Marine pollution

Sustainability Goals:

Subject links:
Science, Geography, Design Technology

Age: 14-16

Curriculum links:
Human impact, Sustainability, Environment, Materials & Properties, Fieldwork, Investigation, Data Analysis, Topical Science, Responsible Citizenship

Ocean Literacy Principles:
6. The ocean and humans are inextricably interconnected

Aim:
To understand the impact of our current linear economy and recognise the need for increased social responsibility to reduce waste, in order to create a healthy environment and a sustainable economy.

Learning Objectives:
- Be able to explain how litter negatively impacts the marine environment, economy and society, and understand the social responsibility we have to reduce this impact.
- Understand how your school is connected to the local community and the wider geography of the UK by studying litter in the environment.
- Design in a schools-based project to reduce waste.
- Design a sustainable circular economy product.

Resources provided:
- Marine pollution PowerPoint
- Marine Litter Fact File
- Litter survey pack
- 10 year data set
- Full curriculum links

Step 1 Background

Litter reaches the ocean in a number of ways: it's washed in from our rivers, is left on our beaches, or is cast overboard from boats. It not only makes the marine environment look unpleasant, but it impacts the health of thousands of marine animals every year, usually by ingestion, entanglement or suffocation. Chemicals used in, and absorbed by, plastics also negatively impact animals' health.

Plastic is the most commonly found beach litter material and it doesn't biodegrade, but breaks down into smaller and smaller pieces, which can be mistaken for plankton or other food sources. Single-use plastic items are a particular problem. They are used once and thrown away, but last forever in our environment. We can all 'do our bit' to reduce our impact on the environment by reducing the number of single use items we buy, particularly plastic.

Step 2 Set the Scene

Use the Marine pollution PowerPoint to introduce the topic and discuss the question, 'what is litter?' Some points for a class discussion could include: what's the difference between litter and waste? What types of products are commonly seen as litter? What are the properties of these products? Where have you seen litter in your local area? Why do people litter?

Split the class into small groups and assign a topic (economic, environmental or social) to each group and ask them to brainstorm ideas for how litter affects this area. After 5 minutes, have a class discussion with groups sharing their thoughts.

Resources required: Marine pollution PowerPoint

Step 3 Activities

Activity 1 – Why is marine litter a problem?

Now turn the focus to marine litter. Start by asking students why they think marine litter is such a topical and important issue, and why marine litter is so problematic. Use the photo slides in the PowerPoint to add information into a group discussion.

Resources required: Marine pollution PowerPoint

Step 3 Activities

Activity 2 – How is your school connected to marine litter?

Activity 3 is split into three mini activities investigating how your school is connected to the ocean and to marine litter.

1. From source to sea

Find out how your local area is connected to the ocean by following your local river on its journey to the ocean. Imagine a litter item travelling along the river to the ocean while you do this. All instructions included in the Marine pollution PowerPoint.

Resources required: Marine pollution PowerPoint, Google Earth

2. Waste audit

Conduct a waste audit at your school to analyse the quantity and variety of waste thrown away. Encourage students to think about what they'd like to find out from completing the survey. For example, how much waste should be recycled? How much waste is single-use plastic? Is there a particular area of the school that's generating more waste? Students should design their own surveys or use Recycle Now's secondary school survey template as inspiration.

After conducting the waste audit, students should analyse and present the data and see whether their questions have been answered by the survey. They should review their methods and make suggestions for future waste audits. Students could use their results to generate a school-wide campaign to reduce the amount and/or type of waste being produced. Tips for running a waste audit are included in the PowerPoint.

Resources required: Marine pollution PowerPoint, Recyle Now Waste Audit

3. Litter survey

To help students realise the environmental responsibility they have as citizens of their local community, conduct a local litter pick. The litter pick will help students see first-hand the amount of litter in the environment and provide them with a great fieldwork experience.

If you're close to a beach, you can use our more in-depth beach clean survey. If you can't access a beach, use our national Source to Sea survey form in your local park, street or school grounds. All the information you need regarding health and safety advice and litter survey forms is provided in the litter survey pack. After the survey, student should analyse and present their data to find out what the most common type of litter is in your local area. As a follow-up activity, students could design a creative community campaign - see the extension activity for more details on this activity.

Resources required: Marine pollution PowerPoint, Litter survey pack

Step 3 Activities

Activity 3 – How can we reduce litter?

Watch the Lifecycle of a plastic bottle video in the PowerPoint to summarise learning so far and introduce one way we can help to reduce the amount of waste we produce. After watching the video, pose the question, 'is recycling the best option?' and have a class discussion. Use the PowerPoint to introduce the issue with the focus on recycling alone, before introducing the circular economy concept.

In small groups, students should study a broken or unwanted product and consider what the product is used for, the length of time it's used for, and all the components the product is made out of. Students should then consider how they could recreate this product using sustainable circular materials. Full activity details can be found in the Circular Classroom Module 3 pack.

