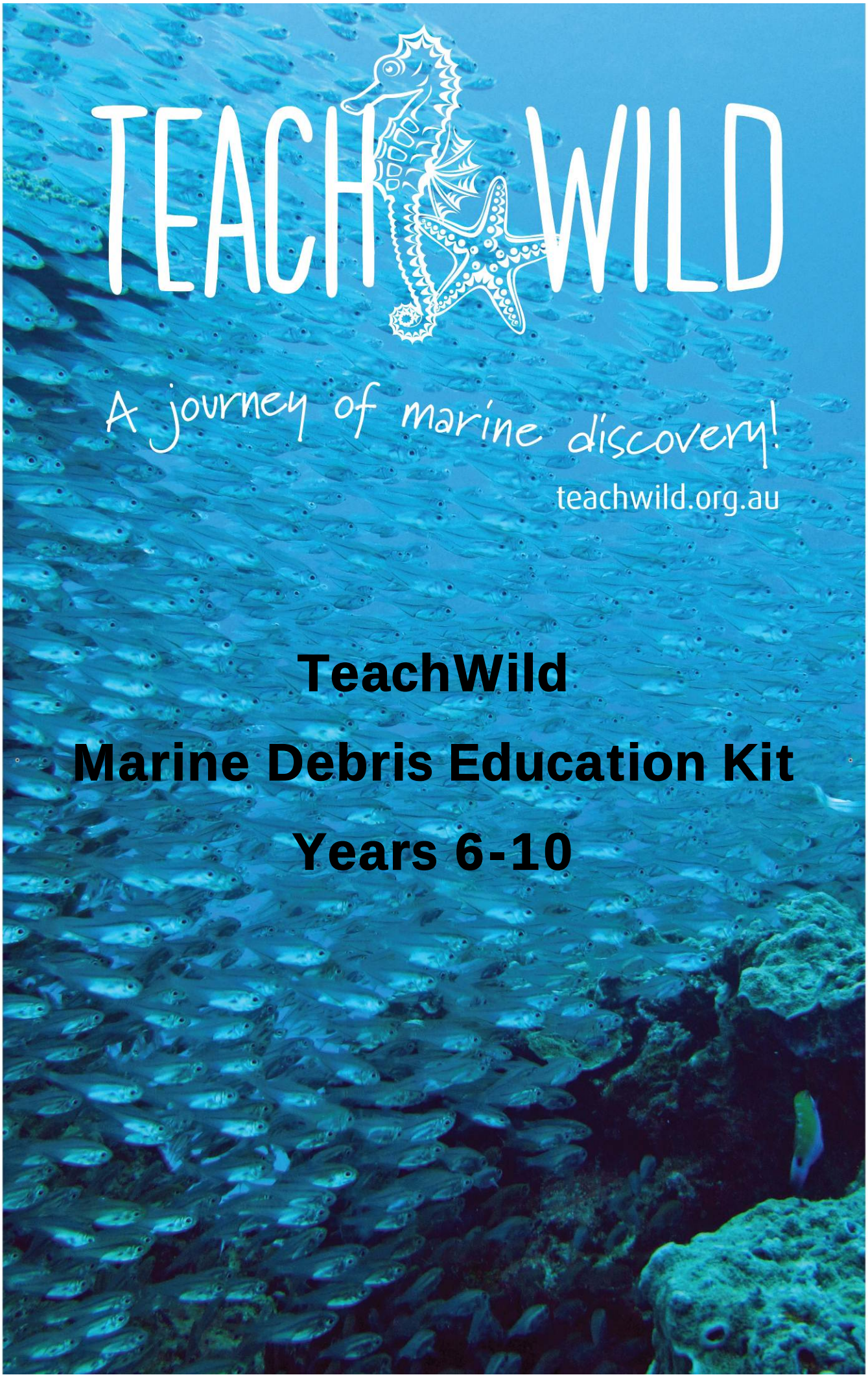



# TeachWild

# Marine Debris Education Kit

# Years 6-10

# Contents



TeachWild is an exciting innovative education program from Earthwatch Institute Australia. At Earthwatch we are committed to educating future generations on the need to protect and conserve our environment. In partnership with Shell and the CSIRO we are proud to offer a comprehensive education kit for years 6-10 on the worldwide issue of marine debris.

# Introduction

TeachWild is an enquiry based learning program addressing the impacts of marine debris on our marine environment. The program actively engages students in becoming citizen scientists and this includes hands-on learning in scientific methodology, data collection and analysis of marine debris. This data will be uploaded onto the TeachWild website to become part of the Australian National Marine Debris database.

## Overview

The purpose of marine debris education is to create an understanding for students of the impacts marine debris has on our ocean health. Throughout the course of study, students will develop problem solving skills in cross curricular areas including oceanography, biology, chemistry, physics and mathematics. They will learn about the impacts that marine debris has on vertebrate marine life. In doing so they will be able to identify different types of rubbish and determine possible sources and movement of debris in the marine environment.

## The Problem

Marine debris is a major global threat to biodiversity. For instance, more than six million tons of fishing gear alone is estimated to be lost in the ocean each year (Derraik 2002). Despite this staggering amount of marine waste, fishing gear forms only a small percentage of the total volume of debris in the ocean, not even making the list of the top 10 most common items found during coastal cleanup operations (Ocean Conservancy 2010).

The data collected for this project will contribute to addressing the four fundamental questions on marine debris:

1) What are the sources, distribution, and ultimate fate of marine debris?
2) What is the exposure of marine wildlife to debris?
3) When wildlife are exposed to debris, what factors determine whether animals ingest or are entangled by debris?
4) What is the effect of ingestion or entanglement on marine wildlife populations?

Marine debris is any human-made object that can be intentionally or unintentionally discarded, disposed of or abandoned that enters our marine environment. Marine debris has known impacts on our marine life and the marine environment such as:

- Ingestion and entanglement in the marine debris
- Bioaccumulation
- Plastic debris can be regurgitated as food for hatchlings (adult birds will regurgitate food for their young which may contain plastic)
- Animals can become entangled which can lead to infection or loss of limbs.

Marine Debris impacts upon a range of species and it is estimated that more than **250 species** are known to be affected worldwide.

Photo- NOAA

Marine Debris can be classed as coming from two different areas- land based and ship based sources. Both create an immediate threat to our marine life.

## Land Based

Litter from land based sources can find its way into our oceans through run off from urban areas. Catchment areas become heavily polluted through poor rubbish disposal practices on land. The origin of land debris is often from runoff, stormwater drains, air-borne debris and irresponsible disposal of rubbish by beach goers and campers.

## Ship Based

Every day ships jettison 5.5 million items of waste at sea. This includes waste such as fishing lines and nets, offshore oil and gas rig/ platform debris, merchant ship, ferry and cruiser line waste, and recreational and tourist vessel garbage. (Clean Up Australia)

Debris can be classified into three groups - degradable, biodegradable and non degradable. Degradable objects will gradually break down into smaller pieces whereas biodegradable objects will decompose back into natural elements. Some biodegradables are more persistent in the environment (wood, natural rubber and cloth) than others that decompose more readily such as paper. Plastic, glass, synthetic rubber, synthetic fabrics and metal typically resist biodegradation and persist in the environment for a long time. Individual items of debris can circulate in the world's oceans for years. As a result, no area whether it is remote or easily accessible is immune to marine debris.

The increased use of plastics over the last few decades, particularly for packaging has impacted on this. It is very difficult to distinguish between those pieces of plastic litter that have entered the ocean recently and those that have been there for years. This is due to the non-biodegradable nature of very durable and long-lived plastics.

## The Solution

The solution to marine debris issues worldwide requires a major reduction in the quantity of debris, especially non-biodegradable debris, entering the marine environment. Education is key to awakening individual, community and industry awareness to the effects of marine debris, and in promoting changes in attitude and behaviours that will lead to a cleaner, healthier marine environment. Use of the 3 R's, Reduce, Reuse, and Recycle knowledge and skills provides a readily used framework for strategies that can be applied to reduce marine debris.

Information uploaded onto the TeachWild website by students will be used as part of the National Marine Debris database. The data collected will contribute to national scientific research in this area. It is through increased understanding of the marine debris problem that scientists will be able to draw accurate conclusions and in turn develop strategies to manage this worldwide issue.

# The TeachWild Kit

The purpose of this kit is to provide students with a comprehensive and interactive learning experience on marine debris. The kit adheres to The Australian Curriculum and provides scope for expansion with nominated extension exercises and additional resources. This kit includes a summary of Lesson Plans (Year 6-10), Curriculum Objectives, Fact Sheets, Student Work Sheets and marine debris survey methodology.

Website links are identified to provide necessary background information to assist students in completing activities. Video footage of the marine environment under stress gives students visible evidence of the issue. Field trips as part of the CSIRO Scientists for a Day Program are designed so students can get hands on experience with in field observations and data collection. It is through evidence based enquiry that students will be able to develop probable solutions to the issue of marine debris.

Students will come to understand that through education, incentives and regulation the problem of marine debris can be better managed. Currently this issue impacts on marine life, the fishing industry and the tourism industry. As future leaders and environmental custodians it is imperative that students understand the value of the marine environment now and into the future.

## Aims

- Identify the types of objects from our daily lives that become marine debris
- Identify some of the impacts marine debris may have on the marine environment
- Make connections between practices on land and determine how they can influence water quality.
- Understand the water cycle and how marine debris is transported through oceanic currents
- Develop an understanding of the interrelationship between the Earth's environment and human activities.
- Investigate the responsibilities of Australia and other countries in managing the marine debris problem.

## Progressive Learning Overview

Step 1- In classroom activities, students are introduced to the concept of marine debris and are asked what the possible impacts on the marine environment are.

Step 2- Students visit a local beach and collect marine debris data with one of our Scientists as part of the Scientist for a Day Program.

Step 3- Students process their findings in groups and draw conclusions regarding the issue of marine debris. These results are discussed in class.

Step 4- The classes' collective data is then uploaded to the TeachWild website for inclusion in the National Marine Debris database.

Step 5- Students complete quarterly follow up monitoring with data entered into the website regularly. Any good footage of students collecting data and explaining the need to do so can be uploaded onto the TeachWild website to share with other students.

Step 6- Student research will be used as part of a national monitoring program on the levels of marine debris. Through investigation, students will have a clearer understanding of marine debris and will learn how science can inform us about environmental issues.

## Data Collection

The project objectives for the marine debris surveys are to:

1) Characterise marine debris for identification of sources which can lead to development of local control and if possible enforcement.
2) Create an understanding of the issue of marine debris impacts on marine life and the marine environment.
3) Create public awareness of marine debris issues and threats.
4) Contribute to cleaner beaches around the country.

## Summary

TeachWild National Marine Debris Kit is an inquiry based learning program that will enable students to gain an understanding of the impact marine debris has on the marine environment. Students will undertake beach surveys and clean-ups, contribute data to a national research program, investigate characteristics and sources of marine debris, discover the worldwide impact of marine debris, and reflect upon their own and others consumer practices. As future leaders and environmental custodians students will develop an appreciation of the value of the marine environment both now and into the future.

## Contacts

For further information please contact us-

Website- www.teachwild.org.au

For teachers and students interested in being involved:
teachwild@earthwatch.org.au

For volunteers- state agencies-members of the public wanting to be involved:
denise.hardesty@csiro.au

# Marine Debris Beach Survey

| Year 6 | Year 7 | Year 8 | Year 9 | Year 10 |
|---|---|---|---|---|
| ACMMG135<br><br>ACMMG136<br><br>Geography- Manage data and information collected and look for patterns and relationships | ACSIS125<br><br>ACMSP167 | ACSIS146 | ACSIS170<br><br>Geography- Planning, collecting and evaluating | Geography- Planning, collecting and evaluating |

See Australian Curriculum in Appendix 1

## Field Equipment for Scientist for a Day

If you are completing the survey with CSIRO and Earthwatch staff, the following equipment will be provided. If you are completing a survey independently, you will need the following equipment:

- 10 Markers for transect line
- Tape measures (rope/string can be used also for transect measurement)
- Camera
- GPS if available. If not, map details of your survey location (to record gps coordinates using the internet when back in the classroom).
- Data sheets- Transect Data Sheet, Marine Debris Beach Survey Sheet, and Marine Debris Size Chart Sheet.
- Wind indicator (a piece of string or light ribbon works for this)
- Compasses

OPTIONAL

- Coastal seashores identification book
- Tangaroa Blue Ocean Care Society Marine Debris ID Manual – can be downloaded for free at http://www.oceancare.org.au/site/index.php?option=com_rokdownloads&view=folder&Itemid=1000100&id=20:marine-debris-id-manual

## Equipment for schools to supply

- Gloves (reinforced), Tongs (for collecting rubbish)
- Hessian/chicken feed bags (these will be reused for future clean up)
- Pens/Pencils/Clipboards
- Data sheets- Transect Data Sheet, Marine Debris Beach Survey Sheet, and Marine Debris Size Chart Sheet.

## Pre Surveying

Prior to the commencement of the excursion certain preparations need to be made such as-

- Tides need to be checked-www.bom.gov.au/oceanography/tides/ with a low tide being preferable as rubbish would have just washed ashore after a high tide.
- Safety brief of the area prior to commencement of activity, including rules such as students are not to pick up any hazardous substances or objects e.g. sharps and litter that has come into contact with bodily fluids. Please refer to Earthwatch Risk Assessment for beach survey safety analysis which is available for download on the TeachWild website.

Students are to make observations and record data on the Marine Debris Beach Survey Sheet and Transect Data Sheet prior to the commencement of data collection including-

- Drawing a mud map of the beach and surrounding areas. If a GPS is available map out the points for each site and record for upload onto the website.
- Weather conditions before, during and after the excursion will determine how much debris is on the beach.
- Landforms - is the beach flat or sloping? Is there evidence of recent storm activity, erosion etc.
- Is there anything else worthy of note? Has the beach been cleaned recently? Nearby industry, pier, city beach, isolated beach?

## Procedure

Divide students into groups, with each group designated a specific section of the beach. Ask students to collect any debris they find washed up on the beach and in the dune area along the transect line. They are to follow the methodology below to ensure a standardised method of data collection is achieved. Explain to students that if all schools that are participating in the survey do not follow the same methodology then the data used for research will not be as accurate as it needs to be.

## Guidelines

Set up Transects according to the following specifications-

- Transects are located at least 50m from beach access point.
- Transects are located at least 25 metres apart (ideally 50 metres)
- Transect to include two metres into continual terrestrial vegetation.
- Transects are 2m wide (can be wider).
- One transect survey form is to be completed per team.
- Minimum of three transects and maximum of six per site.
- Minimum of one transect located within each major habitat type. (Transects are to be proportional to habitat type).

**Survey from beach to 2m into vegetation**

Photo- CSIRO

## Surveying Method

- Nominate one student as the recorder for the group with the other group members responsible for sampling.
- Nominate one student to take photos of the start and end of transect, and other photos of debris/students collecting data if desired.
- Record the start of the transect using a GPS point.
- Place a marker at that point to mark Point 1, measure out the length of transect and place another marker to designate Point 2.

- Two students are to walk on each side of the transect line collecting, identifying and classifying rubbish that is within 1m of their side of transect and placing in bags as they go. Using a 1m piece of string can be quite useful. The total width of transect is 2m. Total number of students here is 4 (two each side)
- Students use the Marine Debris Size Chart to classify the different types of debris from 1-5.
- Once rubbish is identified and classified the student sampler tells the recorder the size and type of debris. This information is recorded on the datasheet.
- Once data is collected by students, all datasheets are to be collected by teachers and collated. The data is then entered into the National Marine Debris database by the teacher or a nominated student.

Photo- Earthwatch

## EMU PARADE Guidelines

The Emu Parade is a simpler method for sampling marine debris and works effectively with primary schools and volunteer groups of all ages. For an 'Emu Parade' divide students into groups of 10 or less, with each group designated a specific section of the beach. Set up transects according to the following specifications-

- Transects are 30m wide (can be wider or narrower) along the beach.
- Transects are located at least 50m from main beach access point, wherever possible.
- Transects are located at least 25 metres apart (ideally 50 metres).
- Transect to run two metres into continual terrestrial vegetation (at the back of the beach, in the dune area, for example).
- Minimum of one parade and maximum of three per site/beach.

