow you to choose which flavour and colour a food has!
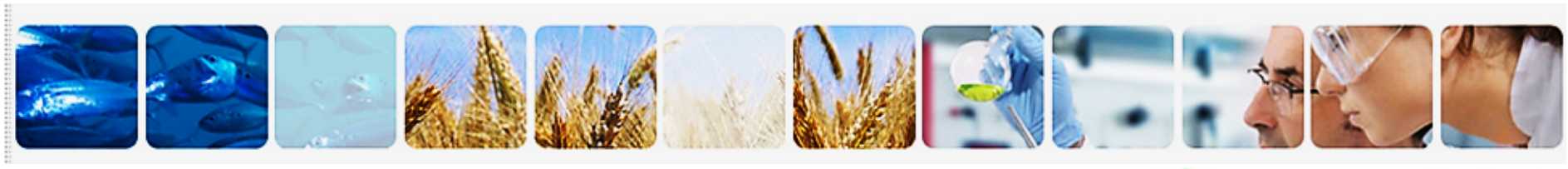
**Conclusion**

Modern biotechnologies involve making useful products from whole organisms or parts of organisms, such as molecules, cells, tissues and organs.

Recent developments in biotechnology include genetically modified plants and animals, cell therapies and nanotechnology.

These products are not in everyday use but may be of benefit to us in the future.

# CommNet

Education
Phase 4
Nanotechnology