Resources required: Marine pollution PowerPoint, Circular Classroom Module 3 pack

Extension activity ideas

Data analysis

We've collated 10 years' worth of Great British Beach Clean data from areas around the UK, organised this data and standardised the results to provide an average figure per 100 metres of beach. This should make the data a bit easier to interpret and manipulate, but you could also tailor this further depending on your current curriculum focus and the age of your group. To provide contextual information on our survey methodology, we've included an annotated dataset.

Students could use the data to explore patterns in particular litter items over time, identify patterns in sources or look at the frequency of different materials. Pivot tables are useful to compare various elements of data and are a key tool we use in our analysis. After analysing the data, students could work in groups to identify a particular issue with an item, source or material, and develop an action plan to reduce the issue.

Please note that by downloading our data you are agreeing to our terms and conditions, namely that you will only use any data as part of Source to Sea and for no other purposes. Full T&Cs can be found here.

Resources required: Data for England, Data for Northern Ireland, Data for Scotland, Data for Wales, Data for whole of the UK

Step 4 Reflect

How does litter negatively impact the marine environment, economy and society? Why do we have a social responsibility to reduce this impact? How is your school connected to the ocean? What does 'circular economy' mean? How could we as individuals, a school or community reduce litter in the environment?

Step 5 Follow up

Further activity suggestions linked to Great British Beach Clean and Source to Sea litter surveys can be found in our GBBC teachers' pack.

To learn about other issues impacting our ocean and how we can work to reduce them, download our new lesson, Threats to the ocean.

Marine Litter Fact File

From source to sea

It is estimated that 11 million tonnes of plastic ends up in the sea worldwide each year (1), and that 80% of litter found in the sea is from inland sources. (2)

Sources on land can include intentional and accidental littering, items flushed down toilets, sinks and drains, windblown litter from bins and landfills, and litter carried by rainwater into drains, rivers and eventually the sea. Litter is also a problem at sea, with sources like fishing, sailing, speed boats, commercial ships and container spills causing litter pollution.

Litter timeline

Litter in the ocean takes longer to degrade than litter on land, but will eventually start to break up due to wave action, currents, saltwater and sunlight. Degradation time varies greatly from 1–450 years depending on the properties of the litter.

Microplastics are a serious environmental issue. They are plastics that have broken up into pieces less than 5mm, as well as pieces that enter the environment this size like microfibres or plastic nurdles, which are the small plastic pellets used in the production of plastic products.

1. Pew 2020
2. Europa 2016

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Marine Litter Fact File

Marine life and litter

Litter items can cause harm to all sorts of marine life, from tiny plankton to whales.

Animals can become entangled in litter, causing injury, reduced mobility and even death. Ingestion of litter, particularly plastic, is very problematic for marine life who are unable to digest it. Large amounts of plastic ingestion can lead to starvation, as there is no room left for food. One study found 100% of turtles to have plastic in their stomach. (3) In some areas, the extreme amount of plastic on the sea floor can suffocate the animals and plants living there.

Invasive species
Ocean currents can move plastics around the world. Small animals and plants can hitch a ride on the surface of plastic and travel with the currents, introducing non-native species to new areas. The introduction of non-native species could cause harm to the ecosystem.

Plastic chemicals
Several chemicals used in the production of plastic materials are carcinogenic. Toxic contaminants can also accumulate on the surface of plastic materials that have broken up and been underwater for a long time. When marine animals ingest plastic accidentally, these toxic contaminants enter their digestive systems and could build up in the food web over time.

Gannet carrying fishing rope.
© JHS Archer-Thomson

Microplastic pieces amongst seaweed. © Natasha Ewins

3. Duncan et al 2018

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Marine Litter Fact File

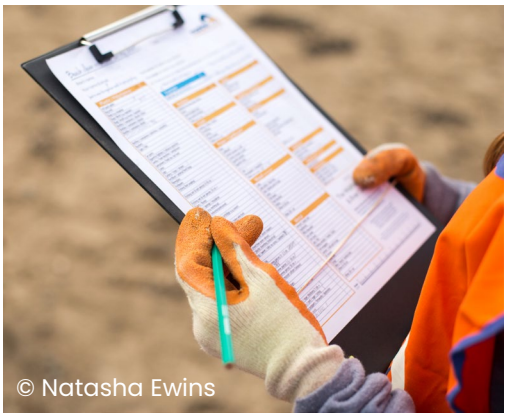
Litter surveys

Litter surveys are not only important for clearing rubbish, but also for gathering data on the types of litter polluting our environment. Beachwatch is our national beach clean and survey initiative, and has been running for over 25 years. Our brilliant volunteers head out to beaches across the UK to clean and survey our coastline, collecting and recording the rubbish they find in a 100m stretch of beach. This litter data helps inform our campaigns and lobby government, and has led to influential changes like the UK-wide carrier bag charge, microbead bans and changes to wet wipe packaging.

We also use the data to determine the sources of litter. For example, if a significant amount of sewage-related debris (SRD) is found in an area, we work with local sewage treatment companies to try to improve treatment plants, and with communities to raise awareness of what should and shouldn't be flushed down the toilet.