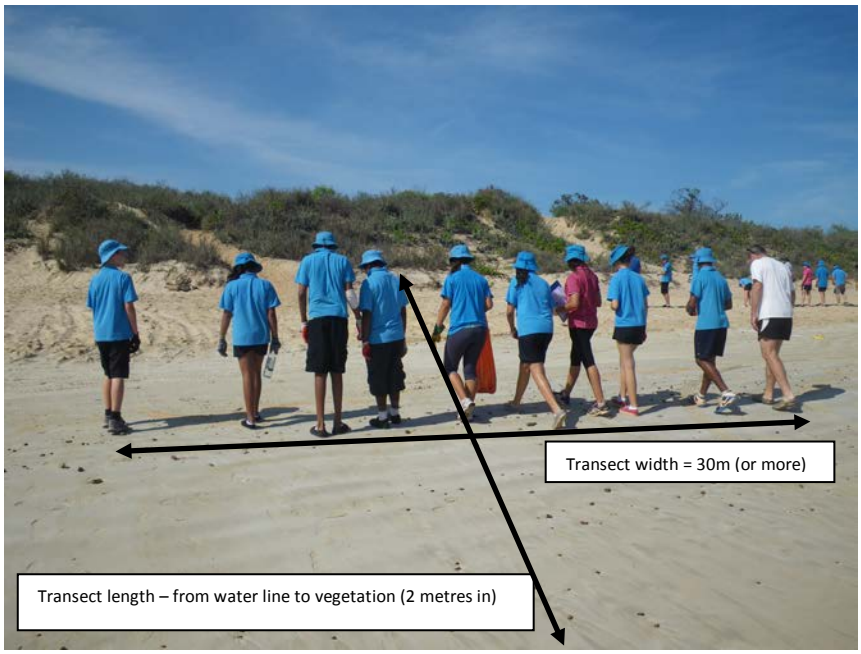
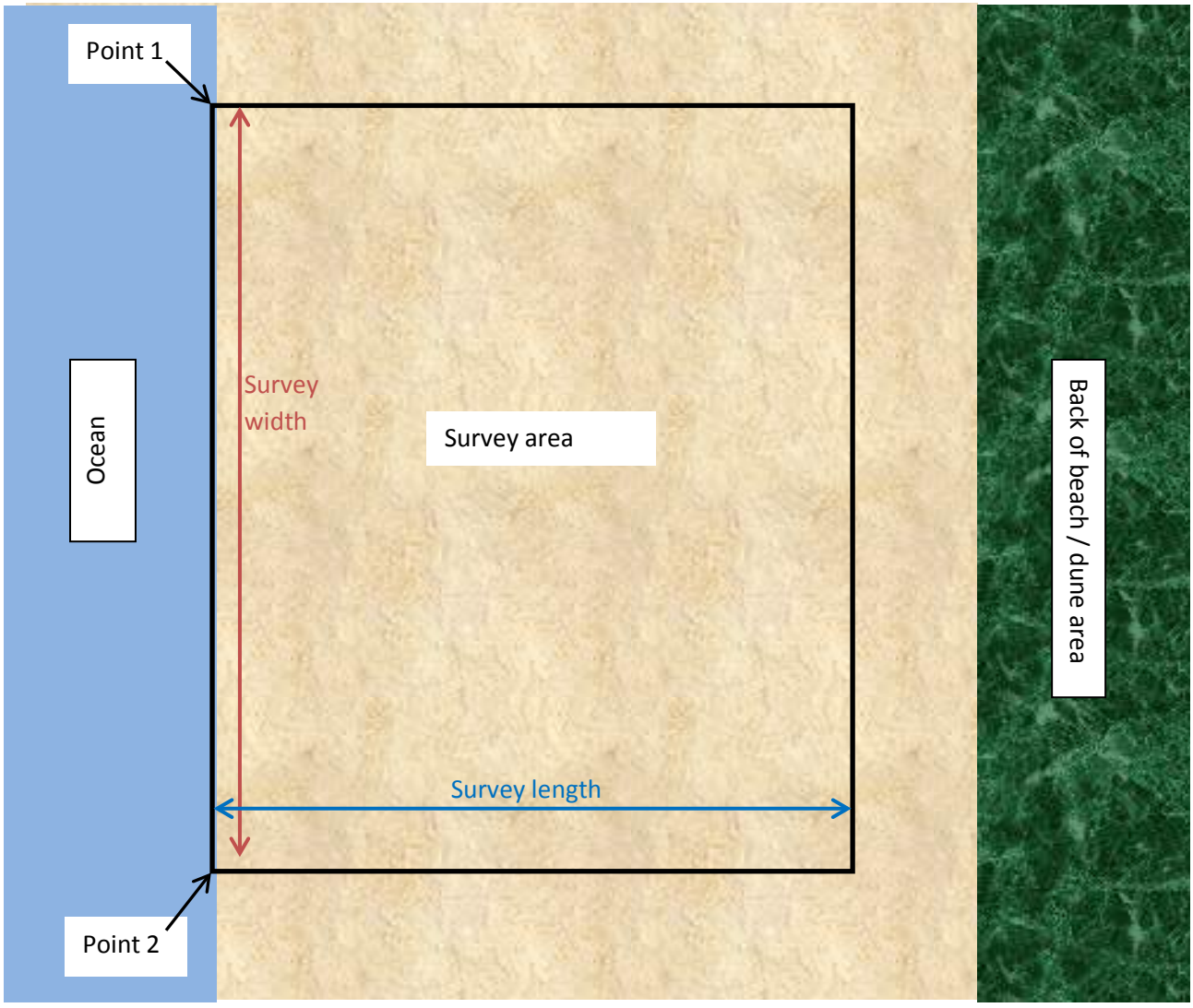



Photo- Earthwatch

## Surveying Method

- Record the start of the parade using a GPS point OR MARK ON MAP. If you don't have a map, you can easily print one from Google maps at the right scale to include the beach.
- Place a marker at that point to mark Point 1, measure out the length of the transect and place another marker to designate Point 2.

- Students walk in a line formation, approximately shoulder to shoulder along the survey area, for the total width of transect (30m, can be wider). Students continue to walk in line formation, back and forth along the transect width, until the survey area (from the water line to into the vegetation at the back of the beach) has been sampled.
- All marine debris found within the survey area is collected in a bag and brought back to the classroom for recording.
- Back in the classroom, debris is sorted into groups according to size. Students use the Marine Debris Size Chart to classify the different types of debris into size classes 1-5. A separate data sheet is used for each size classification.
- For each size classification, the type and colour of marine debris is recorded on the datasheet.
- Data is then put into the National Marine Debris database by the teacher or a nominated student.



| *(Official use only)* | Beach number (unique identity code): …….. | Survey Area (A, B, C, D, E, F, G): …….. |
|---|---|---|

**SURVEY AREA CODE: A = Cape Tribulation – Bris; B = Bris – Melb; C = Melbourne – Streaky Bay; D = Streaky Bay – Perth; E = Perth – Broome; F = Broome – Darwin; G = Around Tasmania**

# MARINE DEBRIS BEACH SURVEY

**Survey Guidelines:**

- Complete one Beach survey form per site and one transect data form for each transect at the site. Record all coordinates in WGS84 datum only.
- Minimum of three transects and minimum of six per site.
  - Minimum of one transect located within each major habitat type (transects proportional to habitat type).
  - Transects located at least 50 m from beach access point (ideally not located both sides of access points, unless different habitat types).
  - Transects located at least 25 meters apart (ideally 50 meters).
  - Transect to include two meters into continuing backshore terrestrial vegetation.

| **SURVEYOR DETAILS** | | |
|---|---|---|
| Organisation: | | *Organisation responsible for survey.* |
| Surveyor name: | | *Name of chief surveyor.* |
| Contact number: | | *Contact number for surveyor.* |
| Access point location: | Latitude: ……<br>Longitude: …… | *Latitude and longitude of access point where you enter the beach (dd.dddd).* |
| GPS accuracy: | | *Accuracy (meters) of GPS at time of reading.* |

| **SITE DETAILS** | | |
|---|---|---|
| State / Territory: | | *State or territory in Australia beach is located.* |
| Beach name: | | *Unique name of beach , if known.* |
| Survey date: | | *Date survey undertaken (dd/mm/yyyy).* |
| Current weather: | Clear Rain/Storm Overcast Drizzle | *Circle best option to describe the weather.* |
| Wind speed: | 0 1 2 3 4 5 | *Circle Speed estimate:*<br>*0: calm (flat ocean)*<br>*1: light breeze (wavelets, <10km/h , <6 knots)*<br>*2: moderate breeze (small waves braking crests, 10-25km/h, 6-20 knots)*<br>*3: strong breeze (waves and many white caps, 25-49km/h, 21- 26 knots)*<br>*4: high wind (white caps and airborne spray, 50-65 km/h , 27-35 knots)*<br>*5: gale (high waves, foam and spray present, 65-85 km/h, 35-45 knots)* |
| Wind direction: *(compass)* | N NE E SE S SW W NW N/A | *Direction from which wind is coming measured by the compass. N/A if no wind.* |
| Wind direction: *(relative to shore)* | onshore offshore sideshore side-on side-off | *Onshore: wind blowing towards shore*<br>*Offshore: wind blowing towards sea*<br>*Sideshore: wind blowing parallel to shore*<br>*Side-onshore: wind blowing sideways and towards shore*<br>*Side-offshore: wind blowing sideways and towards sea* |
| Date of last clean up: | | *If known.* |
| Number of humans: | Time of day (00:00): ……<br>Visible distance (m): ……<br>No. of people: …… | *Number of people counted in the visible area measured by instantaneous count. Visible distance is length of shore with a clear and unobstructed view.* |
| Comments: | | *For example: entangled fauna, recent storms, shipwrecks, boat ramp in close proximity, coastal erosion or other conditions that may affect the survey.* |

## Marine Debris Size Chart

**Guidelines:**

* This chart should be used as a guide to help estimate the size of marine debris during each beach transect (see transect sheet)

* The squares below represent different size classes

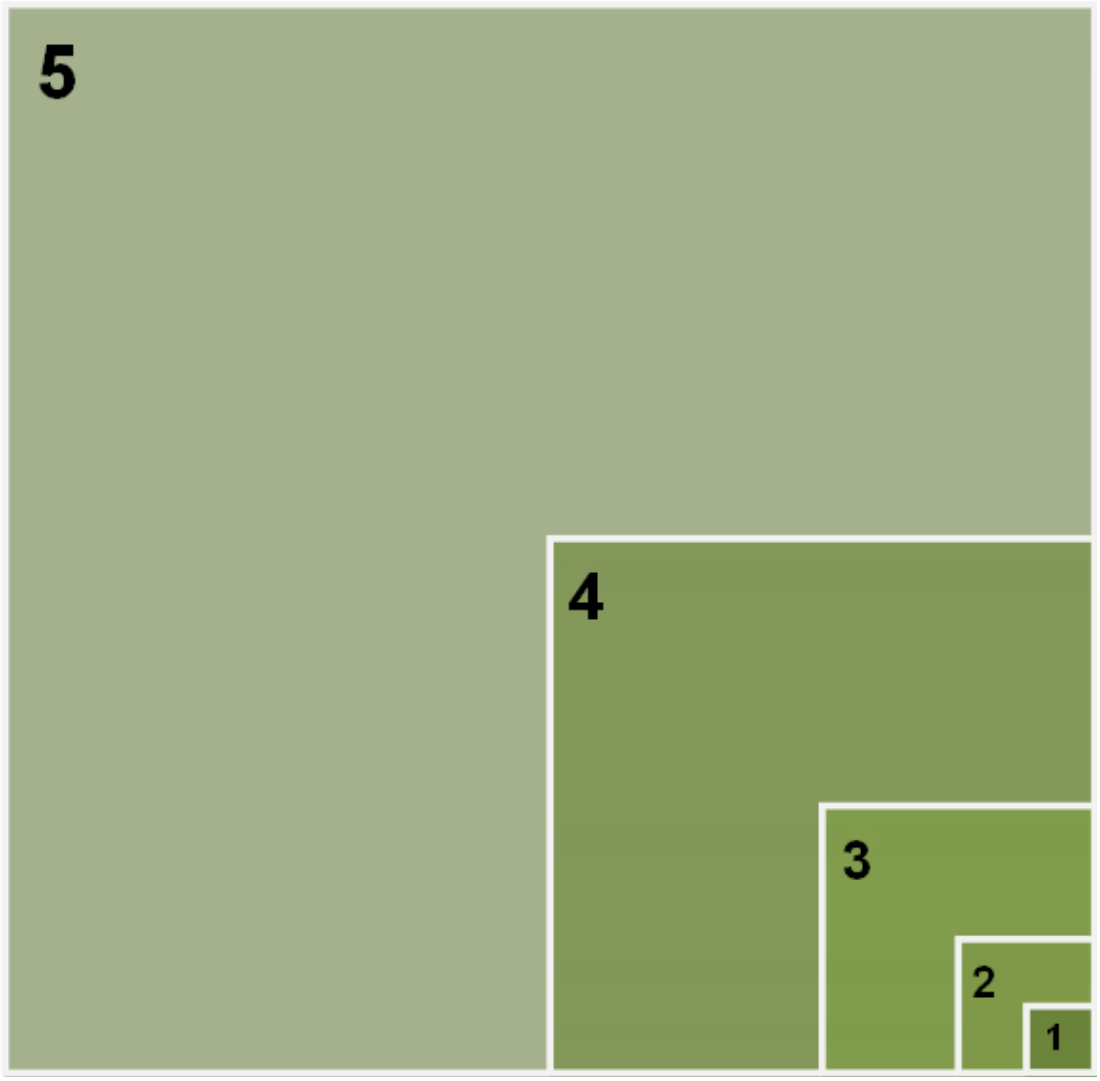
**1** = 0–1 $cm^2$ ; **2** = 1–2 $cm^2$ ; **3** = 2–4 $cm^2$ ; **4** = 4–8 $cm^2$ ; **5** = 8–16 $cm^2$ ; **6** = >16 $cm^2$

* To estimate area, determine which square the object will fit into.

* Note. It may be helpful to fold objects that are long and thin in order to picture the total areas, e.g. plastic straws.

**6** (anything larger than category 5) → • • • ∞

↓ • • • 8



## Transect Data

| | | | |
|---|---|---|---|
| Beach Name: | | Name of surveyor(s): | |
| Transect Number: | | No. of surveyor(s): | |
| Transect width (m): | | Transect Number _____ of _____ | |

| | | |
|---|---|---|
| Transect start: | Latitude: ……<br>Longitude: ……<br>GPS Accuracy: ……<br>Start Time (00:00): …… | *Latitude and longitude recorded in decimal degrees (dd.dddd).*<br>*Accuracy (in meters) of the GPS at time of reading.*<br>*Record Start Time of Transect* |
| Transect end: | Latitude: ……<br>Longitude: ……<br>GPS Accuracy: ……<br>End Time (00:00): …… | *Latitude and longitude recorded in decimal degrees (dd.dddd).*<br>*Accuracy (in meters) of the GPS at time of reading.*<br>*Record End Time of Transect* |
| Photo numbers: | Start of Transect: ……<br>End of Transect: …… | *Number of photo, taken from transect start and end point.* |
| Transect length (m): | | *From water's edge to two meters into continual terrestrial vegetation (meters).* |
| Distance to dominant debris line (m): | | *Distance from water edge to major debris line (in meters) at time of survey. Example 23 meters. If no obvious debris line use NA.* |
| Beach gradient: | 1 2 3 4 5 | *Difference in elevation from start to end of transect.*<br>*1 = < 1 m (less than hip height)*<br>*2 = 1-2 m (hip to head height)*<br>*3 = 2-4 m (1-2 body length)*<br>*4 = 4-8 m (2-4 body lengths)*<br>*5 = > 8 m (more than 4 body lengths)* |
| Substrate type: | Mud Sand Pebble / Gravel Boulders<br>Rock slab Mangrove | *Major substrate type.* |
| Substrate colour: | White / cream Yellow Orange Brown<br>Black Grey Red | *Predominant colour of substrate.* |
| Backshore type: | Cliff Seawall Urban building<br>Forest / Tree (> 3m) Shrub (< 3m) Dune<br>Grass - tussock Grass - pasture Mangrove | *Physical structure of backshore, where beach meets terrestrial vegetation.* |
| Beach exposure or shape: | Concave (cove) Straight Convex (headland) | *Shape of beach where survey is conducted. Based on 25m each side of transect.* |
| Aspect: | N NE E SE S SW W NW | *Direction when you are facing the water.* |
| Comments: | | *For example: transect-related comments such as backshore flora, crossing paths, photo information, etc.* |

**Transect debris (type and colour):** Record one mark (e.g. IIII) for each piece of rubbish larger than 1 $cm^2$ in size, within 1 metre each side of the transect line. If you find items other than those listed, add details to bottom of table.

| Rubbish Type | | Colour of debris | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Clear / translucent | White | Red/ pink | Orange | Yellow | Green | Blue / purple | Brown | Black | Grey / silver |
| Plastic | Hard plastic | | | | | | | | | | |
| | Plastic bags | | | | | | | | | | |
| | Film-like plastics (glad wrap and chip bags) | | | | | | | | | | |
| | Other soft plastics | | | | | | | | | | |
| | Plastic packing straps | | | | | | | | | | |
| | Net (estimate size) | | | | | | | | | | |
| | Fishing line | | | | | | | | | | |
| | Plastic (string, twine, rope) | | | | | | | | | | |
| Cloth | Non-plastic (string, twine, rope) | | | | | | | | | | |
| Glass | Glass | | | | | | | | | | |
| Metal | Fish hook | | | | | | | | | | |
| | Metal (hard) | | | | | | | | | | |
| | Metal (soft, tinfoil) | | | | | | | | | | |
| Rubber | Balloon | | | | | | | | | | |
| | Other rubber items | | | | | | | | | | |
| Foam | Polystyrene (foam, from esky's buoys etc.) | | | | | | | | | | |
| | Other foam | | | | | | | | | | |
| Timber | Wood (posts, beams, ship hulls) | | | | | | | | | | |
| Paper | Cigarette butts | | | | | | | | | | |
| | Paper | | | | | | | | | | |
| Other | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |
| | | | | | | | | | | | |

**Size classes:** Sample debris type and size class at ten intervals along each transect.

| Sampling Interval | Distance from water (m) | Size Class | Type / colour |
|---|---|---|---|
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |

*1. Divide the total transect length by 10 to determine sampling interval, e.g. if transect is 35 m, interval = 3.5 m.*

*2. At each interval record the type and size of the first piece of rubbish encountered. If no rubbish is detected within the interval draw a line through the box and continue to next interval, e.g. if no rubbish is found within the second interval (3.5–7m), but six pieces were detected in the third interval (7–10.5m) mark a line in the box for sample 2, and record the size and type for only the first item detected in sample3*

## Post Survey

Students can clean up the beach area of any additional rubbish that is found if time permits. Scientists and teachers are to ensure that this rubbish is not mixed up with the rubbish that has been recorded on the datasheet.

## Back in the classroom

At the end of the activity once the rubbish has been identified, divide it into two separate piles recyclables and non recyclables. Explain the importance of the need to dispose of all waste thoughtfully and state the fact that in nature there is no waste due to natural cycles, waste is a human invention that is not easily broken down or managed by natural means.

Ask students questions about-

- What was the most common piece of rubbish?
- Why do they think that is so?
- How can they reduce that type of rubbish occurring on the beach?

Ask students to think of reasons why people may be reluctant to modify their consumption and use of products. Investigate successful clean up campaigns such as the elimination of plastic water bottles from schools and the green bag movement.

## Conclusion

Ask students to discuss their findings in their groups. They are to draw conclusions from the data and discuss with their classmates. From that data, ask students to formulate questions for the visiting scientist.

- Why are certain types of rubbish more transportable than others?
- What impacts can prolonged exposure of some plastics in seawater cause?
- Why is ingestion and entanglement of marine life a very real danger?
- What can be done to educate others about the problem of marine debris?

Collate data and upload all of the data collected onto the TeachWild website to become part of the National Marine Debris Database. Arrange to conduct follow up surveys quarterly with the class.

## Further Learning

This activity is designed to be ongoing with further investigation undertaken by students and teachers quarterly. Teachers will be given access to the TeachWild website to upload any additional data and will be provided with online support via

the website. This data will be used as part of the National Marine Debris Database and will be used in scientific research.

Years 8-10 could be involved in a more intensive sampling of marine debris with an accompanying module of chemistry, biology, physics or other area designed to address some of the key elements of that unit of study.

To further increase student's knowledge of the marine debris issue the following Fact Sheets and Student Work Sheets have been developed and can be completed in class to complement the field activity. These activities can also be used as a refresher for students in the lead up to the quarterly sampling led by teachers or as a pre cursor to the first TeachWild visit.

The aim of additional resources is to further increase student's awareness of the marine debris issue and inspire continued appreciation and commitment to the preservation of the marine environment.

## Clean Up Days

Throughout the year there are numerous clean up campaigns designed to help combat the impact marine debris is having on our marine environment. Involvement in these campaigns can complement work done with scientists on the National Marine Debris Survey.

