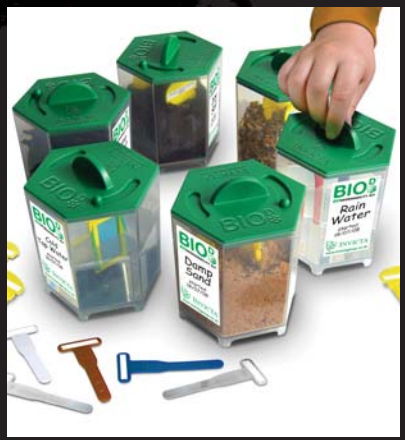
INVICTA EDUCATION

NEW FROM INVICTA'S BIOD™ ENVIRONMENTAL PRODUCT RANGE

BIODEGRADABILITY KIT

The Kit includes samples of BIODEGRADABLE PLASTICS for you to test!



The BioDegradability Kit is a new, unique and innovative environmental science kit for teachers and pupils to conduct experiments and to demonstrate materials biodegrading in media and liquids of their choice.

CONTENTS & INSTRUCTIONS

Set of six empty testing containers with stickers applied

Clip and Cage Frame devices standing in base locators

Set of supplied metal, plastics and card T sections to test

Rapid Biodegradable Plastics Film samples supplied in Kit

Clip Frame devices with stickers attached and loaded with items for testing (not included)

Open and Closed Cage Frame devices with apple samples for testing (not included)

THE BIODEGRADABILITY KIT

The BioDegradability Kit has been designed to support the Teaching of many stages and levels of Science and Geography within the U.K. National Curriculum framework and equally addresses particular requirements of the education systems in most countries of the world to encourage discussion on Sustainability and Environmental issues.

Pupils should be encouraged to bring their own materials to conduct experiments aimed to show how long various everyday materials take to biodegrade (if at all!) The amount of time taken depends on the material it is made from. Anything which is organic will biodegrade, but some 'new' packaging materials, including some plastics, will also do this. Non-organic materials such as 'traditional' plastics, glass and metal take much longer.

CONTENTS

6 x Transparent hexagonal containers with vented lids and base locator stands.

6 x CLIP FRAMES. Suitable for holding flat items such as pieces of newspaper, leaves, paper, foil, and plastic bag etc.

6 x OPEN CAGE FRAMES (cage with bars). Suitable for holding solid materials. Unclip the frame device and open the cage before placing a small piece of material e.g. bread, cotton wool, chewing gum, egg shell, apple etc. inside cage and clipping the frame back together.

6 x CLOSED CAGE FRAMES (cage without bars). Suitable for holding small items that can't be held in either of the other two frame devices. The closed cage frame devices are loaded as above. The closed cages can also be used for "control" experiments, in which samples of the same material are put into a closed and an open cage/clip then tested under the same conditions, to show any degrading differences between something that comes into contact with the testing material and something that doesn't.

6 x BLUE BIODEGRADABLE PLASTICS T SECTIONS Cold Water Soluble.

6 x BROWN BIODEGRADABLE PLASTICS T SECTIONS Hot Tap Water Soluble.

Samples of BLUE RAPID BIODEGRADABLE PLASTICS FILM. Cold Water Soluble.

Biodegradable plastics are able to decompose in the environment because of the action of natural micro-organisms that affect their molecular structures changing them into more inert materials less harmful to the environment. They can be Bioplastics, which are made from components derived from renewable raw materials e.g. potato or corn starch, or petroleum based plastics, both of which when combined with heat and moisture, change allowing the plastics to break down naturally. Degrading petroleum based plastics can increase the release of greenhouse gasses, but natural Bioplastics are carbon neutral so don't have the same effect.

6 x CARDBOARD T Sections (coloured white). A paper-pulp based board composed of two or more plies to provide thickness and strength.

6 x COPPER T Sections (coloured gold and marked with chemical element symbol Cu). Reacts slowly with Oxygen at room temperature to form a layer of brown/black copper oxide.

When oxidation takes place in a damp atmosphere a green layer of copper carbonate (called verdigris or patina) is formed.

6 x TIN T Sections (coloured silver and marked with chemical element symbol Sn). A silvery, malleable metal found in many alloys and used to coat other metals to prevent corrosion, but it can be attacked by strong acids, alkalis and acid salts e.g.; Baking Powder (Sodium Bicarbonate) and Vinegar (Acetic Acid).