Reducing litter

We all need to do our bit to reduce litter in the environment. By rethinking how we shop and what we use in our daily lives, we can all make a difference. Refusing unnecessary plastic and other materials, reducing the amount of products we consume, and repairing rather than replacing are all important actions we can take. Through education, we can help raise awareness, encourage positive consumer behaviour, and campaign for change from businesses and the government.


© Natasha Ewins


© Holtography

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Marine Litter Fact File

Recycling

Even if we reduce the number of items we use, we will still need to throw some away. This is where efficient recycling is key. Download a guide from your local council to help students understand what can be recycled at home and at school. Many items can be recycled, but if your local council has limited recycling options check out Terracycle's website for local drop off points.

Plastics can only be recycled at best 2-3 times before they lose their strength, so we still need to move away from plastics to materials that can be recycled time and time again. We need to change how products are recycled, and how we incentivise best practice to ensure materials and resources are valued. This can include redesigning products or calling for economic incentives like Deposit Return Schemes (DRS), where a small deposit is paid when people buy a single-use drinks container and is refunded when they return it to a store or dedicated recycling point.

Circular Economy

We currently have an economy which is linear, which means we make, use and dispose of products using up finite resources. It's estimated that only 9% of all plastic ever made has been recycled, (4) so we know that recycling alone isn't the solution. Instead we need to move towards a circular economy, where products are designed to be used time and again, repairable, or re-designed into new products. The whole life cycle of the product has been considered so very little ends up in landfill.

Litter collected at a beach clean.
© Natasha Ewins

Single-use plastic straws.
© Natasha Ewins

4. Geyer et al 2017

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WASTE AUDIT

Learning Objectives

- Investigate the different categories of school waste and ways of monitoring the volume.
- Record and analyse waste data.

Curriculum Links

Maths, Science, Citizenship

Sustainable Schools Doorways

Doorway 4 Purchasing and Waste

Materials:

- Bagged rubbish;
- old carrier bags (eight for each group);
- 10-20 large bin bags;
- spring balances or Newton meters;
- ground sheet/floor covers;
- clipboards with copies of the recording sheet;
- rubber gloves (one pair for each adult and child);
- overalls, or old clothing.

A. Preparation

1. Identify an 'average' school day on which you will audit your school's waste (e.g. not during events, the end of term clear out, or when groups are out of school). Let all staff know when the audit will take place.
2. Carry out a risk assessment for the activity.
3. You may want to send a letter home to parents to inform them about the activity, ask them to provide clothing and possibly to request adult volunteers to support the activity in school.
4. Ask the site manager/caretaker to save one day's waste from the entire school, including non teaching areas such as bathrooms, staff rooms, offices and external areas, e.g. the playground.
5. Ask the site manager/caretaker to look through the bags to remove sharp objects and label each bag with the area of the school it came from (e.g. classroom 1, playground). Ensure that bags of food waste are clearly labelled and kept separately. Store all bags of waste safely overnight.

B. The audit

1. Explain health and safety issues to the students, for example, gloves must be worn before touching any waste, students should call an adult if they see any sharp objects in the rubbish etc.
2. Weigh all bags containing food waste (e.g. from the canteen) with the whole class, log the results in grams on the recording sheet and dispose of the waste in the usual manner.
3. Divide a class into three to four groups. Each group should have a ground sheet to work around, a recording sheet and pencil, and a set of spring balances or Newton meters. Each child should wear protective rubber gloves.
4. Each group should empty the contents of one bag of rubbish at a time onto the plastic mat and sort it into the different types of waste shown on the recording sheet.
5. Groups should have a separate carrier bag for each waste type. They will sort the waste into these bags and weigh them using an appropriate spring balance or Newton meter. Log the results on the recording sheet.
6. Once the contents of the carrier bags in each group have been weighed and recorded, empty them into larger bin bags and re-use the carrier bag.
7. When all bags have been sorted and the data has been recorded, dispose of the waste and recyclables in the usual manner.

C. The follow up

1. The next time the group meets, calculate the daily, weekly and annual waste totals for the whole school. Multiply daily totals by five for the weekly results, and the weekly totals by 38 weeks (the average number of weeks per year spent at school). Work out the percentage of different types of waste produced.
2. Compare waste data from different areas around your school and identify waste 'hot-spots'.
3. Discuss your findings. What are the most common types of waste? Is any of it recyclable? Which type of waste would make the biggest difference if recycled?
4. Use the information from your waste audit to plan or improve your recycling scheme as outlined in the 'Action plan' activity.

Ways to adapt and extend the activity

- If you don't have the necessary equipment, attach recording sheets to each bin on the evening before the audit. Get everyone to tally what they throw in the bin. This avoids the need for sorting the waste by hand and is particularly suitable for smaller schools. The tallies can be used to estimate the relative proportions of materials in each area.
- Ask the students to note down at least five action points that could reduce the school's waste. As a group, decide what the top five actions are and break them into smaller, achievable steps.
- Whilst sorting the waste, get pupils to note down the most common waste items. How could you reduce this type of waste?
- Present your findings to the rest of the school through an assembly or newsletter.
- Repeat your audit after you have set up or improved your recycling scheme. This will show if your recycling system and action plan is effective. It also identifies areas which require further work.