Some of the key initiatives are-

Clean up Australia Day

http://www.cleanupaustraliaday.org.au/

Project Aware International Clean Up Day

http://www.projectaware.org/

# Lesson Plans Summary Table

| Year | Activity | Theme | Key Concepts | Adaptable for Year |
|---|---|---|---|---|
| 6 | How long is too long? | Chemistry | Waste Degradation Timeline<br>Waste Reduction<br>Waste Disposal | All Years |
| 7 | Plastics as food | Chemistry<br>Biology | Classification of Marine Debris<br>Properties of Plastic<br>Trophic Levels<br>Food Chains | All Years |
| 8 | Marine Animal Entanglement | Biology<br>Physics | Marine Animal Entanglement and Ingestion of Marine Debris | All Years |
| 9 | Marine Debris- A Global Problem | Oceanography | Great Pacific Garbage Patch<br>Ghost Nets | 10 |
| 10 | Ocean Currents | Oceanography<br>Physics | Ocean Currents<br>Movement of Marine Debris<br>Great Pacific Ocean Patch | 9 |

Teachers Note- All activities are designed to be adapted to suit different year levels. This table can be used as a guide when preparing alternate Lesson Plans.

# Lesson Plan- How long is too long?

| Year | Subject | Code | Key Words | Materials | Duration |
|---|---|---|---|---|---|
| 6 | Geography<br><br>Science | Processing data and information collected and look for patterns or relationships.<br><br>ACSIS232 | degrade, natural cycles, awareness | rubbish from classroom bin | 1 hour |

See Australian Curriculum in Appendix 1

## Overview

Students review the timeline of the rubbish breakdown and from this they can assess their own consumptive behaviour and that of others. They understand the complexity involved in the degradation of everyday items. Through analysis of their own rubbish, students will understand how they are impacting the environment as an individual and they can develop practical solutions to decrease that impact.

## Objectives

- Students collect information and analyse it.
- Students will address the cause and effects of littering and evaluate possible future scenarios, giving reasons for their preferred options.
- Students will develop an understanding of scientific methodology and cause and effect of littering.

## Activity

Introduce students to the concept of marine debris. In the classroom take students through the **Fact Sheet- How long is too long**. Lead a class discussion on the different types of rubbish and the timeline each takes to degrade. Were students shocked by how long some everyday objects take to degrade? If so which ones? After the discussion, ask students to complete the questions on the Student Work Sheet. Students can calculate their savings on reducing waste using the following equation- Savings per month x bank charges for account=net savings rate x time= total savings.

# FACT SHEET- How long is too long?

Rubbish is often not easily degraded or managed by natural means. Degradation doesn't equal disappearance. Degraded rubbish continues to persist in the marine environment. It is important that we understand and create awareness of the time it takes for everyday rubbish to break down.

| Item | Time |
|---|---|
| Apple Core | 2 months (in water) |
| Aluminium can | 200-500 years |
| Cardboard box | 2 months (in water) |
| Disposable nappy | 450 years (in water) |
| Fishing line | 600 years (in water) |
| Leather | up to 50 years |
| Nylon fabric | 30-40 years |
| Orange/banana peel | up to 2 years |
| Plastic Bag | 500+ years |
| Plastic Bottle | Forever |
| Plastic coated paper | 5 years |
| Plastic film container | 20 -30 years |
| Styrofoam/ Polystyrene | Forever |
| Tin can | 50 years |
| Wool socks | 1-5 years |

Source- www.createyourowneden.org.nz

## STUDENT WORK SHEET

1. Are you surprised by how long some everyday items took to break down? If so what items?

_____

_____

_____

_____

2. What's in your waste? (refer to list)

| Item | Components |
|---|---|
| 1. _____ | 4. _____ |
| 2. _____ | 5. _____ |
| 3. _____ | 6. _____ |

3. Can you trace back every piece of waste in your classrooms bin? Create a timeline of 10 items and the time it takes for each item to break down in the space below-

**Waste bin**



6weeks 6months 5 years 50 years 400 years

4. Create a timeline of 10 items found on the beach in the space below-

**Beach**

6weeks 6months 5 years 50 years 400 years

5. Compare the two timelines, does rubbish from the beach have a different timeline to rubbish from the bin? Yes/ No

6. Why do you think this is the case?

_____

_____

_____

7. Think about the waste in your bin at home. Where does the majority of your waste come from?

_____

_____

_____

8. Where does your waste end up? Provide three possible answers-

_____ _____

_____

9. Did the waste in the bin and the waste found on the beach survey differ?

_____

_____

10. What type of waste did you find most on the beach?

_____

_____

_____

11. As consumers, what could we do to reduce this type of waste on the beach?

_____

_____

_____

12. How much will you save per month by reducing your waste?

_____

_____

_____

13. What are the three R's?

_____ _____

_____

14. What other R's can you think of that would assist in reducing waste?

_____

# Lesson Plan- Plastics as Food

| Year | Subject | Code | Key Words | Materials | Duration |
|---|---|---|---|---|---|
| 7 | Science | ACSIS124<br>ACSSU112 | plastic, plankton, size categories, food chain | Assortment of different sized plastic pieces and rubbish | 45 minutes |

See Australian Curriculum in Appendix 1

## Overview

In class students are to look at the degradation of debris. Students will look at the rate at which rubbish takes to break down and in turn will understand how persistent debris is in the marine environment. They will begin to understand the effects that our consumer behaviour can have on the environment. They will look at the properties of plastics and understand that the rate in which plastic breaks down in the marine environment is slow and that plastic readily enters food chains, often with impacts on marine life.

## Objectives

- Students develop an understanding of the properties of plastics and the impact they have on the marine environment.
- Students work collaboratively by discussing the problems associated with persistent plastics in the marine environment and investigate the impact on marine food chains.
- Students will use information and knowledge of their previous investigations of marine debris to predict the outcomes of the possible impacts of variation in the size of the plastics on marine animals.

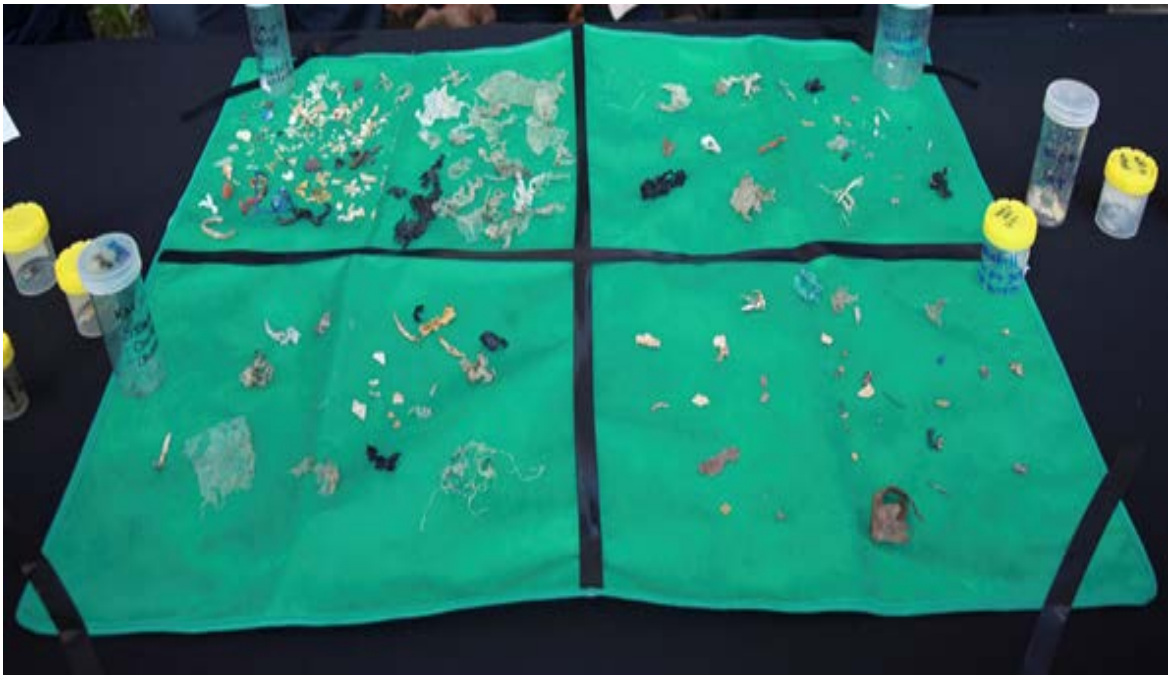
## Activity

Introduce students to the plastic problem using the Fact Sheet-Plastics as Food.

Divide the class into groups of four. Give them a pile of plastics and rubbish to sort and classify using the Marine Debris Size Chart.

Students are to look at the size of the pieces and the colours and separate accordingly.

Ask students to answer the questions on the Student Work Sheet.



Discuss with the class that there are numerous implications for marine debris.

Discuss the potential implications of marine debris on future generations

**Quaternary consumer**: a carnivore at the topmost level of the food chain that has little or no natural enemies. Feed on tertiary consumers.

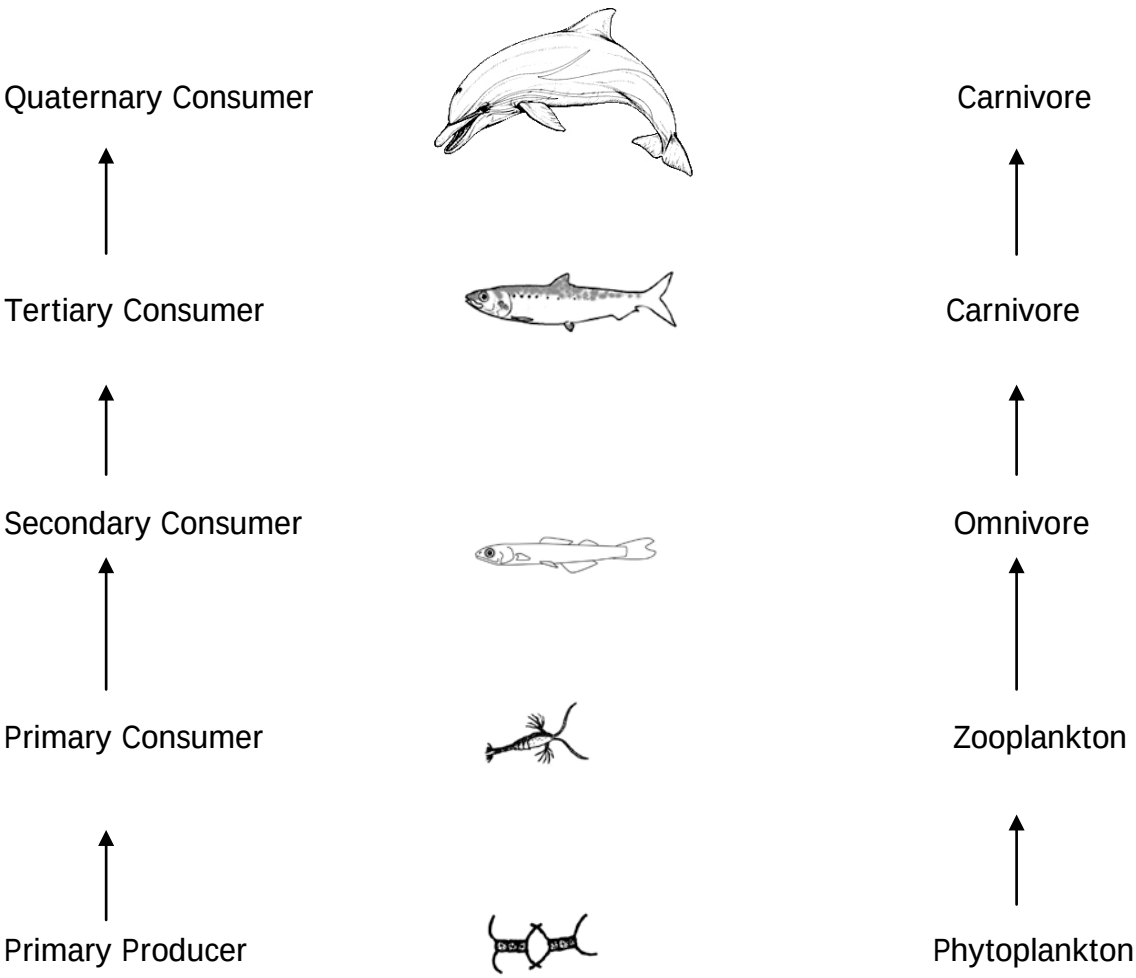
**Tertiary consumer**: feeds on other carnivores; an animal that feeds only on secondary consumers.

**Secondary consumer**: a carnivore that feeds only upon herbivores.

**Primary consumer**: an animal that feeds on plants; a herbivore.

**Primary producer**: any green plant or any of the various microorganisms that can convert light energy or chemical energy into organic matter.

Explain to students that plastic will move through the food chain through the different trophic levels. They are to document this on the Student Work Sheet. Below is an example of a simple food chain



## FACT SHEET- Plastics as Food

Plastic is estimated to constitute 90% of all trash floating in the world's ocean. In some areas the plastic outweighs plankton by a ratio of 6-1. Plankton is the life force of the oceans and is a crucial food source to numerous species including fish and whales. Without these drifting organisms (animals, plants, bacteria) our ocean health would be severely lacking. Those animals that rely on plankton as a food source often get confused and instead eat pieces of indigestible plastic that can cause blockages and even death. Toxic chemicals used in the process of creating plastic often leeches out when exposed to water.

Sorting marine debris into size categories gives scientists a good idea of how long the debris may have been in our oceans for, important signs of degradation are changes in the shape, colour and size of the item. The smaller the pieces of plastic the easier it is for plankton feeders to mistake for food and ingest. This then enters the food chain and may make its way to the higher level consumers who by eating those small organisms then ingest the debris those organisms have eaten. The higher an animal is on the food chain the greater the quantity of debris that is consumed and accumulated.

One of the more problematic types of plastics is Plastic Resin Pellets (PRP) which are pre production plastic resin pellets typically less than 5mm in diameter found outside of the typical plastics manufacturing stream. These pellets are an intermediate good used to produce the final plastic product. The longer these pellets remain in seawater the more toxic they become. PRPs resemble fish eggs and are often ingested by birds and fish who mistake them for food.

Photo Earthwatch

## Student Work Sheet

1. After sampling marine debris, take a look at the different size categories. What size of debris did you see most of?

_____

_____

2. What size of debris do you think poses the greatest danger to the marine environment?

_____

3. Why did you choose this size? _____

4. What colour plastic do you think is most attractive to marine animals and why?_____

   _____

   _____

5. List 6 items you use on a daily basis that has the greatest chance of becoming marine debris? What makes you think that? List the items below and the reason for selecting the item-

| | Item | Reason |
|---|---|---|
| 1. | _____ | _____ |
| 2. | _____ | _____ |
| 3. | _____ | _____ |
| 4. | _____ | _____ |
| 5. | _____ | _____ |
| 6. | _____ | _____ |

6. List at least 3 reasons why persistent plastics are an issue in the marine environment?

_____

_____

_____

_____

7. Pick one marine organism listed below. Decide what it eats, and what eats it. How does it eat its food?

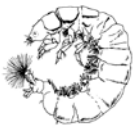
Phytoplankton

Zooplankton

Mesopelagics

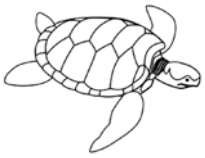
Small Pelagics

Squid

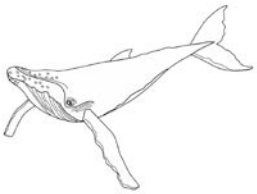


Benthic Invertebrates

Benthic Fish

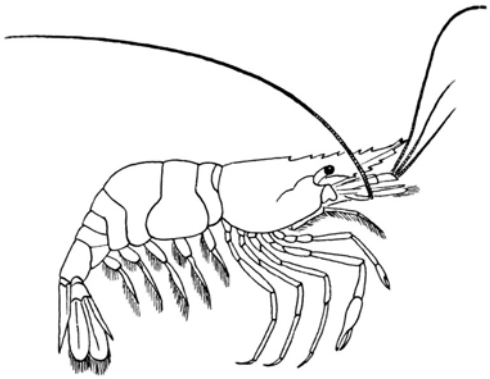


Marine Reptiles



Marine Mammal

8. When plastic enters a food chain where does it end up? In groups of four, trace a Plastic Resin Pellet (PRP) that has been ingested by a prawn. Where could this piece of plastic end up in a food chain? Draw the food chain in the space below.



9. What are some of the potential the social, cultural, economic or environmental implications of not addressing the plastics issue?

Social_____ Cultural_____

Economic_____ Environmental_____

# Lesson Plan- Marine Animal Entanglement

| Year | Subject | Code | Key Words | Materials | Duration |
|---|---|---|---|---|---|
| 8 | Science | ACSIS148 | entanglement, ingestion, health | Plastic drinking bottle<br>A3 paper<br>Assortment of rubbish | 45 minutes |

See Australian Curriculum in Appendix 1

## Overview

Students look at the significance of the marine debris issue and how this relates to marine animals. Entanglement and ingestion of marine debris by marine animals is discussed with the impacts thoroughly examined. During the activity, students experience a simulation of what it is like to be entangled by marine debris. They then develop an education campaign aimed at members of the public. Students will gain experience in developing an education campaign based on the marine debris issue and using current scientific knowledge of the issue.

## Objectives

- Students identify the effect of marine debris on marine animals.
- Students develop an education campaign to draw attention to the marine debris issue using digital media.
- Students ensure that science ideas are communicated to the public using appropriate language and representations that the intended audience are able to identify with.

## Activity-Marine Animal Entanglement

Introduce students to the concept of marine animal entanglement- how marine animals become entangled and the likely impacts on the animal (identified in the Fact Sheet). Create a simulation of the entanglement of a marine animal in different types of marine debris. A plastic bag, mesh netting, a tin can, rope, strapping band and paper can be used to “entangle” the marine animal.

1. Fill a sink or large tub with water
2. Attach a piece of lightweight rope to a drink bottle; fill the drink bottle ¼ full with water so that it partially sinks.
3. Wrap the first piece of rubbish around the bottle so that it will not come off the bottle easily.
4. Using the rope slowly drag the bottle through the water.

Make sure that you attempt to bring the bottle to the surface now and then throughout the demonstration so students can get an idea of how problematic it will be for surface breathing animals. Students are to observe what happens with each of the pieces of rubbish and record on the Student Work Sheet.

Students are to put together a poster aimed at educating the general public on the impacts of marine debris on marine animals. Students are to use a variety of media in the development of the poster including digital technologies and are to incorporate a slogan, a photo depicting a marine animal entangled in marine debris, a sentence to invoke emotion in the audience (students can draw on their experience from observing entanglement) and a confronting fact they have researched (eg. 250+ species are known to be affected by marine debris).