6 x ALUMINIUM T Sections (coloured silver and marked with chemical element symbol Al). It is not water soluble under normal conditions but is corrosion resistant due to a thin surface layer of aluminum oxide that forms when the metal is exposed to air, effectively preventing further oxidation.

Also included are rapid degrading blue plastics film samples and sheets of self adhesive peelable stickers.

INSTRUCTIONS

The BioDegradability Kit should be used only under adult supervision.

Complete and apply the self adhesive stickers to each container. Information should include the chosen testing material and possibly the experiment starting date.

Select the material to be tested from samples obtained by the teacher and/or class e.g. fruit or vegetable, bread, sugar, tree bark, leaves, newspaper, carrier bag, crisp packet, etc.

Place the testing material in the most suitable holder i.e. clip, open or closed cage frames. Clip/cage frames may be either suspended from the grooves in the lid locators or slotted into the grooves of the base locators, but the T Sections should either be held in the lid locators (for testing in liquids) or carefully "planted" in solid testing media.

Ensure that all self adhesive labels have been completed (e.g. students name, start date of experiment and actual item being tested) and applied to the clip or cage frames or T sections, so that your results can be recorded.

Select and obtain the testing media e.g. soil, sand, hot and cold water, sea water, compost, manure etc., and after any clips have been placed in the base locator, fill container at least half full with it, but do not allow any of the testing media to come in to contact with the self adhesive labels as writing on them may become unreadable, which would make recording results extremely difficult.

Consider what natural conditions would occur in the environment. In some cases, try to replicate those conditions to see the effects of degrading in the environment.

The location of the experiment will affect the degradation process of materials e.g. direct heat, sunlight. Ensure that the kit is not subjected to extremes of heat e.g. boiling water. For hot water experiments keep replenishing the hot water so that the temperature is kept as constant as possible.

Replace the lid on the container and begin your test. The vented lid should be kept closed to retain moisture where appropriate, or open to allow condensation or gases to escape.

Regularly observe and record what happens to each item. See guide chart for approximate decomposition rates.

After completing experiments great care should be taken in removing the testing material as partial or complete degradation may have taken place. Testing for any residue can take place at this time (any colour left behind after the T sections have degraded is only non toxic pigment).

Note: After completing experiments, remove all stickers then wash the containers, lids, frames, clips, cages and locators in warm soapy water and dry thoroughly prior to storage or re-use.

SAFETY/STORAGE/ENVIRONMENT INFORMATION

Do not select or use poisonous materials for testing materials or media.

Do not drink or consume any testing materials or media.

In order to protect the environment dispose of all testing materials and media in a designated collection facility in your school or area.

Store the BioDegradability Kit in the box provided in a moisture free environment together with the silica sachets.

Lid vents should be left open when stored.

All selected testing media should be approved for use by a teacher prior to any experiments taking place to avoid danger of any chemical reactions.

Examples of suggested experiments are shown here.
NOTE: Testing media are not included with the Kit.

COMMON TERMS & DESCRIPTIONS

BIODEGRADATION is the enzymatic degradation of an organic material by micro-organisms. Complete biodegradation leads to the end products of carbon dioxide, water and biomass. Not all biodegradable materials are compostable. Not all biodegradable materials are biobased – they can be petrochemical based.

COMPOSTING is the process that creates compost, a dark brown, soil-like material produced by the decomposition or breakdown of organic material through biodegradation. Anything that once lived will compost, including fruit and vegetable scraps. Some things, like grass cuttings and soft young weeds, rot quickly. Older and tougher plant material is slower to rot. Some new types of packaging material will also compost.

DEGRADABLE materials are not biodegradable or compostable. Materials degrade as result of physical and chemical impact (fracture into smaller pieces). Biological activity is not a significant part of the breakdown of these products.

RENEWABLE items are made from resources which can be renewed within 1-2 years, e.g. plant products. Note the difference from petrochemical products where renewal is millions of years.

SUSTAINABLE items can be reused or recycled indefinitely at end of designed use.

PLASTICS BIODEGRADABLE POLYMERS can be processed by extrusion, film blowing, sheet casting, injection moulding and blow moulding.