Top tip

Why not contact your local authority recycling department to see if there is anyone that can come and help you run this activity?

Pupil worksheet: Waste Audit

Date(s) of audit: _____

Area of school	White paper (g)	Coloured paper (g)	Card-board (g)	Plastic (g)	Metal (g)	Glass (g)	Food waste (g)	Other (g)	Total (area)
Example: Classroom 1	200g	140g	80g	40g	0g	100g	40g	600g	
Total (material)									

Material	School Total (kg) per day	School Total (kg) per week (x5 days)	School Total (kg) per year (x38 weeks)	%
White paper				
Coloured paper				
Cardboard				
Plastics				
Metal				
Glass				
Fabric				
Food waste				
Total				100%

MARINE CONSERVATION SOCIETY | **Great British Street Clean**

Stopping litter from land to sea

Total participants:

Weight of litter: kg

Number of bags:

Weirdest item found?

Where did you clean? (please circle)

Town | Countryside | Park | Street | River

Playground | Grounds of the office | Other

☐ School group?
☐ Youth group?
Age range:

First half of your postcode:

The litter you record on your local clean-up will help us identify and create a snapshot of the litter that is still plaguing our environment, including new single-use items such as PPE.

80% of the litter we find in our ocean comes from inland, help us stop ocean pollution in its tracks! Spot the litter, tick what you found, then pick it up.

Glass bottles

Tally:

Metal drink can

Tally:

Plastic drink bottles

Tally:

Loose plastic bottle caps/lids

Tally:

Plastic drink cups

Tally:

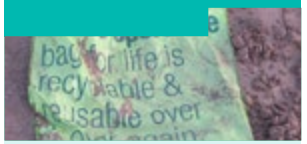
Polystyrene cups

Tally:

Paper cups

Tally:

Plastic bag for life



Tally:

Single-use plastic bag

Tally:

Polystyrene fast food container

Tally:

Single-use plastic gloves

Tally:

Single-use face mask

Tally:

Balloons

Tally:

Wet wipes

Tally:

Choose Your Litter Survey

Use our beach clean information if you're near the coast, or our street clean information if you're inland.

Beach clean

To get started, you'll need to register as a volunteer on the Beachwatch website. On the website you can find all the information and resources you'll need, including our Organiser Guide and risk assessment template. There's also some additional guidance on leading a litter pick with groups and schools. If you have any questions about leading a beach clean, please contact the team at beachwatch@mcsuk.org.

Inland clean

Head out to your local river, street, park or your school grounds. Pick up and record the litter you find using our Source to Sea Litter Quest survey form. Health and safety guidance, an example safety briefing and a risk assessment template can be found on our website.

In the classroom

If you're not able to take your school out into the local area, you could use the surveys to discuss which litter items students have seen in their local area, or items which students have in their homes that could end up as litter. You could discuss which items are 'new' types of litter (e.g. Covid-related items), how everyday products end up as litter, and which items could be recycled or that we can manage without. Older groups could debate whether single-use items should be produced at all.

Please read and follow the government, and local, rules in your area.

Before

- Choose the location for your litter pick and survey to suit the age and ability of your group, and make sure you work away from any roads.
- Equipment list:
    - Sturdy shoes
    - Gloves - ideally thick gardening-style gloves
    - Litter pickers if you have them, or metal tongs, which make good improvised pickers
    - Bin bags
    - Cover up any cuts
    - Hand sanitiser
    - Waterproofs or sunscreen – whichever is needed.
- Check and update your risk assessment on the day, and run through the safety guidelines and expectations for behaviour. The group should alert an adult if anything sharp, dangerous or nasty is found.
- Run through the survey forms before you start to ensure everyone understands how to record the data.
- If you're using our beach clean forms, ensure everyone understands the different categories and explain how this data is used.
- If using our Source to Sea forms, students should read the Source to Sea Fact File to understand why we're asking them to record these items, and follow this up with a group discussion.

During

- Head out on your litter pick, collecting and recording the items you find.
- Don't touch your face when litter picking, and use hand sanitiser often.
- Put any sharp or dangerous items in a separate bucket or container.
- Make sure you take photos and share them with us using #LitterQuest or #GreatBritshBeachClean or email education@mcsuk.org including your group name.

After

- Wash your hands with soap for 20 seconds as soon as possible.
- Clean your litter picking kit thoroughly with household disinfectant.
- Snap a photo of your Source to Sea survey card and post it on social media using the hashtag #LitterQuest.
- Upload your survey data using either the Source to Sea page or Great British Beach Clean page. Explain to the group that the data they collected will be analysed and used to help lobby governments and inform our campaigns.