Collect all of the class slides and put together into a single PowerPoint Presentation, play this back to the class. Ask them how they felt after watching the slide show. How could they get this information out to their target audience? Devise strategies with students and implement any good ideas that students come up with.

# FACT SHEET-Marine Animal Entanglement

Marine animals can be at risk when they come into contact with marine debris. Marine Debris can affect a range of marine species with an estimated 250 species currently known to be affected.

These species include seabirds, marine mammals and sea turtles which die after becoming entangled or ingesting marine debris which they have mistaken for food.

## Entanglement

Entanglement is when an animal gets caught in marine debris. It can occur accidently or when an animal is curious about an object, is looking for shelter or simply because an animal swims past an object and gets caught up in it.

It is harmful because it can cause-

- Drowning
- Disruption or prevention of feeding by the animal
- Restrict movement or ability to swim
- Increase vulnerability to predators
- Restriction that result in infection or loss of limb(s)
- Decrease in hunting and movement efficiency

Photo- NOAA

Monofilament line, derelict fishing gear, rope and strapping bands are common items that entangle marine life.

## Ingestion

Ingestion is when an animal mistakes marine debris for food, eats it and the animal's body cannot process it. Small or tiny bits of debris can also be ingested by filter feeding organisms leading to problems in the food chain affecting plankton to top order predators.

It is harmful because it can cause-

- Blockages of the oesophagus and the intestinal tract of the animal.
- Sharp objects can cause injuries and infections.
- Toxins can accumulate in an animal's tissues affecting the health of the animal.

## STUDENT WORK SHEET

1. How do you think the rubbish can affect a marine animal?

Immediately_____

1 week later_____

1 year later (if it does not die)_____

2. In the table below record your observations (e.g. time taken to move through the water, drag created from the marine debris, the ability for the object to "surface" etc). Include a list of animals that may be affected by each item of rubbish.

| Item | Observation | Animal |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

3. How do different items affect drag?_____

_____

_____

_____

_____

4. Conduct research on the internet to find a photo of a marine animal entangled in marine debris. Use the photo as the central part of an advertising campaign aimed at bringing attention to the general public. Create an emotive slogan for the campaign, and include facts on marine animal entanglement researched on the internet. Using an A3 piece of paper create a draft of your campaign poster. Once you are happy with the layout create a poster using Microsoft PowerPoint.

# Lesson Plan- Marine Debris- A Global Problem

| Year | Subject | Code | Key Words | Materials | Duration |
|---|---|---|---|---|---|
| 9 | Science | ACSIS164 | Great Pacific Garbage Patch, gyre, ghost nets, species diversity, relative abundance. | Access to the internet | 1 hour |

See Australian Curriculum in Appendix 1

## Overview

Students assess the marine debris problem on a local and a global scale. They develop a sense of understanding that it is not restricted to one particular area but is a global issue. Students identify why the Great Pacific Garbage Patch exists and explore the possibilities of one occurring on the Australian coastline. The issue of ghost nets is also explored with possible solutions addressed.

## Objectives

- Students use the internet to distinguish that marine debris is a global issue.
- Students compare local data to worldwide data as part of the research process, and refine their line of questioning to target specific information and data collection to find possible solutions to the Great Pacific Garbage Patch.
- Students look at the ghost nets issue, determining what is needed to address the issue and what may be some possible solutions.

## Activity

Introduce students to the significance of the Great Pacific Garbage Patch and the ghost nets issue using the **Fact Sheet- Marine Debris- a Global Problem**.

Discuss with students how this issue is not just localised, but is an issue on a global scale. Explain that economics has a major impact on what can and cannot be done to address this problem.

Students are to spend the first half of the lesson investigating the Great Pacific Garbage Patch using resources from the internet. They are to look at the scope of the issue and try and determine how it can be better managed or cleaned up.

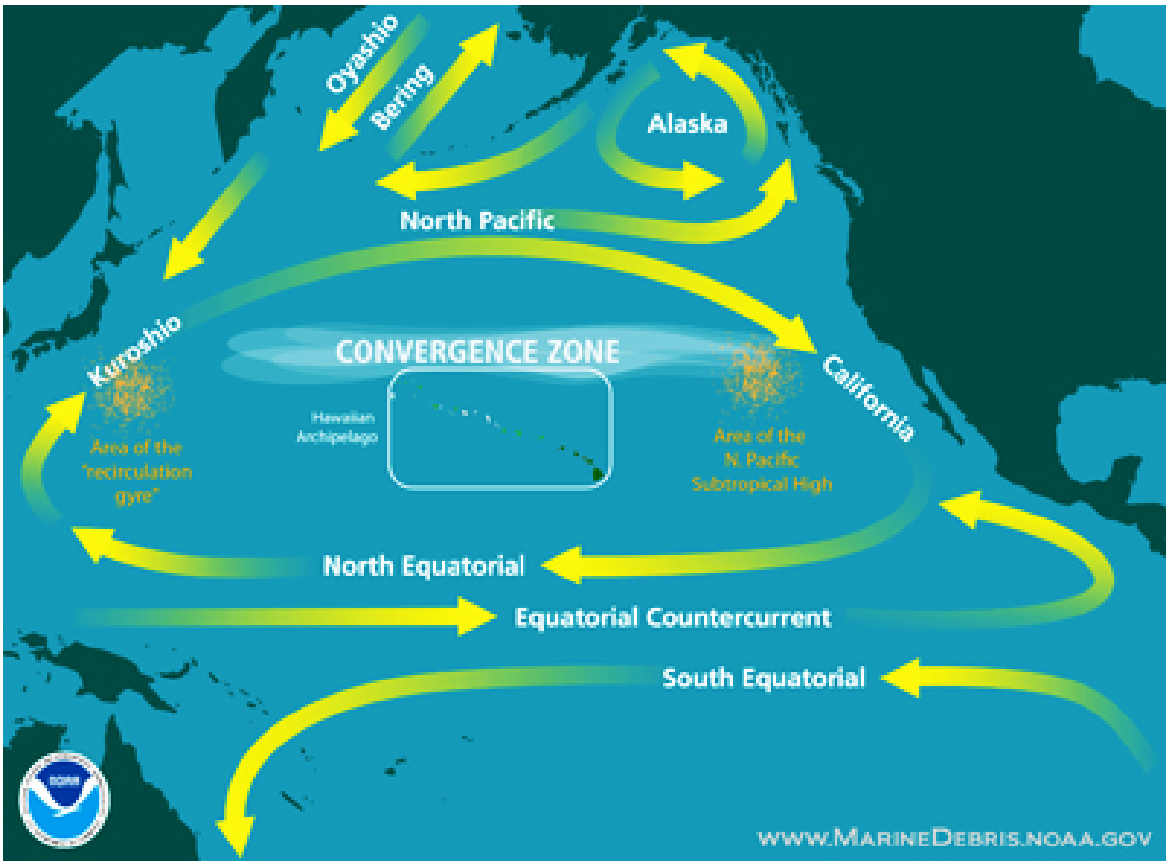
Once students have adequately researched the issue they are to answer the questions on the Student Work Sheet. After the completion of the Student Work Sheet, lead a class discussion based on the students' answers.

Photo- NOAA PIFC

# FACT SHEET- Marine Debris- A Global Problem

## The Great Pacific Garbage Patch

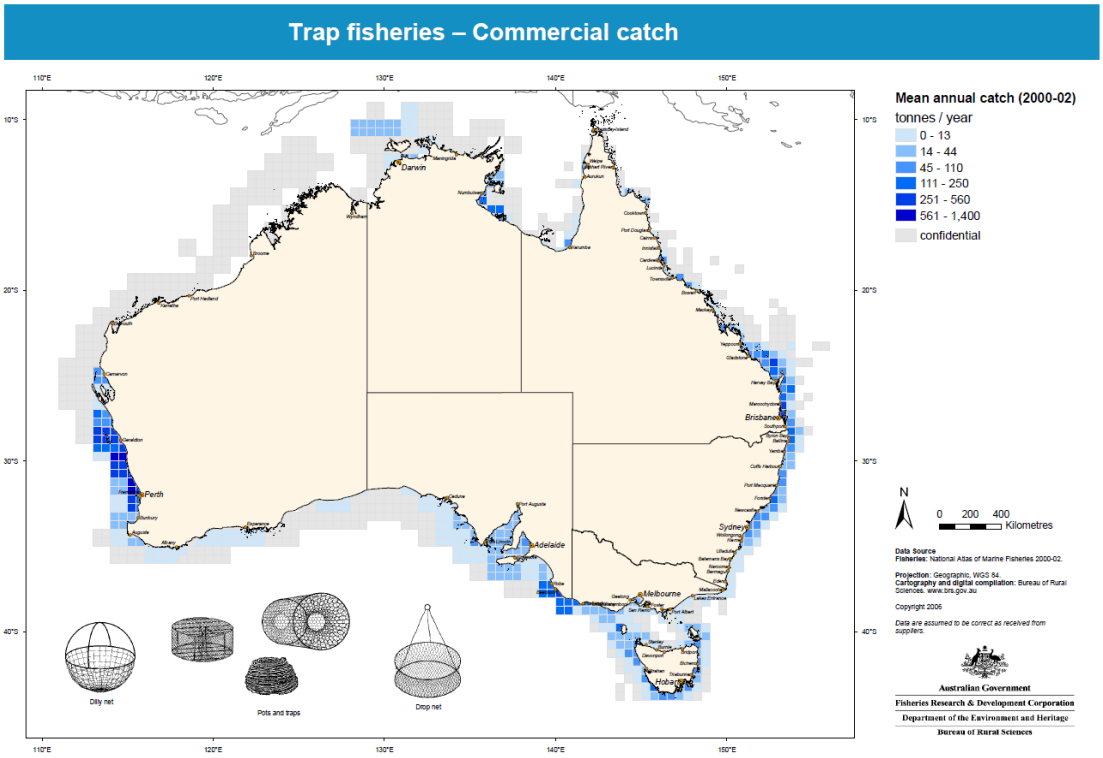
It is one of the most identifying features of the marine debris issue, spanning an area of 1 760 000 square kilometres. This patch of garbage is bigger than Queensland. It is an area where a large quantity of marine debris is caught between currents, causing a 'soup' of debris. The patch results from oceanic forces bringing the debris together as a result of ocean currents. The gyre is not static, but moves continually with currents from the surrounding areas. The North Pacific gyre is one of the five major oceanic gyres. A gyre in oceanography is a large system of rotating currents. The North Pacific Gyre comprises of four prevailing ocean currents, the North Pacific current to the North, the Californian current to the East, the North Equatorial current to the South and the Kuroshio current to the West.



## Ghost Nets

Fishing nets, fishing line, crab and lobster pots or other fishing gear lost or discarded can continue to fish for marine life long after being left behind. This is called ‘ghost fishing’. Commercial fishing nets can be very long (up to kilometres even!) and can be transported by currents and waves for tens to hundreds of kilometres. These nets can become concentrated in relatively small areas by winds and currents, continuously ghost fishing for years or even decades. Ghost nets can catch crabs, fish, sharks, sea turtles and other marine creatures that cannot free themselves before drowning or dying from starvation. Derelict fishing gear is also dangerous to aquatic habitats including coral reefs, sea grass beds and shallow areas of an estuary.  The synthetic materials used in ghost nets break down very slowly.

Ghost fishing also kills a number of fish that may have been sold at the market or would have spawned the next generation. The continual loss of animals from ghost fishing can impact upon both the recreational and commercial fishing industry.




## Tackling the issue

Ghost nets are a major problem in our world’s oceans. Ghost nets are increasing in our oceans.

## STUDENT WORK SHEET

In groups of four discuss the following questions-

1. How did the Great Pacific Garbage Patch come to exist?

_____

_____

_____

2. Why does it exist in that area?

_____

_____

_____

_____

3. Provide three possible solutions to the Great Pacific Garbage Patch problem-

_____

_____

_____

4. Is it possible for a Garbage Patch to occur in the oceans around Australia? Why/Why Not?

_____

_____

_____

5. What current measures are in place to prevent rubbish moving into your local waterway?

_____

_____

_____

6. Who is responsible for ensuring rubbish does not enter our ocean?

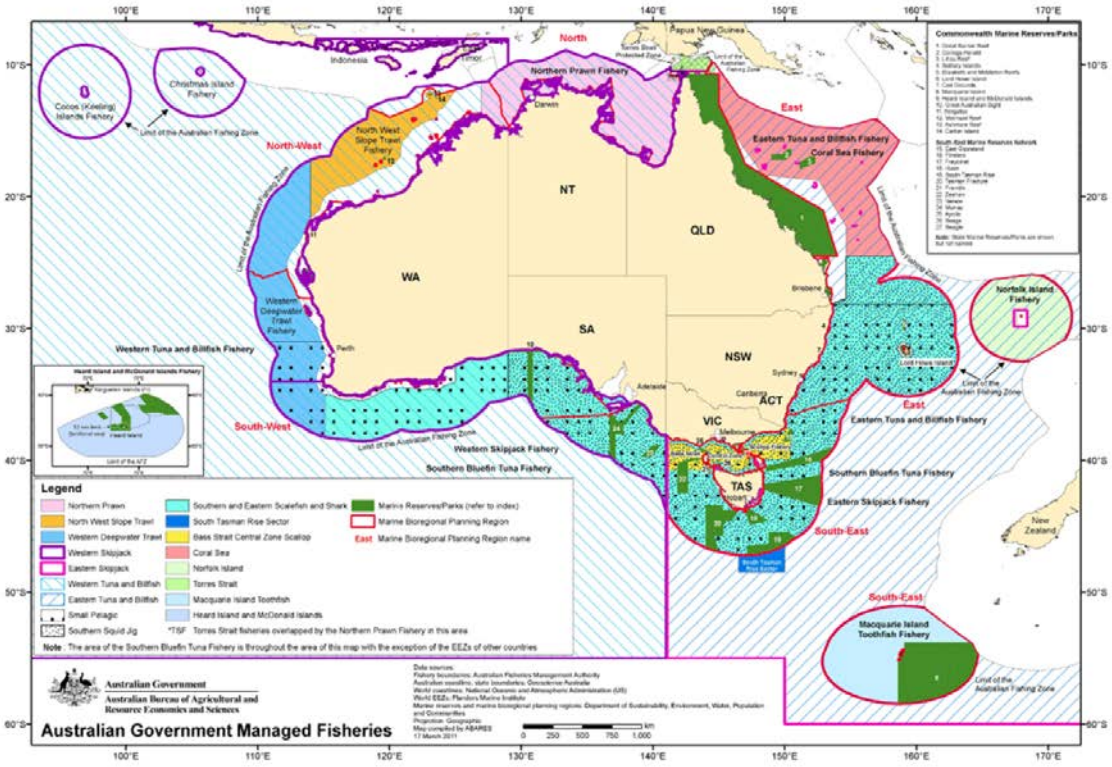
_____

_____

_____

_____

7. What are Ghost Net hotspots along the coastline of Australia? Mark them using a red pen and an X on the map below




8. Does the area where ghost nets occur have any correlation to the type of fishing taking place in that area? Yes/ No

9. List three environmental impacts from ghost nets-

_____ _____

_____

10. Name two programs currently running in Australia that are working towards eliminating the Ghost Net problem.

_____ _____

# Lesson Plan- Ocean Currents

| Year | Subject | Code | Key Words | Materials | Duration |
|---|---|---|---|---|---|
| 10 | Science | ACSIS198<br>ACSIS206<br>ACMSP247 | Great Pacific Garbage Patch, ghost nets, ocean currents, modelling, media | Access to the internet | 2X1 hour lessons |

See Australian Curriculum in Appendix 1

## Overview

Students look at the effect ocean currents have on the transportation of marine debris. They analyse the movement of a piece of debris using scientific modelling techniques, and pinpoint the origin. They develop an understanding of the role media plays in relaying information on the issue of marine debris to the public.

## Objectives

- Students develop an understanding of the movement of ocean currents.
- Students look at the modelling of ocean currents and develop an understanding of how they influence the transportation of marine debris.
- Students develop a hypothesis about the movement of marine debris on ocean currents.
- Students identify that the Great Pacific Garbage Patch has come about due to ocean currents, and identify the problems that are associated with marine debris that is found in this area.

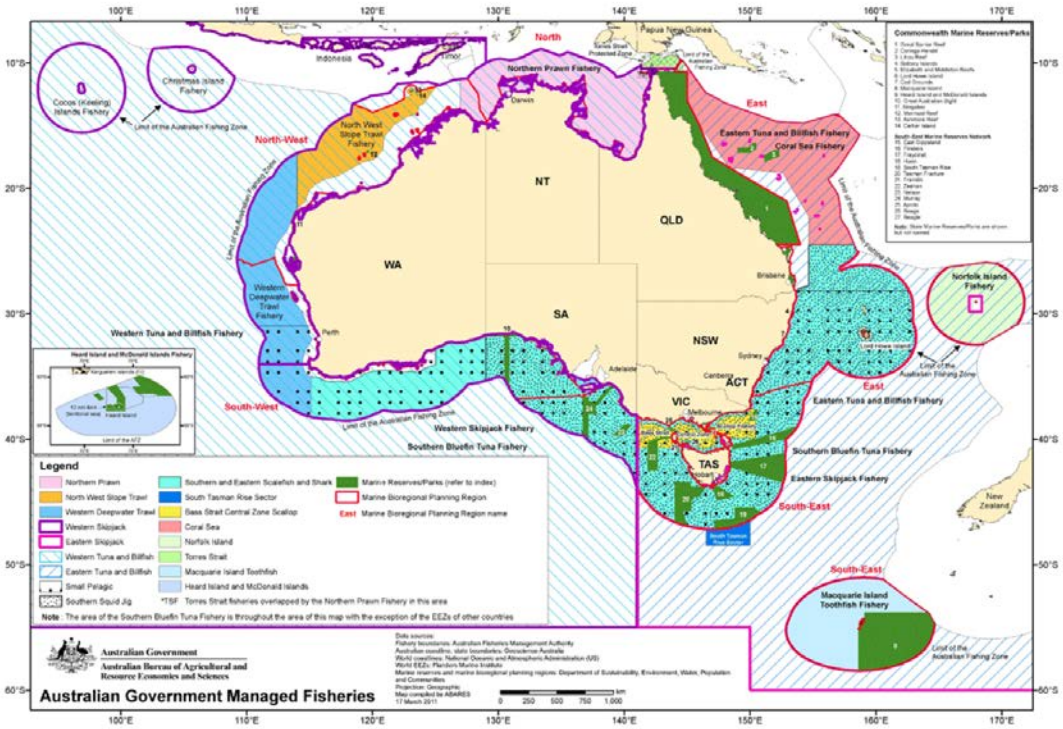
## Activity

This activity will need to be undertaken over two lessons with the first lesson covering ocean currents and the movement of marine debris and the second lesson covering ghost nets and the effect they have on marine animals.