WATER SOLUBLE POLYMERS are biodegradable, soluble at pre-determined temperatures, have strength greater than polythene, are non-toxic, static dissipating (for electronics), high gas barrier (for food packaging), chemical and oil resistant, visual appeal (colours, clarity and gloss), printable and sealable. Examples are; soluble bottle caps and labels, protective films and wraps, hazardous or dust/powder packaging, single use pre-measured sachets, anti–infection processes (laundry bags, biohazards, pathology items), lost core moulding, recycling collections (e.g. paper and glass)

NON-SOLUBLE COMPOSTABLE POLYMERS can be processed by conventional melt and conversion methods. Examples are; film and sheet material used for food packaging, horticultural products (e.g. seed trays and plant pots), consumable and industrial packaging, organic waste bags, agricultural wraps and bags and disposable personal items.

Other NON SOLUBLE COMPOSTABLE PLASTICS; products include food trays, cartons and bottles, food service products and limited life components, medical products, recreational items (golf tees and agricultural piping).

Stand the items to be tested in a container then carefully add your chosen testing medium ....

.... put the lid on, then keep checking ....

.... to see if there are any signs ....

.... of Biodegrading taking place.

Or attach suitable T sections and Frame devices to the lid locators ....

.... put the lid on, placing them into your chosen testing liquid ....

.... so the effects of any Biodegrading will be easy to see and record.

Try testing the Rapid Biodegrading Plastics Film samples in cold water for rapid results!

APPROXIMATE DEGRADING TIME FOR SOME MATERIALS

TESTING MEDIA ⇩	Water soluble film samples from Kit	Banana skin	Leaves	Card or paper	Biodegradable plastics products	Stick	Wool	Tin	Standard plastic carrier bag	Glass
Water	Seconds	1 - 2 weeks	4 - 6 weeks	1 week	6 months	4 - 6 months	6 - 12 months	5 years	400 years	Indefinite
Soil	NA	1 week	4 weeks	2 - 4 week	4 - 6 months	2 - 4 months	1 year	200 years	400 years	Indefinite
Dry Sand	NA	2 - 3 weeks	10 - 12 weeks	2 years	2 - 4 years	4 years	5 years	500 years	400 years	Indefinite

TEACHERS **PROJECT NOTES**

UK NATIONAL CURRICULUM **KEY STAGES 1-4**

BACKGROUND INFORMATION

Plastics are used in many everyday applications and can easily be made into many forms (e.g. bags, bottles, containers, cups, packaging). These articles can be manufactured by using a variety of different processes depending on the item being produced. These processes include extrusion, moulding & casting.

The disadvantages with 'conventional plastics' are that they:
a) Degrade slowly – if at all
b) Are often difficult to recycle with a lack of recycling operations or infrastructure
c) Incorporate toxic additives
d) Are petrochemical based and give greenhouse gas emissions on incineration
e) Go into landfill disposal

There is an increasing legislative, regulatory and environmental awareness about plastics disposal. Biodegradable plastics are now available as an alternative to conventional plastics. These materials are environmentally advantageous, biodegradable and compostable. They can be disposed of without adverse environmental effects.

SUGGESTED EXERCISES

- Demonstrate the degradability of the water soluble T sections and film samples and discuss specific uses for hot or cold water degrading polymers.
- Ask students to prepare for biodegradable studies by sourcing appropriate materials.
- Working in groups, ask students to prepare a selection of their own biodegradable experiments that can be monitored over days or weeks, also monitoring non-degrading tests.
- Ask students to try and predict what will happen, work out the best strategy for checking progress, and show progress and any results in a clear chart.
- Set up the experiments as described in the instructions.
- At the end of one week (or suitable time span) observe the containers & check the materials for any changes e.g. colour, texture etc. Record all observations.
- Continue observing the materials on a regular basis noting the differences between the same material in a variety of media or with various levels of moisture content.
- Additional experiments could include placing the material in a container in a sunny spot and/or in a dark cupboard.
- Other extensions of the experiments could include determining if temperature affects the biodegradinging process? Although biodegrading can occur at a wide range of temperatures, are the micro-organisms more active in warm temperatures?
- Does size affect the process? Smaller pieces of material will allow the composting organisms to have easier access and so speeds up the process.
- Investigate what is left behind after Biodegrading has occurred. Ask students to research and compare the environmental effects of biodegradable and non-degradable plastics.
- Consider the differences (if any) of degrading a biodegradable material in organic media and non-organic or sterile media.
- Discuss the potential advantages of biodegradable polymer plastics over non-degradable plastics and the effects each will have on the environment (pollution and landfill etc). Consider the biodegrading process.
- Consider industrial/financial issues raised by using biodegradable polymers in the manufacturing process.
- What is the difference between Biodegradable products and Recyclable products?
- "Renewable can also be considered sustainable but sustainable is not necessarily renewable." Discuss.