Source to Sea Fact File

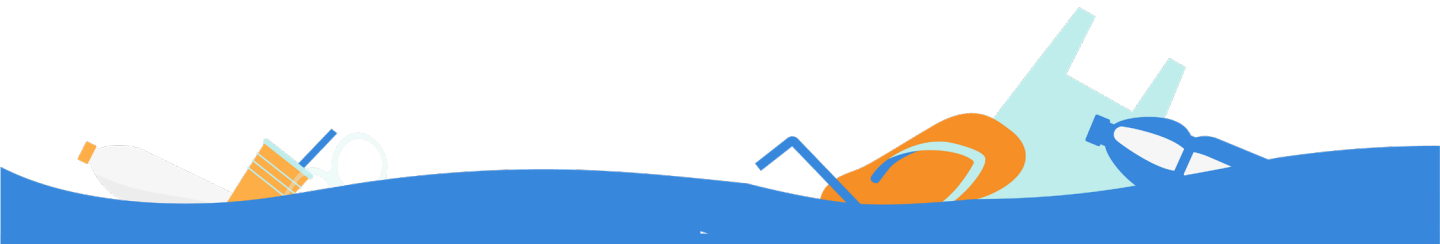
Take part in Source to Sea: Litter Quest as part of the Great British Beach Clean. This September, there's something for everyone, everywhere. No matter where you live across the UK, you can help keep our seas clean.

Why your help matters

We know that litter from towns, parks and even the remotest country lanes often make their way down to our ocean. **Every item dropped in the street has the potential to pollute our seas** by travelling down rivers and streams, being washed down drains or by being blown onto our beaches.

As part of our litter cleans we collect data to track rubbish back to its source - our survey results are then used to find solutions to ocean pollution, and to campaign for measures to bring positive change.

We've used data collected in previous years to make the case for the 5p carrier bag charges across the UK, and are campaigning for Deposit Return Schemes for all types of drinks containers.



MARINE CONSERVATION SOCIETY

Source to Sea Fact File

The Litter Quest items

This year we've chose **14 items** for you to record and report back to us – these items have been chose carefully, and by taking part in our inland cleans, you can help us, keep our seas safe and healthy – for us all to enjoy.

What we're looking for – Food & drink containers:

1. **Polystyrene fast food container** – these break up easily into small pieces. Did you know polystyrene is a type of plastic?

2. **Glass bottles** – these can easily get broken and become pieces which can hurt us and wildlife

3. **Metal drink can** – Scotland will introduce a deposit return scheme in 2022 on glass, metal and plastic (PET) bottles – but we want all the UK governments to take urgent action and bring in their own schemes

4. **Plastic drink bottles** – 9 billion drink containers are wasted each year by not being recycled

5. **Loose plastic cases/lids** – In the UK there is currently no legislation for lids to be tethered to bottles. We believe this small change could help reduce litter from lids. How many can you spot?

MARINE CONSERVATION SOCIETY

Source to Sea Fact File

6. **Plastic drink cups –** what happens to plastic cups from places like takeaways? Help us hunt down the offenders so we can see where they end up

7. **Polystyrene cups** – are made from a type of plastic and break down really easily into smaller pieces. We think these tiny pieces of plastic might be spreading far and wide – how many can you spot?

8. **Paper cups** - did you know that lots of paper cups have plastic lining them on the inside. Does that make them paper, or plastic – what do you think?

During last year's Great British Beach Clean we found an average of 30 drinks-related litter items for every 100m of beach, and all these items were also found on 99% of inland cleans.

We want to see **Deposit Return Schemes** introduced across the UK, where consumers pay a small deposit on these items when they buy them, and receive their money back when they return them. Scotland will introduce a Deposit Return Scheme in July 2022, but England, Wales and Northern Ireland have yet to create the legislation.

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Source to Sea Fact File

What we're looking for – Plastic bags:

9. **Single-use plastic bags** – we know that when shops started charging people for bags for their shopping, around half the number of bags were found on our beaches. But can you see any in the park or on a street near you?

10. **Plastic bags for life** – these bags are made from thicker plastic and are meant to be used many, many times. But we think some may have been used just once, and could find their way into the sea.

Since charges were introduced across the UK, we've seen an over 50% drop in single-use plastic carrier bags on our beaches. (1) We want to know if this drop can also be seen inland. Although there's been a charge on single-use plastic carrier bags for at least 5 years (Wales introduced it in 2011, Northern Ireland 2013, Scotland in 2014, England in 2015), 'bags for life' have been encouraged as a reusable alternative. But we suspect that these may still be used as a single-use item, and so still harming our environment.

What we're looking for – Wet wipes:

11. **Wet wipes** – often found on beaches from being flushed down the toilet, but they're also used around towns and cities.

Last year we found 18 wet wipes per 100m of beach during GBBC. By tracking them back through the sewage system and their journey from our streets and parks, we can put a stop to pollution.