Introduce students to ocean currents using the F**act Sheet- Ocean Currents** and explain how the movement of marine debris can be modelled along these ocean currents, with the country of origin often able to be determined. The CSIRO

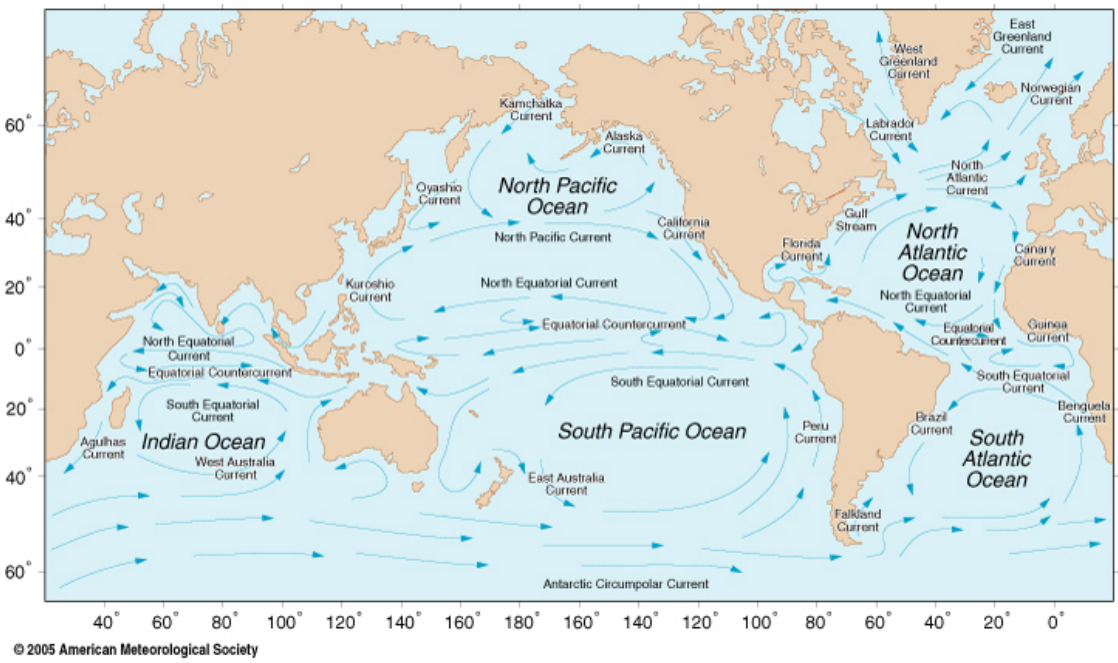
modelling system can accurately determine where an article of marine debris has come from and determine where it will go. Use the website [www.csiro.au/connie2/](www.csiro.au/connie2/) to help students predict the journey their piece of marine debris may take. Run students through the work sheet and ask them to answer the questions.

In Lesson 2, give students an overview of what is involved in research. This can include collecting data or reviewing data from secondary sources. Explain to students that once essays are completed, students are subject to peer review whereby they will gain an understanding of the process involved in preparing a paper for publication. They will need to ensure that the information in the paper is fact checked and accurate. Discuss with students that presenting accurate factual information is important. Students should identify that there is often discrepancies in facts from different sources. Discuss with them why this can be the case. For example, media sometimes misrepresents the facts to the public to sensationalise the story, by presenting small bits of information because of time constraints (and in doing so misrepresents or mistakes facts), data may not be collected accurately by different organisations putting forward the facts. There are many factors that can lead to variation – and our cultural and social biases contribute to this as well. Ask students to write an essay on the scientific, environmental, economic or social arguments for problems associated with ghost nets.



## FACT SHEET Ocean Currents

Ocean currents are a continuous directed movement of ocean water generated by forces acting upon the mean flow. These forces can include breaking waves, wind, temperature, salinity differences and tides caused by the gravitational pull of the moon and the sun. Depth, contours and shoreline configurations and interactions with other currents influence the currents direction and strength. Ocean currents and wind are responsible for the movement of marine debris across the globe.




The movement of marine debris along oceanic currents is often complex and is dependent on the properties of the debris. Marine debris that is buoyant tends to move greater distances than that which sinks to the bottom. Buoyant pieces of debris move more easily with action from wind, water and waves. It is due to these properties that buoyant pieces of debris can move over vast distances, far from their points of origin.

If a piece of rubbish is degradable it will gradually break down into smaller pieces in the marine environment. If or as an item breaks into smaller bits, it may then be accessible to wildlife further down the food chain. Also, it may move more quickly or longer distances. If a piece of rubbish is biodegradable, it is capable of decomposing back into natural elements.

Modelling of oceanic currents can aid us in identifying where debris originates.

## STUDENT WORK SHEET 1- Ocean Currents

1. How does rubbish finds its way into our ocean and become marine debris?

_____

_____

2. Why is management of stormwater runoff important?

_____

_____

3. Once rubbish is in the ocean how does it travel?

_____

4. To understand where the rubbish originated from fill in the following details-

item_____description_____

Where item was found-

latitude_____longitude_____

5. The source the debris was from LAND\SEA (please circle)

6. What is the information we need to find out-

Language on item_____ Country of origin_____

Possible city 1_____ Possible city 2_____

Possible currents the debris followed_____

7. Before using the CSIRO website, develop your own hypothesis of where the rubbish has come from, take into account the oceanic currents and probable origin of the rubbish from the other identifying features.

_____

_____

_____

_____

_____

Use the CSIRO website, did you have an accurate idea of the origin? Was your hypothesis proven? If not you will need to revise your hypothesis and test the theory again.

8. Where did your debris originate from?_____

9. Did the path you predicted follow the path on the map? YES\NO (circle)

10. What ocean currents were involved?_____

11. Develop a hypothesis of where you think the item will have ended up after one year and what state the debris would have been in, think of the probability of the object being in a degraded state.

_____

_____

_____

12. The North Pacific Gyre is an area where marine debris accumulates and is known as the Great Pacific Garbage Patch, why do you think that is? (refer to your map)

_____

_____

_____

_____

## Student Work Sheet 2- Marine Debris in the Spotlight

In groups investigate some recent reports in the media on ghost nets; discuss your findings in your group. Individually, write a one page essay on some of the arguments for the problems associated with ghost nets .Include statistical information to validate the argument, including the amount of ghost nets entering our waterways each year, the amount of marine life that may become entangled each year as a result of ghost nets and the dollar value of lost tourism on both a global and local scale. Language such as 'given', 'of', knowing that' is to be included in the text to tie the statistics together with your conclusions from your research. Useful internet sites to start with include:

Ghost Nets Australia www.ghostnets.com.au

World Wildlife Fund http://wwf.panda.org/about_our_earth/blue_planet/problems/

# Lesson Plan Analysis of data

| Year | Subject | Codes | Key Words | Materials | Duration |
|---|---|---|---|---|---|
| 7-9 | Maths | Year 7- ACMSP172<br>Year 8- ACMDP206<br>ACSIS145<br>Year 9- ACMSP283 | Statistical analysis, mean, median, range, analysis. | Computer with Microsoft Excel. | 45 minutes |

See Australian Curriculum in Appendix 1

## Overview

Students will further analyse data collected from the field trip or in class to draw accurate conclusions. They will be able to identify the mean, median and range and discuss with their classmates the significance of each.

## Objectives

- Create a graphical representation of data
- Analyse data and draw conclusions from the bar chart
- Calculate the mean, median and range of the results
- Discuss findings in a group

## Activity

Students are to further analyse the data collected via surveying or as part of the in classroom sorting activity using a bar chart. Students are to input the data into an excel (or similar) spreadsheet. They are to compare the data and identify the mean, median, and range of their results. By comparing their findings, students are to identify common trends in the data and discuss with their classmates what they can conclude from this.

## Analysis of data

After completing the in classroom activities students will conduct an analysis of data using either a bar graph created in excel (or similar) or the TeachWild website. Analysis of the data will vary depending on the year of the students.

To enter the data into an excel (or similar) spreadsheet use the following steps-

Tally up all of the class's data on the board. Use Microsoft Excel (or similar) to analyse data with students to create a bar chart as a graphical representation of the class results.

**To do this-**

Step 1- Enter data into an Excel spreadsheet with name of rubbish on the left hand side and the corresponding amount of rubbish on the right hand side.

Step 2- Click on Insert, Bar Chart.

Under the more functions tab calculate the mean, median and range of the results.

Discuss the following questions in class-

After students have analysed the data, ask them are they surprised by the results?

Would this be a result of incorrect methodology being used in surveying or could it be a result of some areas being more prone to marine debris? What factors might affect if debris occurs randomly or non-randomly? (beach characteristics such as slope, being a cove or point, oceanic currents, etc.)?

How much does wind influence the movement of rubbish along the beach?

Was there a particular area along the beach where you found the largest amount of rubbish? What factors may have influenced this?

# Extension Exercises

## Year 6

Ask students to collect rubbish at home for a marine debris art project. The artwork is to represent marine life in their natural habitat. Explain to students that through education we create awareness, get them to sit down with a family member and ask the student to talk to them about what they have learned about marine debris.

Once the artwork is completed, hold an exhibition at school where students can present their works to the community. Actively involve students in the lead up to the exhibition by developing a promotions committee who will be responsible for ensuring the success of the exhibition. Get students to promote the event using environmentally friendly methods such as e-brochures, radio and tv interviews.

Marine debris artwork created Year 9 Coastal Ambassador students at Phillip Island Nature Park

## Year 7

Students to look at the effects that marine debris can have on marine food chains. Share the resource link, a news report on the affect marine debris is having on Flesh-Footed Shearwaters on Lord Howe Island.

Once students have seen the report, ask them to look at food chains in the marine environment. How does the plastic end up in the stomach of the seabirds? Why is it so hard for the bird to process the plastic? How does it end up in the food chain in the first place and what are the repercussions of this for Threatened Species? What can they do to ensure that one of the more pristine places in the world remains that way?

Resources

Catalyst segment on Flesh-Footed Shearwaters
http://www.abc.net.au/catalyst/stories/3583576.htm

7.30 Report

http://www.abc.net.au/7.30/content/2012/s3405538.htm

### Year 8

In class, brainstorm ideas and initiatives to combat marine debris, use these ideas to develop a Marine Life Warriors campaign. The campaign is to encourage the public to protect and conserve our oceans and marine life. Divide students into groups and set a research task on the topic, what impacts can students see marine debris having on our environment, 5 years, 10 years, 25 years and 100 years down the track. How can students combat this now? How can they best target polluters? Students are to present their campaign to the class and the class is to decide what campaign is the best. The nominated campaign can be shared with other schools on the TeachWild website (or highlighted in a web based conference with other schools).

### Year 9

Students are to develop an education campaign for recreational and commercial fishers to raise awareness of ghost netting. Students are to look at ways in which to educate different cultures from around the globe about the proper disposal of nets. This campaign is to be accompanied by an outline of the affects of ghost nets on the marine environment and marine life if they are left to continually fish in our seas.

Resources

http://www.ghostnets.com.au/

### Year 10

Students are to simulate the transportation of rubbish on ocean currents and identify how rubbish on land ends up becoming marine debris. Fill a tub with water and sand. Get one person to make waves at one end and slowly put pieces of rubbish into the water. Watch as the movement of the water pushes the rubbish onto the sand, create smaller then larger waves. Ask students why they think storm swells produce more marine debris on the beach and what effect oceanic currents have on the transportation of rubbish across the globe. What types of debris are easily transported?

# In Classroom Marine Debris Monitoring

As all students are unable to actively participate in surveying out in the field, the in classroom activities have been designed to provide a similar experience. All students will learn the required skills to sort and classify examples of debris using the field data sheets- Transect Debris (type and colour) and Marine Debris Size Chart. They will also grasp the concept of marine debris beach surveying and understand why scientists use the methodology they do for data collection and how that data is then used in scientific research. A PowerPoint presentation and support notes can be used to guide students through these activities and is available for download as a separate component to this kit.

# Lesson Plan Marine Debris Monitoring

| Year | Subject | Codes | Key Words | Materials | Duration |
|---|---|---|---|---|---|
| 6-10 | Science, Maths, Geography | Year 6- ACSIS232, ACSIS105<br><br>Year 7-ACSIS125, ACMSP167, Geographical Inquiry and Skills- Observing and Questioning.<br><br>Year 8- ACSIS146, Geographical Inquiry and Skills- Observing and Questioning.<br><br>Year 9- ACSIS170, ACMSP283<br><br>Year 10- ASIS198 | marine debris, entanglement, behaviour, prevention. | PowerPoint presentation, projector, laptop, variety of rubbish to sort, Transect Debris Sheet, Marine Debris Size Chart Sheet. | 1hour |

See Australian Curriculum in Appendix 1

## Overview

## Teachers Note

Keeping a box of marine debris handy for further analysis by students is advised. For students unable to visit aquatic habitats, seeing and handling of debris will show them the different properties of debris. This may help to increase students understanding of items that can end up in the marine environment and what the effects may be of those items.

For inland schools that wish to use this kit, terminology will need to be adjusted with marine debris replaced by aquatic debris and activities adapted accordingly.

Students are introduced to the concept of marine debris by TeachWild staff. They look at the structural properties of different type of debris and begin to understand the significance of the issue. Marine animal entanglement, ingestion, and impacts of debris on habitat are also explored in depth. The ability for rubbish to stay in the marine environment for long periods of time and the rate at which certain everyday items degrades is highlighted to students. A hands on activity involving sorting of marine debris is undertaken by students and is supervised by TeachWild staff. Students look at the methodology behind marine debris surveying and gain a clear insight as to why it is important to collect scientific data to address an environmental issue. They discuss possible solutions to the marine debris problem with scientists and develop an understanding of the importance of changing our behaviour to address the problem.

## Objectives

- To develop a clear understanding of the problem of marine debris.
- Discuss problems associated with marine debris, including marine animal entanglement and ingestion, impacts of marine debris on habitat, and effects marine debris can have on humans.
- Participate in marine debris sorting, analysis of data collected and make conclusions from this data.
- Communicate findings from their scientific investigation.
- 
- Recommend actions for remediation and pollution prevention.

## Activity

This activity is in two parts with the PowerPoint Presentation designed to be an introduction to the marine debris problem and key concepts. The PowerPoint presentation will be followed on by the Marine Debris Sorting Activity where students will actively participate in collection of data by sorting and classifying of debris in groups.

## Marine Debris Sorting Activity

1. Students are divided into groups of 3-6 and are handed a bag of rubbish to sort. Group size depends upon number of students in class and number of adult helpers.
2. Each group is to nominate a recorder for the group who will be responsible for accurately recording the data using both the Transect Debris Sheet and Marine Debris Size Chart. Students will identify the rubbish and classify rubbish in regards to size and material.
3. Once the data has been collected, scientists will ask students if they can see any clear results and what conclusions they can derive from the raw data, such as- Is there one item that is more common than other items? What size of debris is most common? What impact might this have on marine animals?
4. If time permits, students are to enter data into excel and develop a bar graph and further discuss results. Scientists ask students if the analysed data matches up with the students hypothesises of the raw data? Is so why do they think this is the case? If the hypothesis was inaccurate why do they think this is so?

# Additional Activities

The following activities are designed to be undertaken at the end of the lesson if time permits, each is to run for between 5-10 minutes and will expand upon the information already learnt by students in the classroom and out in the field.

## Activity 1- Reuse, Recyclable and Non-Recyclable- Year 6

After the sorting activity, students are to identify recyclables, non-recyclables and items that could be reused. Students are to look at the codes on the base of the different items. Codes from 1-5 are recyclable with any over that number not able to be recycled
. These items end up in our garbage dumps as land fill. Explain to students that what products we choose to buy has an impact on our environment. If they had a choice would they choose a product if the container it came in could not be recycled? Explain the value of choosing a recyclable option. Reiterate to students that we as individuals can all make a difference if we choose what we buy wisely; being wise with our waste is one of the most important things we can do to combat the marine debris problem.

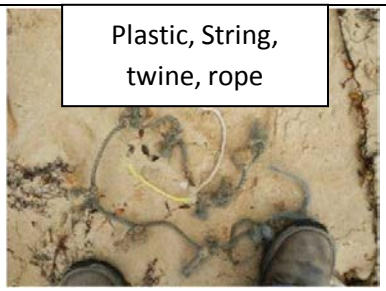
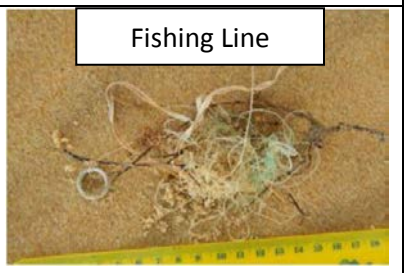
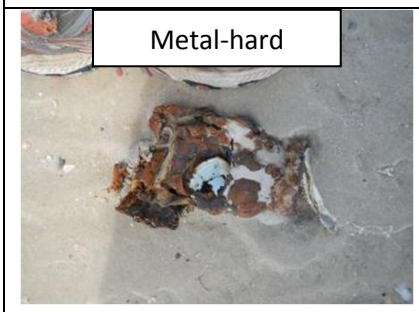
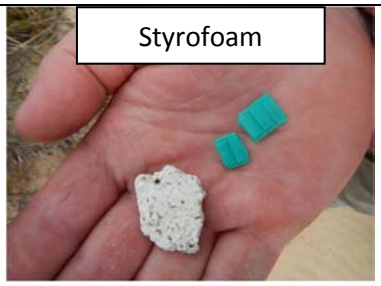
## Activity 2- Degradation of Plastic- Year 7

Students are to look at the rate at which plastic degrades within the marine environment, using two spoons, one made of plastic and the other made out of corn starch. Put each spoon in hot water and look at how long it takes to degrade. This may take some time but students will get to see how slowly plastic degrades in the marine environment. They will see how gradually the plastic will break down into smaller and smaller pieces. Ask students how these fragments might affect marine animals.

## Activity 3- How Harmful is it? - Year 8

Hand out to students the following photographs and ask them to comment on how harmful they think each piece of rubbish is to a marine animal with a rating out of 10. On the back of each of the photographs students are to comment on how the piece of rubbish may affect a marine animal, for example a fishing line may become entangled around a seabirds beak, this might limit the birds ability to eat. What might be the consequence of reduced ability to eat?