USEFUL WEBSITES

www.biopolymer.net
www.compostnetwork.info
www.defra.gov.uk/ENVIRONMENT/WASTE/topics/plastics.htm
www.eea.europa.eu/themes
www.european-bioplastics.org
www.foe.org.uk/campaigns/waste/links.html
www.unep.org/themes/consumption/index.asp

KEY STAGE 1 - SCIENCE

SC1 - SCIENTIFIC ENQUIRY
1 Collect evidence by making observations.
2b Use first-hand experience.
2e Follow simple instructions.
2g Communicate what happened.
2j Review their work and explain what they did to others.
SC2 - LIFE PROCESSES AND LIVING THINGS
5c Care for the environment.
SC3 - MATERIALS AND THEIR PROPERTIES
1d Find out about the uses and properties of materials.
BREADTH OF STUDY
2a Use simple scientific language to name and describe materials and processes.
2b Recognise that there are hazards in materials and physical processes.

KEY STAGE 1 - GEOGRAPHY

1c Express their own views about environments.
3a Describe what places are like.
3c Recognise how places have become the way they are.
5a Recognise changes in the environment.
5b Recognise how the environment may be improved and sustained.

KEY STAGE 2 - SCIENCE

SC1 - SCIENTIFIC ENQUIRY
1b Test ideas using evidence from observation and measurement.
2a Ask questions that can be investigated scientifically and decide how to find answers.
2c Think about what might happen or try things out when deciding what to do, what kind of evidence to collect, and what equipment and materials to use.
2d Make a fair test or comparison by changing one factor and observing or measuring the effect while keeping the other factors the same.
2e Use simple equipment and materials appropriately and take actions to control risks.
2f Make systematic observations and measurements, including the use of ICT for data logging.
2g Check observations and measurements by repeating them where appropriate.
2h Use a wide range of methods, including diagrams, drawings, tables, bar charts, line graphs and ICT, to communicate data in an appropriate and systematic manner.
2j Make comparisons and identify simple patterns or associations in their own observations and measurements or other data.
2k Decide whether these conclusions agree with any prediction made and/or whether they enable further predictions to be made.
2l Use their scientific knowledge and understanding to explain observations, measurements or other data or conclusions.
SC2 - LIFE PROCESSES AND LIVING THINGS
5f That micro-organisms are living organisms that are often too small to be seen, and that they may be beneficial.

KEY STAGE 2 - GEOGRAPHY

5a Recognise how people can improve the environment or damage it.
5b Recognise how and why people may seek to manage environments sustainably, and to identify opportunities for their own involvement.

KEY STAGE 3 - SCIENCE & MATHEMATICS

Students will be involved in testing a range of materials. This will involve identifying suitable materials & investigating the composting process. Within this, students can think about a number of issues including; what can be composted, decomposition rates, measurement and recording of rates of decomposition, and micro-organisms and their benefits. They will therefore cover aspects of;
SC1 - SCIENTIFIC ENQUIRY
SC2 - LIFE PROCESSES AND LIVING THINGS
SC3 - MATERIALS AND THEIR PROPERTIES
SC4 - PHYSICAL PROCESSES
MA2 - NUMBER AND ALGEBRA
MA3 - SHAPE, SPACE AND MEASURES
MA4 - HANDLING DATA

KEY STAGE 3 - GEOGRAPHY

5a Describe and explain environmental change and recognise different ways of managing it.
5b Explore the idea of sustainable development and recognise its implications for people, places and environments and for their own lives.

KEY STAGE 3 - CITIZENSHIP

Use the kit to bring People and the Environment alive. Unit 21 (QCA scheme of work) suggests that children should learn about the impact of local action on the wider environment, the concept of sustainability and a topical local environmental issue.

KEY STAGE 4

The kit directly supports the teaching of numerous subjects including both Science and Applied Science CGSE courses as well as entry level courses such as Science Plus.

SAFETY STANDARDS ..... All products conform to British and European Standards (EN71) and where appropriate carry the CE mark.

3 YEAR GUARANTEE ..... All products are guaranteed against manufacturing defects for a full 3 years. Details are available on request.

RECYCLABLE ..... Invicta will accept all products returned at the end of their working life for recycling.

INVICTA EDUCATION *STATEMENT* ..... All our plastics products are free of heavy metals including lead, cadmium and chromium.

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