1. Comparing 2015 litter data with 2020

MARINE CONSERVATION SOCIETY

Source to Sea Fact File

What we're looking for – PPE:

12. **Single-use face masks** - We didn't see many people wearing these in everyday life before the pandemic, but now it's commonplace. Have people been disposing of them in the right way? Let us know what you see!

13. **Single-use plastic gloves** - Like the face masks, we rarely saw these being used outside of medical settings and specialist jobs until last year, when lots of people started wearing them. Can you spot them amongst the litter around you?

PPE has been really important during the pandemic, but unfortunately it hasn't always been disposed of properly. PPE was found on almost 70% of inland cleans over Great British Beach Clean in 2020. We want to see how common it is one year on.

What we're looking for – Balloons:

14. **Balloons –** have you ever thought about what happens to your balloon once you have let it go? Help us track down the facts to find out

Over the past 5 years, we've found on average 3 balloons per 100m during GBBC! Balloons marketed as 'biodegradable' can last up to 4 years in the marine environment. Animals get tangled in balloon ribbons, restricting their movement and ability to eat. To reduce this threat, we want to get outdoor balloon and sky lantern releases stopped.

MARINE CONSERVATION SOCIETY

Curriculum Links - England

Key Stage 3

Science

- Experimental skills and investigations
    - Ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience
    - Make predictions using scientific knowledge and understanding
    - Use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety
    - Make and record observations and measurements using a range of methods for different investigations, and evaluate the reliability of methods and suggest possible improvements
- Analysis and evaluation
    - Apply mathematical concepts and calculate results
    - Present observations and data using appropriate methods, including tables and graphs
    - Interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions
    - Present reasoned explanations, including explaining data in relation to predictions and hypotheses
    - Evaluate data, showing awareness of potential sources of random and systematic error
    - Identify further questions arising from their results
- Interactions and interdependencies
    - Relationships in an ecosystem
    - How organisms affect, and are affected by, their environment, including the accumulation of toxic materials.

Geography

- Geographical skills and fieldwork
    - Build on their knowledge of globes, maps and atlases and apply and develop this knowledge routinely in the classroom and in the field
    - Use fieldwork in contrasting locations to collect, analyse and draw conclusions from geographical data, using multiple sources of increasingly complex information
- Human and physical geography
    - Understand how human and physical processes interact to influence, and change landscapes, environments and the climate, and how human activity relies on effective functioning of natural systems

Design Technology

- Design
    - Identify and solve their own design problems and understand how to reformulate problems given to them.
- Make
    - Select from and use a wider, more complex range of materials, components and ingredients, taking into account their properties
- Evaluate
    - Understand developments in design and technology, their impacts on individuals, society and the environment, and the responsibilities of designers, engineers and technologists

Technical knowledge

- Understand and use the properties of materials and the performance of structural elements to achieve functioning solutions

Curriculum Links - England

Key Stage 4

Science

- Analysis and evaluation
    - Applying the cycle of collecting, presenting and analysing data, including:
    - Presenting observations and other data using appropriate methods
    - Translating data from one form to another
    - Carrying out and representing mathematical and statistical analysis
    - Representing distributions of results and making estimations of uncertainty
    - Interpreting observations and other data, including identifying patterns and trends, making inferences and drawing conclusions
    - Presenting reasoned explanations, including relating data to hypotheses
    - Being objective, evaluating data in terms of accuracy, precision, repeatability and reproducibility and identifying potential sources of random and systematic error
    - Communicating the scientific rationale for investigations, including the methods used, the findings and reasoned conclusions, using paper-based and electronic reports and presentations

- Ecosystems
    - Positive and negative human interactions with ecosystems

Geography

- Maps, fieldwork and geographical skills
    - The use of a range of maps

- Use of data
    - Data should include both qualitative and quantitative data and data from both primary and secondary sources: fieldwork data; GIS material; written and digital sources; visual and graphical sources; and numerical and statistical information. Using data should include its collection, interpretation and analysis, including the application of appropriate quantitative and statistical techniques (a list of required skills and techniques is given in the Appendix); it also includes the effective presentation, communication and evaluation of material.

- Resources and their management
    - An overview of how humans use, modify and change ecosystems and environments in order to obtain food, energy and water resources

Curriculum Links - England

Key Stage 4 (continued)

Design Technology

- Aims
    - Develop realistic design proposals as a result of the exploration of design opportunities and users' needs, wants and values
    - Use imagination and experimentation and combine ideas when designing
    - Communicate their design ideas and decisions using different media and techniques, as appropriate for different audiences at key points in their designing
    - Develop a broad knowledge of materials, components and technologies and practical skills to develop high quality, imaginative and functional prototypes
    - Be ambitious and open to exploring and taking design risks in order to stretch the development of design proposals, avoiding clichéd or stereotypical responses
    - Use key design and technology terminology including those related to: designing, innovation and communication; materials and technologies; making, manufacture and production; critiquing, values and ethics.