# How Harmful is it?

| | | |
|---|---|---|
| Hard Plastic  | Plastic Bag  | Film Like Plastic  |
| Soft Plastic  | Plastic, String, twine, rope  | Fishing Line  |
| Metal-hard  | Metal-soft  | Balloon  |
| Styrofoam  | Wood  | Paper  |

## Activity 4- Marine Debris Quiz- Year 9

Divide the class into groups of three to four for a quiz on marine debris. The first group that raises their hand and answers correctly gets a point on the board with the group with the most points announced as the marine debris champions. Ask students to answer the following questions-

Q-What is marine debris?
A-Any man-made object that can be intentionally or unintentionally discarded, disposed of or abandoned that enters our marine environment

Q-How does rubbish from land end up in our waterways?
A-The origin of land debris is often from runoff, stormwater drains, air-borne debris and irresponsible disposal of rubbish by beach goers and campers.

Q- How does marine debris travel?
A- Marine debris travels along wind, water and waves.

Q- Why is marine debris a problem?
A- It impacts upon our marine environment through wildlife entanglement and ingestion. Debris can degrade, breaking down into smaller and smaller pieces. It also visibly pollutes beaches and there is economic loss of revenue for the fishing and tourism industries.

Q- How many tonnes of marine debris enter our waterways each year?
A- 7 billion tonnes

Q- What are the 3 R's?
A- Reduce, Reuse, Recycle

Q- What can be done to combat the marine debris problem?
A- Education and research creates an understanding and awareness of the issue. Collecting scientific data can identify sources and hotspots of marine debris, so that we can make better, more effective decisions. The National Marine Debris database will utilise important data in furthering research efforts and increase knowledge on the extent of the problem, students are doing their part by monitoring marine debris in their local area.

## Activity 5- Marine Debris Movement- Year 10

A fan and a tub of water are required for this activity. Students will be looking at the buoyancy and movement of the different types of rubbish. Using the rubbish from the sorting activity put each different type of rubbish in front of the fan. Ask students to keep an eye on how far the rubbish moves and determine how it moves through the air, e.g. does it spiral through the air, or drift? When all pieces of debris have been passed in front of the fan, ask students the following questions-

- Which piece of rubbish moved the greatest distance and how easily did it move?
- Why do they think this is so?

Put the tub of water in front of the fan and repeat the process.

- Did the presence of water slow the more moveable pieces of rubbish down or was it more buoyant?
- What types of rubbish will move the greatest distances?
- Will this type of rubbish persist more in the marine environment or not?

Once the activity is completed reiterate to students that ocean currents drive marine debris all over the world and that the properties of an item can determine how far it will go e.g. moveability in wind, buoyancy and the ability to persist in the marine environment are all factors in modelling the movement of marine debris.

# Student / Teacher Website Resource List

This resource list has been compiled to provide background information on marine debris to further enhance students learning experience. Earthwatch is not responsible for changes to content on any of the following websites aside from the TeachWild website and accepts no responsibility should content change and not be of an acceptable standard.

TeachWild
teachwild@earthwatch.org.au

CSIRO marine debris research
http://www.csiro.au/Organisation-Structure/Flagships/Wealth-from-Oceans-Flagship/marine-debris.aspx

Oceanographic web based model:
http://www.csiro.au/connie2/

http://theconversation.edu.au/marine-debris-biodiversity-impacts-and-potential-solutions-2131

## Further relevant references

Australian Government, Department of Sustainability, Environment, Water, Population and Communities, Australian Antarctic Division
http://www.antarctica.gov.au/science/australian-antarctic-science-strategy-200405-201011/impact-of-human-activities-in-antarctica/past-research/marine-debris

Australian Government- Great Barrier Reef Marine Park
http://kurrawa.gbrmpa.gov.au/corp_site/info_services/publications/sotr/shipping/page_04.html

GhostNets Australia
http://www.ghostnets.com.au/

Humane Society International Australia
http://www.hsi.org.au/?catID=117

Marine Education Society of Australasia
http://www.mesa.edu.au/

Oceanwatch Australia
http://www.oceanwatch.org.au/?s=marine+debris

Reef Watch South Australia
http://www.reefwatch.asn.au/

Surfrider Australian Foundation
http://www.surfrider.org.au/2011/02/national-marine-debris-initiative/

The Australian Marine Conservation Society
http://www.amcs.org.au/default2.asp?active-page-id=114

The Conservation Beta
http://theconversation.edu.au/marine-debris-biodiversity-impacts-and-potential-solutions-2131

Wikipedia Marine Debris Definition
http://en.wikipedia.org/wiki/Marine_debris

## Education Kits

Healthy Waterways
http://www.healthywaterways.org/HealthyWaterways/Education/Litterandwasteresources/Games/EducationalResources.aspx

Marine or Ocean Pollution
http://www.teachers.ash.org.au/jmresources/seaweek/links.htm

Marine Waters Western Australian Teacher Education Resources
http://marinewaters.fish.wa.gov.au/marine-biology/

Perth Beachcombers Education Kit
http://www.fish.wa.gov.au/beachcombers-kit/coastal-uses-impacts/marine-debris/

Tangaroa Blue Ocean Care Society Marine Debris ID Manual
http://www.oceancare.org.au/site/index.php?option=com_rokdownloads&view=folder&Itemid=1000100&id=20:marine-debris-id-manual

## Articles

ABC-Whale Death Article
http://www.abc.net.au/local/stories/2011/10/18/3342237.htm

Ghost Nets in Northern Australia
http://www.ghostnets.com.au/pdf/emr_525.pdf

Great Pacific Garbage Patch
http://marinedebris.noaa.gov/info/patch.html

Jennifer Lavers- Plastic Pollution – A Global Problem
http://www.jenniferlavers.org/plastic-pollution/

Lord Howe 's mutton bird population in decline, 7.30 report-
http://www.abc.net.au/7.30/content/2012/s3405538.htm

## National Oceanic and Atmospheric Administration- United States Department of Commerce-

NOAA Marine Debris Program
http://marinedebris.noaa.gov/outreach/welcome.html

National Ocean Service
http://oceanservice.noaa.gov/education/

## New Zealand

Ministry for the Environment
http://www.mfe.govt.nz/issues/oceans/kids/reducing-pollution.html

Sea Sheppard- The Plastic Sea
http://www.seashepherd.org/commentary-and-editorials/2008/10/30/the-plastic-sea-372

# Appendix 1- The Australian Curriculum

The Australian Curriculum sets out the core knowledge, understanding, skills and general capabilities important for all Australian students. Three main areas of the curriculum were explored in the development of this kit - Science, Maths and Geography. The Geography syllabus is currently in draft stage with key learning areas for students identified and outlined. The curriculum has been reviewed and key learning areas that are achieved by each year through use of the kit identified and addressed during classroom and field based activities. An expanded version of the curriculum can be found at-

http://www.australiancurriculum.edu.au/

## Science

### Year 6

Code ACSIS232

With guidance, pose questions to clarify practical problems or inform a scientific investigation and predict what the findings of an investigation might be-

- Refining questions to enable scientific investigation
- Asking questions to understand the scope or nature of a problem
- Applying experience from previous investigations to predict the outcomes of investigations in new contexts.

Code ACSIS105

Use equipment and materials safely, identifying potential risks

- Discussing possible hazards involved in conducting investigations and how these risks can be reduced.

*Code ACSIS232- Prior to field work, scientists discusses with students the reasons for undertaking marine debris surveying. Students determine why they think marine debris surveying is important and what methods they think should be used. They are asked to predict the outcome of the survey. During the classroom activity students are able to use experience gained from the field investigation and apply this to their predictions of the differences in the decay of rubbish from the bin and on the beach.*

*Code ACSIS105- Prior to fieldwork; students are asked what they think the risks associated with fieldwork are and students are to determine how they may be mitigated.*

## Year 7

Code ACSIS124

Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge

- Working collaboratively to identify a problem to investigate.
- Recognising that the solution of some questions and problems requires consideration of social, cultural, economic or moral aspects rather than or as well as scientific investigation.
- Using information and knowledge from previous investigations to predict the expected results from an investigation.

Code ACSIS125

Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments ensuring safety and ethical guidelines are followed-

- Working collaboratively to decide how to approach an investigation
- Learning and applying specific skills and rules relating to the safe use of scientific equipment
- Identifying whether the use of their own observations and experiments or the use of other research materials is appropriate for their investigation.
- Developing strategies and techniques for effective research using secondary sources, including use of the internet.

Code ACSSU112

Interactions between organisms can be described in terms of food chains and food webs; human activity can affect these interactions.

- sing food chains to show feeding relationships in a habitat
- constructing and interpreting food webs to show relationships between organisms in an environment
- classifying organisms of an environment according to their position in a food chain
- recognising the role of microorganisms within food chains and food webs

*Code ACSIS124- Working in groups students investigate the problem of marine debris. Students look at the impact plastics are having on marine food chains. They look at their own and others consumptive behaviour obtaining a greater understanding of the scale of the issue from a social, cultural, economic and moral point of view rather than or as well as scientific investigation through fieldwork.*

*Code ACSIS125- Working in groups students discuss the sampling method prior to the surveying. Through guidance from scientists students will learn and apply skills and rules in the use of scientific equipment used in the surveying of marine debris. Students are encouraged to make their own observations of the results and discuss their findings with the scientist at the end of the survey. Students then use the internet to identify possible strategies and techniques to enhance their research.*

*Code ACSSU112- Students look at the different trophic levels and identify where different types of organisms fit into the food chain. Students develop their own food chain and trace the movement of a piece of plastic up that food chain. They also identify the role of microorganisms within food chains and food webs.*

## Year 8

Code ACSIS145

Summarise data from students own investigation and secondary sources, and use scientific understanding to identify relationships and draw conclusions-

- Constructing tables, graphs, keys and models to represent relationships and trends in collected data.
- Drawing conclusions based on a range of evidence including primary and secondary sources.

Code ACSIS146

Reflect on the method used to investigate a question or solve a problem, including evaluating the quality of the data collected and identifying improvements to the method.

- Suggesting improvements to investigation methods that would improve the accuracy of the data.

Code ACSIS148

Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate

- Using digital technologies to construct a range of text types to present scientific ideas
- Selecting and using appropriate language and representations to communicate science ideas within a specified text type and for a specified audience.

*Code ACSIS145- In the classroom, prior to uploading the data onto the TeachWild website, students analyse the data themselves by creating a graph in excel of all the data collected. Students draw their own conclusions from the data and compare this to the results published on the TeachWild website.*

*Code ACSIS146- Students identify any faults they can find with the survey method and determine how they think the survey method can be improved to collect more accurate data.*

*Code ACSIS148- Students develop a poster targeted at the general public which includes the use of digital technologies and emotive language to communicate scientific ideas concluded from their simulated experience of marine debris entanglement.*

## Year 9

Code ACSIS164

Formulate questions or hypotheses that can be investigated scientifically

- Using internet research to identify problems that can be investigated
- Evaluating information from secondary sources as part of the research process
- Revising and refining research questions to target specific information and data collection or finding a solution to the specific problem identified
- Developing ideas from students own or others' investigations and experiences to investigate further

Code ACSIS169

Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies.

- Using spreadsheets to present data in tables and graphical forms and to carry out mathematical analyses on data.
- Describing sample properties (such as mean, median, range, large gaps visible on graph) to predict characteristics of the larger population
- Designing and constructing appropriate graphs to represent data and analysing graphs for trends and patterns.

Code ACSIS170

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence

- Comparing conclusions with earlier predictions and reviewing scientific understanding where appropriate
- Suggesting more than one possible explanation of the data presented.

*Code ACSIS164- Through researching marine debris on a local and global scale students identify the problem that is the Great Pacific Garbage Patch. They evaluate the information gathered from this research and determine why the Great Pacific Garbage Patch exists in that area. As individuals, students discuss the problem with their classmates and determine how to best investigate the issue further.*

*Code ACSIS169- With the data collected from sampling students enter it into an excel spreadsheet for further analysis. Students use the data to develop a graph which shows the comparison between the trends and patterns of the data.*

*Code ACSIS170- Prior to the excursion taking place students predict what they think the outcome of it will likely be, including if they think there will be a lot of rubbish washed up on the shoreline and what piece of rubbish they think will be the most common. After conducting fieldwork students compare actual conclusions with hypotheses derived from the previous in classroom discussion. Post survey, students discuss with scientists what is the scientific basis for the modelling of marine debris and what they expect the predicted outcomes from the modelling of the debris to be. In the group discussion students suggest two possible reasons for the data results and explain how they came to these conclusions.*

## Year 10

Code ACSIS198

Formulate questions or hypotheses that can be investigated scientifically

- Developing hypotheses based on well developed models and theories.
- Using internet research to identify problems that can be investigated.
- Formulating questions that can be investigated within the scope of the classroom or field with available resources.
- Developing ideas from students own or other's investigation and experiences to investigate further.
- Evaluating information from secondary sources as part of the research process.

Code ACSIS206

Critically analyse the validity of information in secondary sources and evaluate the approaches used to solve problems.

- Researching the methods used by scientists in studies reported in the media.
- Judging the validity of science- related media reports and how these reports might be interpreted by the public.
- Describing how scientific arguments as well as ethical, economic and social arguments are used to make decisions regarding personal and community issues.

*Code ACSIS198- Students develop a hypothesis on the movement of marine debris based on oceanic currents. Students are able to identify the problem of the Great Pacific Garbage Patch and investigate further using secondary sources and the internet.*

*Code ACSIS206- Using the Student/Teacher Website Resource List as guidance, students investigate some recent reports in the media on marine debris. They write an essay that is peer reviewed, through their research student's look at the validity of science found in media reports and develop an understanding of how these reports may be interpreted to the public. Students comment on the ethical, economic and social arguments for the problems associated with ghost nets within developing countries.*

# Mathematics

## Year 6

Code ACMMG135

Connect decimal representations to the metric system.

- Recognising the equivalence of measurements such as 1.25metres and 125 centimetres.

Code ACMMG136

Convert between common metric units of length, mass and capacity

- Identifying and using the correct operations when converting units including millimetres, centimetres, metres, kilometres, milligram, grams, kilograms, tonnes, millilitres, litres, kilolitres and mega litres
- Recognising the significance of the prefixes in units of measurements.

*Code ACMMG135- During sampling students use transects to map sampling area, measuring tapes are used and centimetres converted to metres.*

*Code ACMMG136- Students convert centimetres to metres whilst using a measuring tape and recognise the significance of the use of cm and m.*

## Year 7

Code ACMSP167

Construct sample spaces for single- step experiments with equally likely outcomes

- Distinguish between “equally likely” outcomes and outcomes “not equally likely”.
- Discussing the meaning of probability terminology (for example probability, sample space, favourable outcomes, trial, chance events and experiments)

Code ACMSP172

Describe and interpret data displays and the relationship between the median and mean

- Using mean and median to compare data sets and explaining how outliers may affect the comparison.
- Locating mean, median and range on graphs and connecting them to real life.

*Code ACMSP167- Prior to the excursion discuss with students the equally likely outcome of finding a large amount of marine debris on the beach as opposed to small amount. Through surveying students will discuss such terminology as probability of there being rubbish, the sample space of the survey and what trials have been conducted previously to develop a standardised methodology for sampling. They will also look at what role chance events such as weather conditions play in the quantity of marine debris collected and how experimental design plays a role in the quality of data collected and used for analysis.*

*Code ACMSP172- Using excel students create a bar chart and identify the mean, range and median from the data. Students look at what outliers could have affected the results. They understand that it could be a result of incorrect methodology being used in surveying or it could be a result of some areas being more prone to marine debris then others due to beach characteristics and oceanic currents.*

## Year 8

Code ACMSP206

Explore the practicalities and implications of obtaining representative data using a variety of investigative processes.

- Understanding that making decisions and drawing conclusions based on data may differ from those based on preferences and beliefs.
- Investigating an international issue where media reporting and the use of data reflects different cultural or social emphases (for example whaling, football World Cup outcomes)

*Code ACMSP206- From the data collected and conclusions drawn from the previous investigation, students will be able to distinguish between conclusions based on preference and beliefs. By investigating the international issue of marine debris students will be able to determine how data can reflect a different cultural or social emphasis in the media by using the Student/Teacher Website Resource List to aide further investigation on the effects marine debris has on marine animals.*

## Year 9

Code ACMSP283

Compare data displays using mean, median and range to describe and interpret numerical datasets in terms of location (centre) and spread.

*Code ACMSP283- Post surveying students look at the data collected and each group determines the mean, median and range. They then discuss these results in class and interpret the datasheets in terms of location (centre) and spread. Results from student's data are then compared to the National Marine Debris Database on the TeachWild website.*

## Year 10

Code ACMSP247

Use the language of if... then 'given', 'of', 'knowing that' to investigate conditional statements and identify common mistakes in interpreting such language.

- Evaluating media reports that refer to data from a range of contexts, where the evaluation allows students to demonstrate their statistical literacy.

*Code ACMSP247- Using the Teacher/Student Website Resources List students research some of the statistics on marine debris including- the amount of ghost nets entering our waterways each year, the amount of marine life entangled each year as a result of ghost nets and the dollar value of lost tourism on a local and global scale.*

*Students sift through media reports to find answers to these questions, it is through this investigation that they will find discrepancies in the facts, they will acknowledge that common mistakes are made in the interpretation of statistics and understand that it is dependent on the correct interpretation of statistical language. Students essay writing includes the current statistics on ghost nets using language such as 'given, 'of" knowing that' to tie statistical information together.*

# Geography

## Year 6

### Processing data and information collected and look for patterns or relationships

#### Manage data and information collected and look for patterns or relationships

- Converting data into a useful form, such as a spreadsheet, display, graph or distribution map, then making decisions informed by trends in data or information.
- Creating or adding to maps (such as grid maps), including a scale and demonstrating specific features or relationships,
- Using tables and charts to compare information from different information sources.

#### Combine data and information to draw and share conclusions, considering their impacts

- Explaining a situation in terms of cause and effect and suggesting and evaluating possible future scenarios, giving reasons for their preferred options.
- Considering their findings or conclusions and identifying the probable reactions and responses of those who hold other viewpoints.

*Survey- Using the mud map students developed of the survey site, students map out the areas that have been surveyed and record using symbols on the map of the areas that are dense with rubbish. Students then identify trends with the data collected.*

*In the classroom- Students look at the degradable properties of rubbish and develop an understanding of how long common articles of rubbish can take to break down in the environment. They consider their findings and identify how waste can be broken down in the environment. Students identify how the general public will react to the timeline of rubbish through their own reactions and that of their classmates.*

## Year 7 & 8

### Geographical Inquiry and Skills

#### Observing and Questioning

Determine a focus for the inquiry within an area of interest, for example, make a prediction or develop a key question.

- Considering an area of study or current event to generate ideas for an inquiry, such as describing their response and developing an inquiry from that.
- Distinguish between the geographical and other kinds of questions, for example, “so what” questions about effects, ‘what ought’ questions about what should happen, ‘what might happen’ questions about the future and ‘what if’ questions about alternatives in a geographical context.