- Contextual challenges
    - Offer a broad range of real-world contexts, representing contemporary issues and concerns

- Technical principles
    - The impact of new and emerging technologies on industry, enterprise, sustainability, people, culture, society and the environment, production techniques and systemshow the critical evaluation of new and emerging technologies informs design decisions; considering contemporary and potential future scenarios from different perspectives, such as ethics and the environment
    - The sources, origins, physical and working properties of the material categories or the components and systems, and their ecological and social footprint
    - The way in which the selection of materials or components is influenced by a range of factors, such as functional, aesthetic, environmental, availability, cost, social, cultural and ethical

- Designing and making principles
    - Investigate factors, such as environmental, social and economic challenges, in order to identify opportunities and constraints that influence the processes of designing and making
    - Selecting and working with appropriate materials and components in order to produce a prototype

Curriculum Links - Wales

Progression Step 4

Science and technology

- Being curious and searching for answers is essential to understanding and predicting phenomena
    - I can research, devise and use suitable methods of inquiry to investigate my scientific questions
    - I can use my findings to draw valid conclusions
    - I can evaluate and identify ways of improving the reliability of data, taking anomalies into account
    - I can explain how the impact of our actions contribute to the changes in the environment and biodiversity

- Design thinking and engineering offer technical and creative ways to meet society's needs and wants
    - I can investigate, evaluate, select and combine component parts, materials or processes to improve the functionality and effectiveness of my outcomes
    - I can evaluate and apply responsible habits of working which consider environmental and societal impacts

Humanities

- Enquiry, exploration and investigation inspire curiosity about the world, its past, present and future
    - I can use my experiences, knowledge and beliefs to generate ideas independently and frame enquiries, using a range of research approaches when required
    - I can analyse, present and reflect on my findings, describing patterns and explaining relationships across data and sources
    - I can analyse the usefulness and consider the reliability and validity of a range of evidence relating to my enquiry
    - I can reflect on the approaches I have taken to enquiries and identify areas of improvement for future enquires
    - I can draw considered and reasoned conclusions to my enquiries, while understanding that other people may form different conclusions from the available evidence

- Informed, self-aware citizens engage with the challenges and opportunities that face humanity, and are able to take considered and ethical action
    - I have an understanding of my own and others' environmental, economic and social responsibilities in creating a sustainable future

Curriculum Links - Wales

Progression Step 5

Science and technology

- Being curious and searching for answers is essential to understanding and predicting phenomena
    - I can devise, justify and use systematic methods of enquiry to rigorously investigate my scientific questions and recognise limitations
    - I can link experimental findings and theoretical knowledge to draw valid conclusions
    - I can critically evaluate the quality of data and justify improvements
    - I can evaluate contemporary issues that affect the planet and biodiversity
    - I can evaluate the effectiveness and impact of scientific and technological solutions on a personal, societal and environmental level

- Design thinking and engineering offer technical and creative ways to meet society's needs and wants
    - I can tackle challenging problems, independently and collaboratively, to address wider design requirements in increasingly unfamiliar contexts
    - I can independently select, justify and combine component parts, materials and processes to improve functionality and can evaluate their impact on the effectiveness of my outcomes
    - I can apply and justify responsible habits of working which take into account impacts on the environment and society

Humanities

- Enquiry, exploration and investigation inspire curiosity about the world, its past, present and future
    - I can independently undertake a range of full and thorough enquiries, selecting the most effective approach and justifying my methodologies
    - I can evaluate and reflect on my findings, synthesise information, analyse patterns and trends, predict possible outcomes (where appropriate), and present well-supported and justified conclusions
    - I can critically evaluate the usefulness, validity and reliability of qualitative and quantitative evidence
    - I can independently evaluate the success of enquiries, suggesting improvements and refining methods for future enquiries
    - I can make coherent and reasoned responses and judgements that take into consideration different viewpoints

- Informed, self-aware citizens engage with the challenges and opportunities that face humanity, and are able to take considered and ethical action
    - I have built a detailed understanding of what it is to be an ethical, informed citizen and can critically evaluate my role as one, recognising my responsibilities and those of others towards society, the environment and creating a sustainable future
    - I can explain the importance of the role played by groups, governments, businesses and non-governmental organisations in the creation of a sustainable future, and how they impact on people and their rights and on the environment

Curriculum Links - Scotland

Third-Fourth Level

Science

Third Level

- Inquiry and investigative skills
    - Plans and designs scientific investigations and enquiries
    - Carries out practical activities within a variety of learning environments
    - Analyses, interprets and evaluates scientific findings
    - Presents scientific findings

Skills and attributes of scientifically literate citizens

- Expresses informed views about topical scientific issues, including those featured in the media, based on evidence and demonstrating understanding of underlying scientific concepts

Fourth Level

- Inquiry and investigative skills
    - Plans and designs scientific investigations and enquiries
    - Carries out practical activities within a variety of learning environments
    - Analyses, interprets and evaluates scientific findings
    - Presents scientific findings

Skills and attributes of scientifically literate citizens

- Expresses informed views about topical scientific issues, including those featured in the media, based on evidence and demonstrating understanding of underlying scientific concepts

Social Sciences

Third Level

- People, place and environment
    - I can identify the possible consequences of an environmental issue and make informed suggestions about ways to manage the impact
    - I can use a range of maps and geographical information systems to gather, interpret and present conclusions and can locate a range of features within Scotland, UK, Europe and the wider world

People in society, economy and business

- I can use my knowledge of current social, political or economic issues to interpret evidence and present an informed view.