*In the classroom- Prior to the excursion students will look at the marine debris problem. They will develop an inquiry by looking at the effects marine debris is having across the globe. In class scientists will take students through the scale and nature of the problem and apply it in a local and global context. Students will be asked questions in a geographical context such as- So what if people litter and it ends up in our oceans? What ought to be the repercussions of this? What might happen to marine life? What if this continues to happen across the globe? Students will then be able to answer these questions and determine probable solutions to the marine debris problem.*

## Year 9 & 10

Planning, collecting and evaluating

Determine a purpose and operational scale of the geographical inquiry and independently design the inquiry.

- Considering what answers or explanations are needed and at what scale, for example, at the local or global scales.
- Design the inquiry and develop a plan to determine which data will be needed and to locate this data from fieldwork, library and online research using spatial technologies, maps, statistics, photographs and other images.
- Collecting primary data and secondary data, including fieldwork techniques such as interviews, surveys, observation, taking photographs, annotating maps and land use surveys
- Determining which information sources will provide relevant, reliable and representative data, and addressing issues, for example, using another collection method such as a survey or soil testing.

*In the classroom- Students are to formulate questions as to why surveying of marine debris is necessary. They are then to develop a clear plan of what data is needed and how this data would best be collected. During fieldwork students will look at the methodology used by the scientists in the surveying process .Prior to surveying students investigate how they think the scientist's methodology will achieve accurate results. Students are responsible for the collection of data and fieldwork techniques, including transects. Once fieldwork is completed students can use other information collected during the fieldtrip such as photographs, maps and observations and upload this onto the TeachWild website to share with other schools. Students comment on this information and explain what the cumulative data means on both a local and global scale in an open forum.*

# Appendix 2- Website Instructions

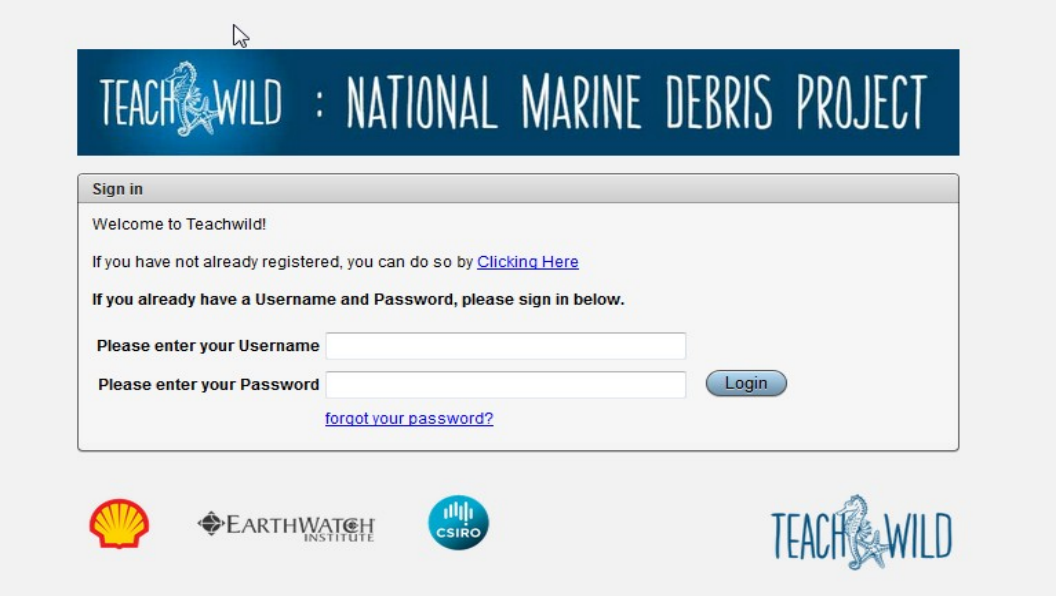
## TeachWild Website – Database Instructions

To upload your marine debris data go to the TeachWild site- www.teachwild.org.au and follow these simple steps-

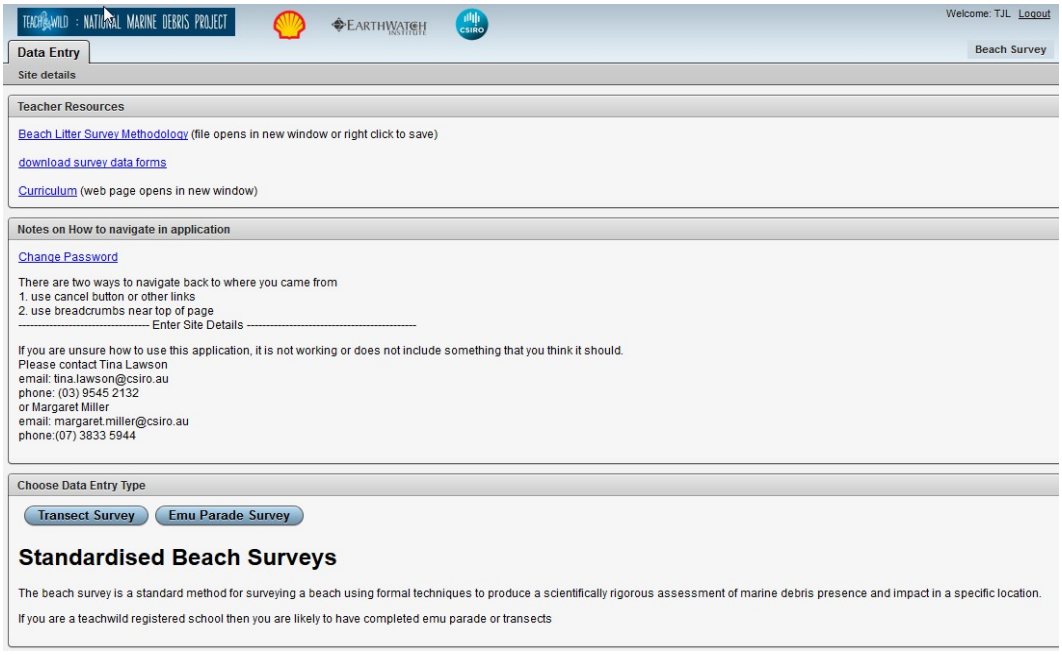
Click on 'Log your data here' on the home page

**Transects** - To enter data, you first need to be registered.

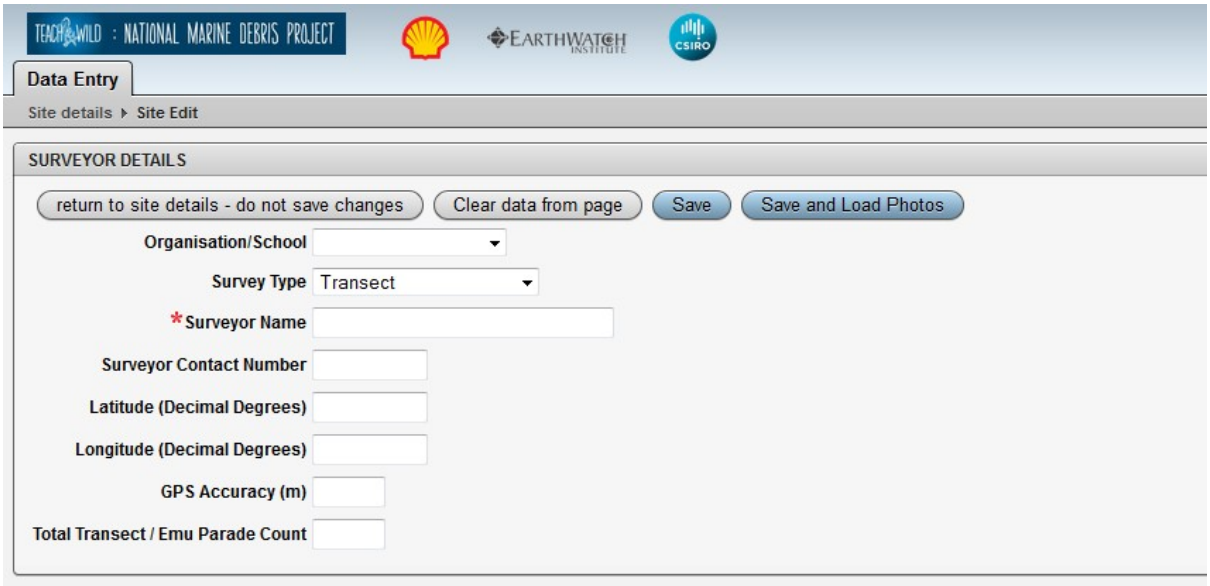
1) Enter your username and password, press the "Login" button



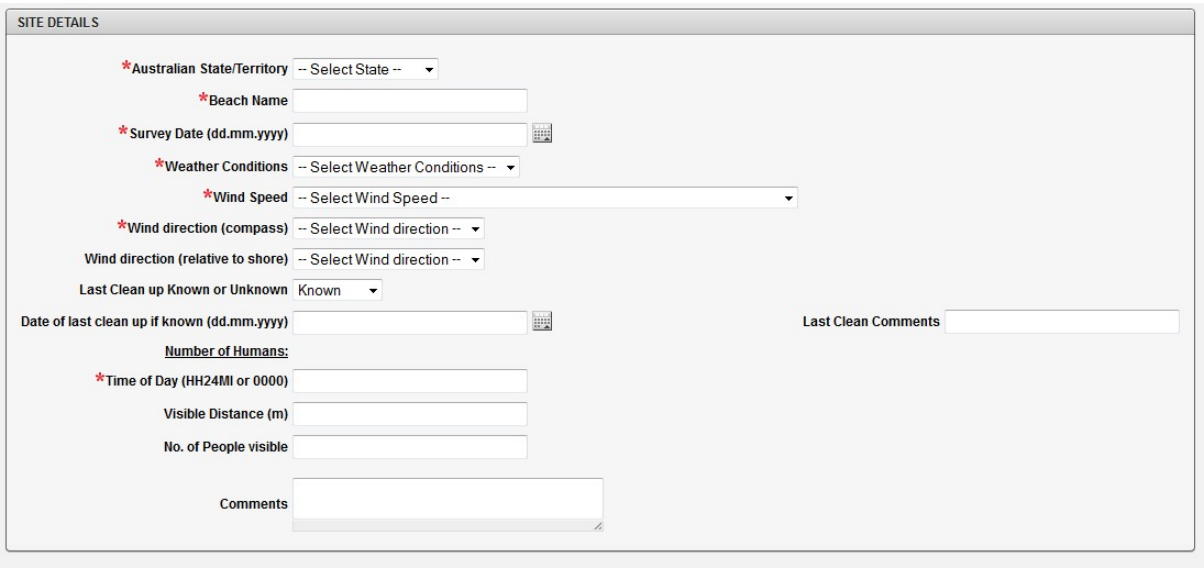

2) Click on the "Transect Survey" button



3) Enter in the ‘surveyor details’, these are the same details as can be found on your ‘Marine Debris Beach Survey’ data sheets – NOTE: The “latitude (Decimal Degrees)” field must be negative (e.g. -35.12546)




4) Enter in the ‘site details’ as required, these are the same details found on your ‘Marine Debris Beach Survey’ data sheets




5) Click either the “save” or “save and load photos” button
   a. If you clicked the “save and load photos” button, enter in a description such as ‘beach looking north’ then navigate to where your photo is stored, click on it then press the “upload” button. The screen will come up with a ‘action processed’ box (this means your data has been uploaded and you can load subsequent photos) then you will need to press the “cancel” button to get back to your site to enter transect details

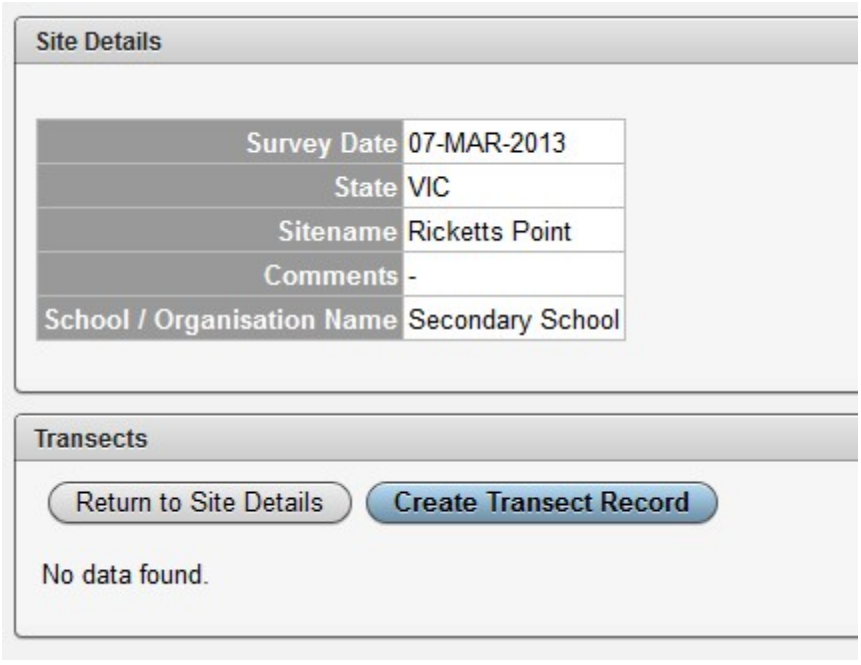

b. Clicking “save” will take you back to the front screen where you can now enter your transect data

Transect Sites

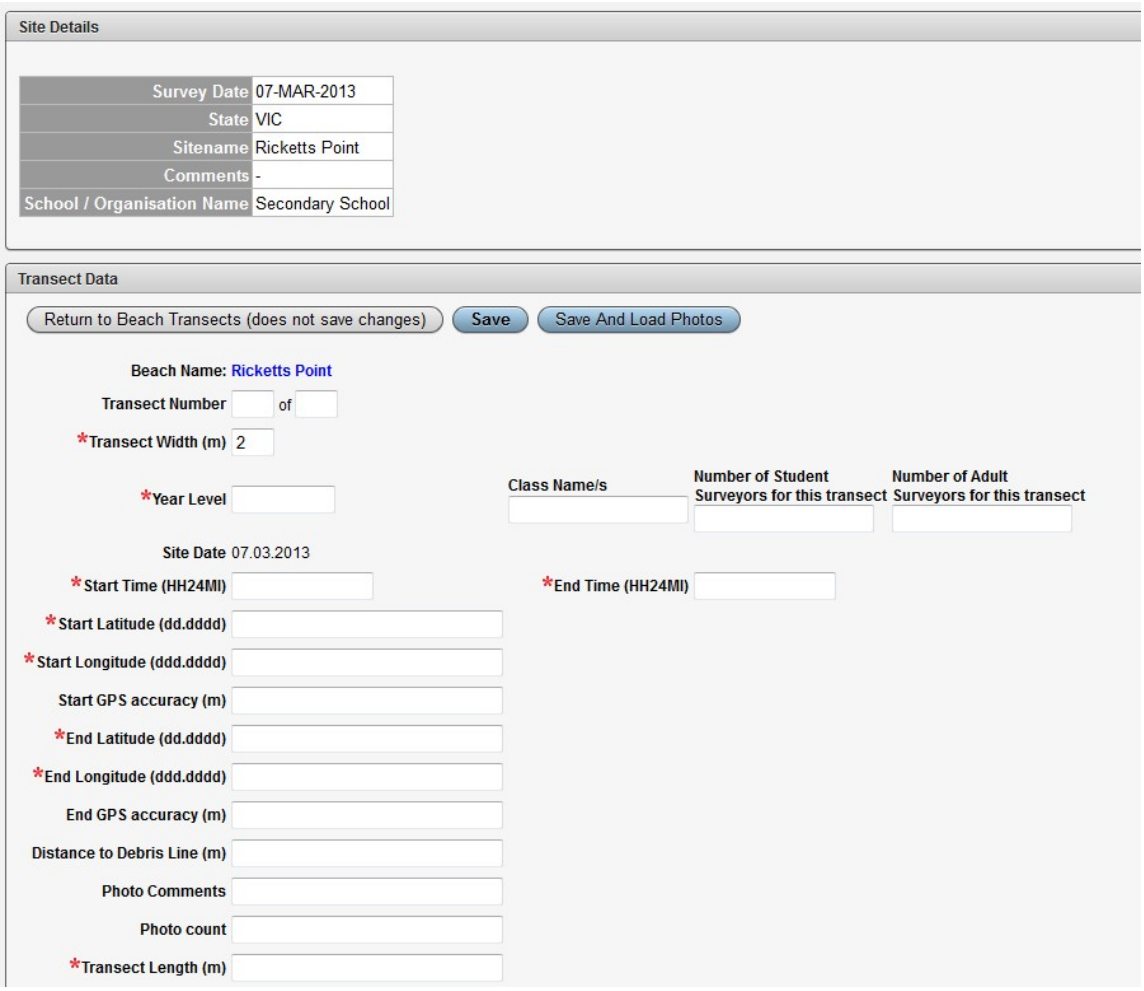
Map - to check site positions

| Go To Transects | Edit | State | Beach Name | Latitude (DD) | Longitude (DD) | GPS Accuracy (m) | Total Transects | Trip Leader | Weather | Wind Speed | Wind direction (compass) | Wind direction (relaticve to shore) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | VIC | Ricketts Point | -37.59637 | 145.01957 | - | - | SEAWK | Clear | 0 - calm (flat ocean) | S | - |
| | | VIC | Cape Woolamai | -38.54617 | 145.34106 | 2 | 3 | TJL | Clear | 2 - moderate breeze (small waves breaking crests, 10-25km/h, 6-20 knots) | SE | side shore |
| | | VIC | Summer land bay | -38.51021 | 145.15067 | 3 | 4 | TEACHW | Clear | 1 - light breeze (wavelets, <10km/h , <6 knots) | S | side on |
| | | VIC | Smiths beach | -38.5043 | 145.2569 | 3 | 2 | ANTHON | Clear | 1 - light breeze (wavelets, <10km/h , <6 knots) | S | on shore |