Fourth Level

- People, place and environment
    - I can discuss the sustainability of key natural resources and analyse the possible implications for human activity
    - I can develop my understanding of the interaction between humans and the environment by describing and assessing the impact of human activity on an area
    - I can use specialised maps and geographical information systems to identify patterns of human activity and physical processes

Curriculum Links - Scotland

Third-Fourth Level (continued)

Design Technology

Third Level

- Impact, contribution, and relationship of technologies on business, the economy, politics, and the environment
    - I can evaluate the implications for individuals and societies of the ethical issues arising from technological developments
    - I can identify the costs and benefits of using technologies to reduce the impact of our activities on the environment and business

Design and constructing models/product
- I can create solutions in 3D and 2D and can justify the construction/graphic methods and the design features

Exploring uses of materials
- I can explore the properties and performance of materials before justifying the most appropriate material for a task

Fourth Level

- Impact, contribution, and relationship of technologies on business, the economy, politics, and the environment
    - I can examine a range of materials, processes or designs in my local community to consider their environmental, social and economic impact
    - I can present conclusions about the impact of technologies on the economy, politics and the environment

Design and constructing models/product
- I can apply design thinking skills when designing and manufacturing models/products which satisfy the user or client

Exploring uses of materials
- I consider the material performance as well as sustainability of materials and apply these to real world tasks

Curriculum Links - Scotland

Senior Phase

Environmental Science

National 4

- Skills, knowledge and understanding
    - Demonstrating knowledge and understanding of environmental science by making statements, describing information and providing explanations
    - Applying environmental science knowledge to familiar situations, interpreting information and solving problems
    - Planning and safely carrying out practical investigations/experiments to illustrate effects
    - Using information handling skills by selecting, presenting and processing information
    - Evaluating information to solve problems and make decisions
    - Making generalisations based on evidence/information
    - Drawing valid conclusions and giving explanations supported by evidence
    - Suggesting improvements to practical investigations

- Earth's resources
    - The responsible use and conservation of non-renewable and renewable resources; the formation and use of fossil fuels; the derivation and uses of materials derived from crude oil

- Sustainability
    - The sustainability of key natural resources and possible implications for human activity; the interaction between humans and the environment and the impact of human activity on an area; raw material and its environmental impacts and sustainability

National 5

- Skills, knowledge and understanding for the course
    - Demonstrating knowledge and understanding of environmental science by making statements, describing information, providing explanations and integrating knowledge
    - Applying knowledge of environmental science to new situations, interpreting information and solving problems
    - Planning, designing, and safely carrying out experimental/fieldwork investigations to test given hypotheses or to illustrate particular effects
    - Selecting information from a variety of sources
    - Presenting information appropriately in a variety of forms
    - Processing information (using calculations and units, where appropriate)
    - Making predictions and generalisations based on evidence/information
    - Drawing valid conclusions and giving explanations supported by evidence/justification
    - Suggesting improvements to practical experimental/fieldwork investigations
    - Communicating findings/information

- Living Environment
    - Human influences on biodiversity
    - Earth's Resources
    - Sustainability

Curriculum Links - Scotland

Senior Phase (continued)

Geography

National 4

- Skills, knowledge and understanding
    - Developing and applying straightforward skills, knowledge and understanding in geographical contexts
    - Using straightforward mapping skills, including the use of Ordnance Survey maps in familiar contexts
    - Using straightforward research skills, including fieldwork skills, in familiar contexts
    - Using and interpreting a limited range of numerical and graphical information in familiar contexts

- Global Issues
    - The impact of human activity on the natural environment

National 5

- Skills, knowledge and understanding for the course
    - Developing and applying skills and detailed knowledge and understanding in geographical contexts
    - Using a range of mapping skills, including the use of Ordnance Survey maps
    - Using a range of research skills, including fieldwork skills
    - Using and interpreting a range of numerical and graphical information

- Geographical skills
    - Extracting, interpreting and presenting numerical and graphical information which may be: graphs, tables, diagrams, maps

Design and Manufacture

National 4

- Skills, knowledge and understanding
    - Applying, with guidance, basic knowledge and understanding of design factors, graphic techniques, modelling techniques, planning techniques, evaluation techniques, the impact of a range of design and manufacturing technologies on our environment and society

National 5

- Skills, knowledge and understanding
    - Applying knowledge and understanding of:
        - Design factors
        - Graphic techniques
        - Modelling techniques
        - Planning techniques
        - Evaluation techniques
        - Tools, materials, and processes
        - Manufacturing techniques
        - Knowledge and understanding of the impact of a range of design and manufacturing technologies on our environment and society