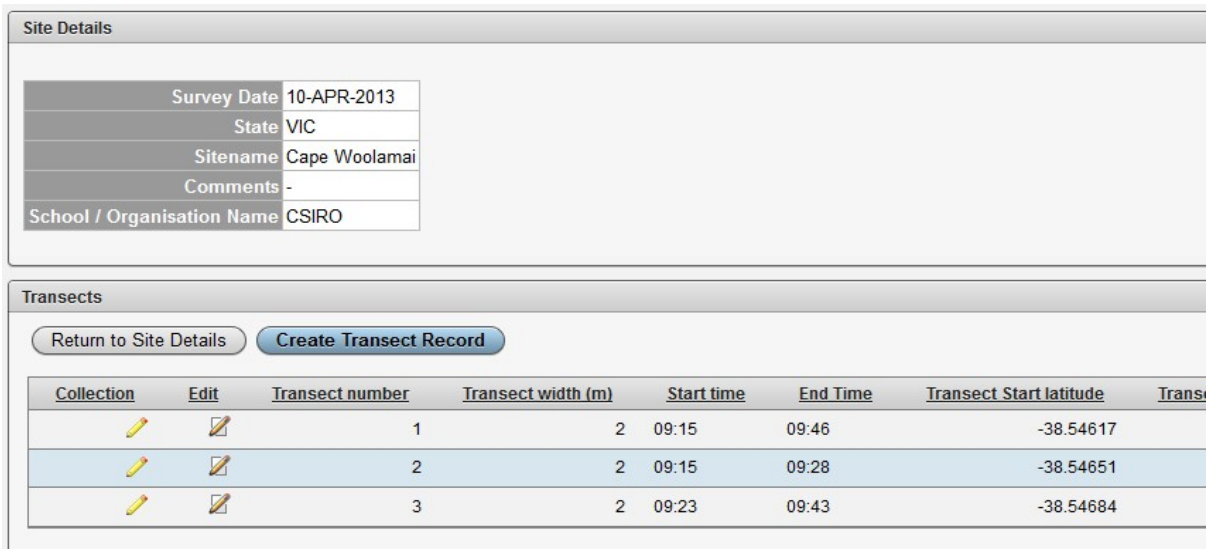
6) To enter transect details, click on the  icon under ‘go to transects’, and then click on the “Create Transect Record” button



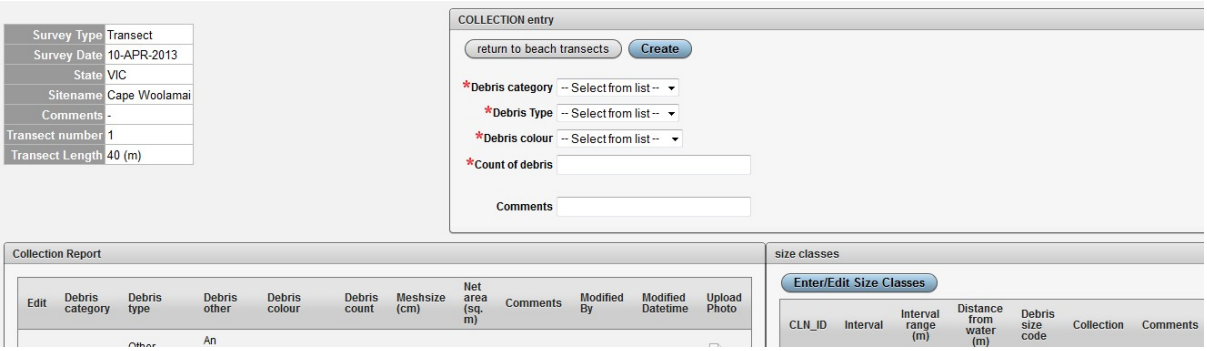
7) Enter in all the 'transect data' noting that these are the same details on your "Transect Data" data sheet – NOTE: Again the "latitude (Decimal Degrees)" must be negative (e.g. -35.12546)




8) Click either the "save" or "save and load photos" button
   a. If you clicked the "save and load photos" button, do the same steps as you did previously
   b. Clicking "save" will take you back to the transect data screen where you can enter your collection data



9) To enter your collection data, click on the  icon under ‘collection’, then enter all your data using the “create” button once you have entered in the debris category, type, colour and number.



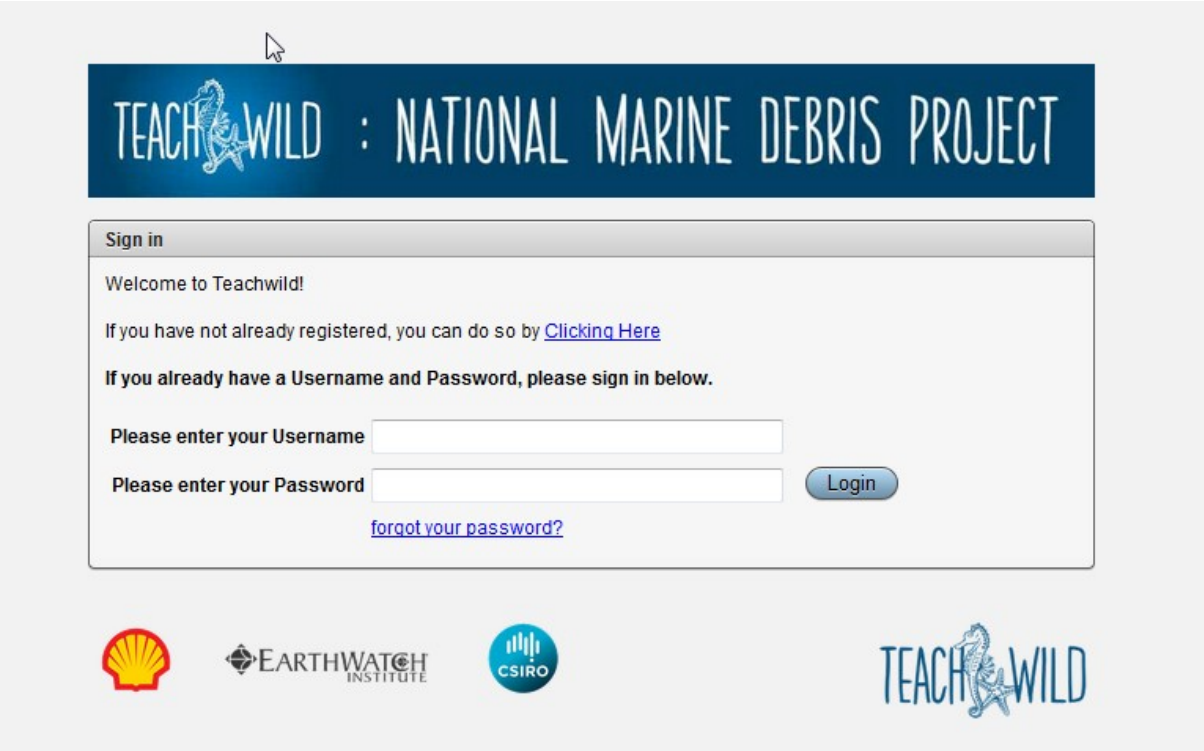

10) Click on the “enter/edit size classes” button, click on the “add ten rows” button and enter your size class data

11) Repeat steps 6 to 10 for each transect

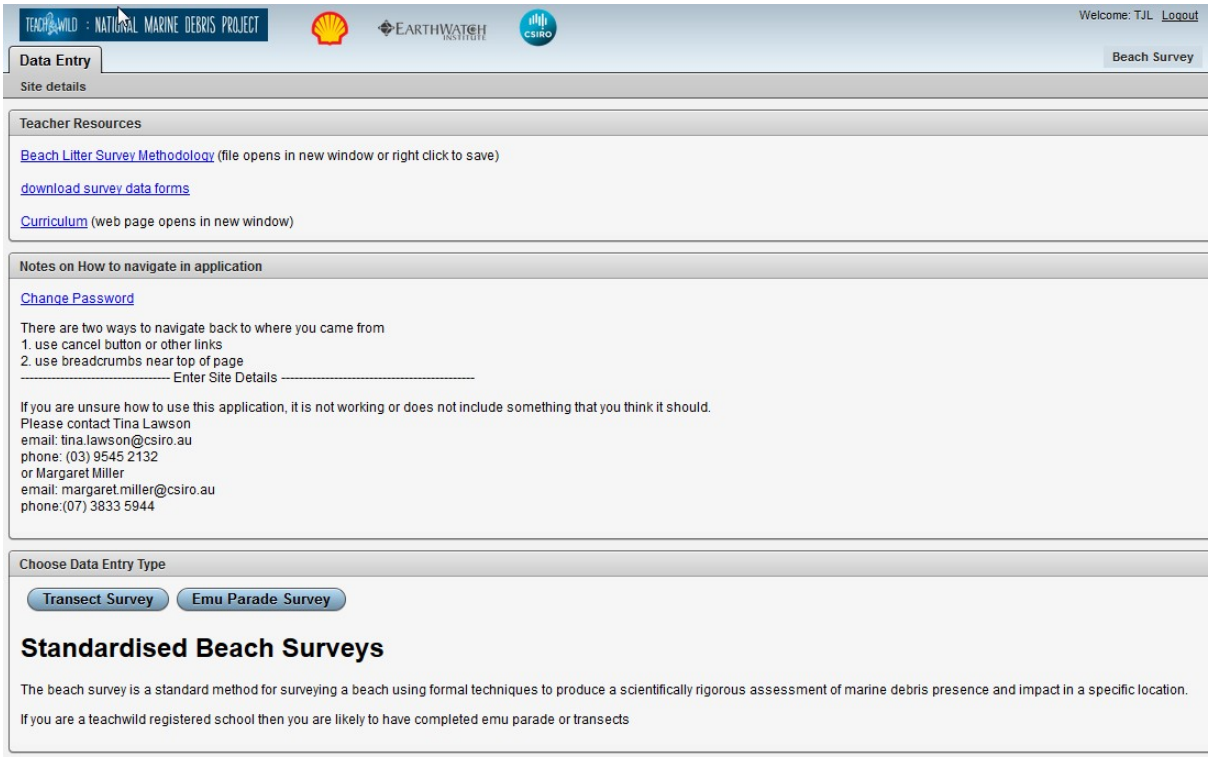
## Database instructions: Emu Parade

To enter data, you first need to be registered.

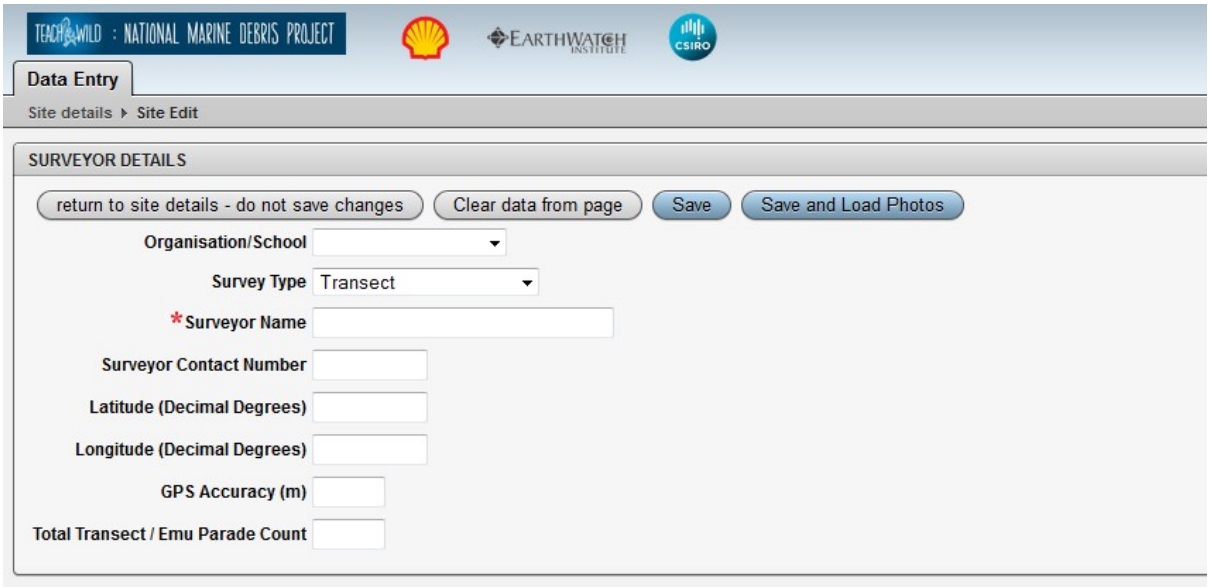
1) Enter your username and password, press the “Login” button



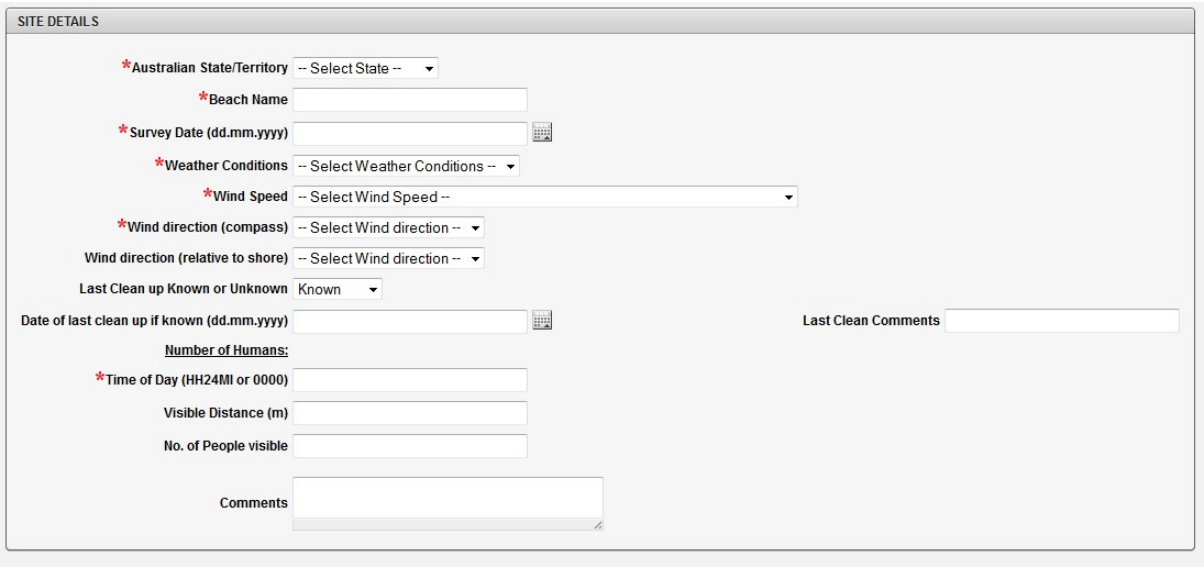

2) Click on the “Emu Parade Survey” button



3) Enter in the 'surveyor details', these are the same details as can be found on your "Marine Debris Beach Survey" data sheets – NOTE: The "latitude (Decimal Degrees) must be negative (e.g. -35.12546)



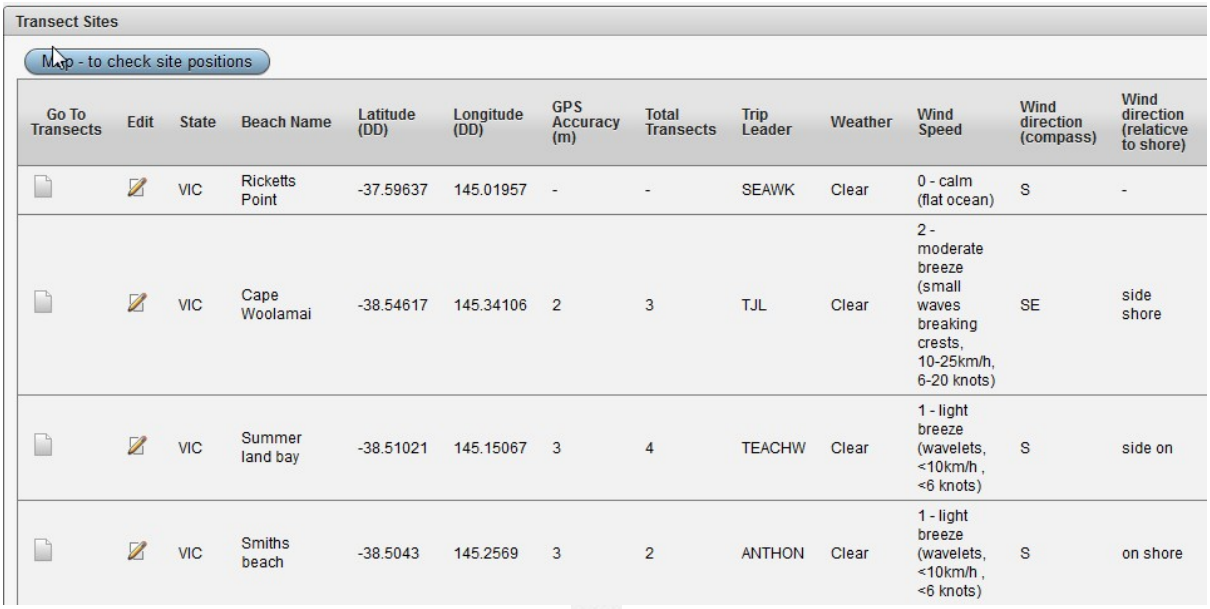

4) Enter in the 'site details' as required, these are the same details as can be found on your "Marine Debris Beach Survey" data sheets




5) Click either the "save" or "save and load photos" button

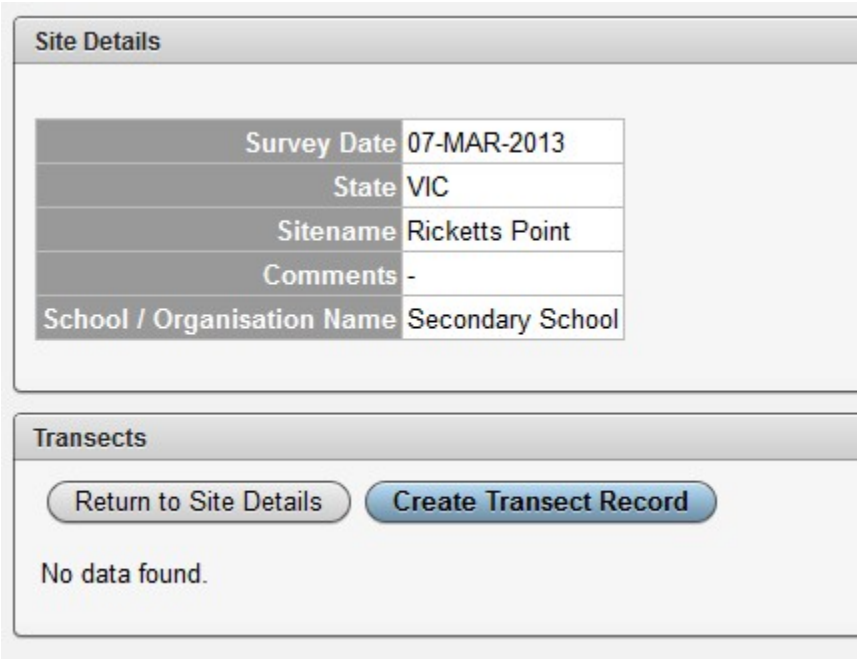
   a. If you clicked the "save and load photos" button, enter in a description such as 'beach looking north' then navigate to where your photo is stored, click on it then press the "upload" button. The screen will come up with a "action processed" box and you will then need to press the "cancel" button to get back to your site to enter transect details


b. Clicking “save” will take you back to the front screen where you can now enter your transect data

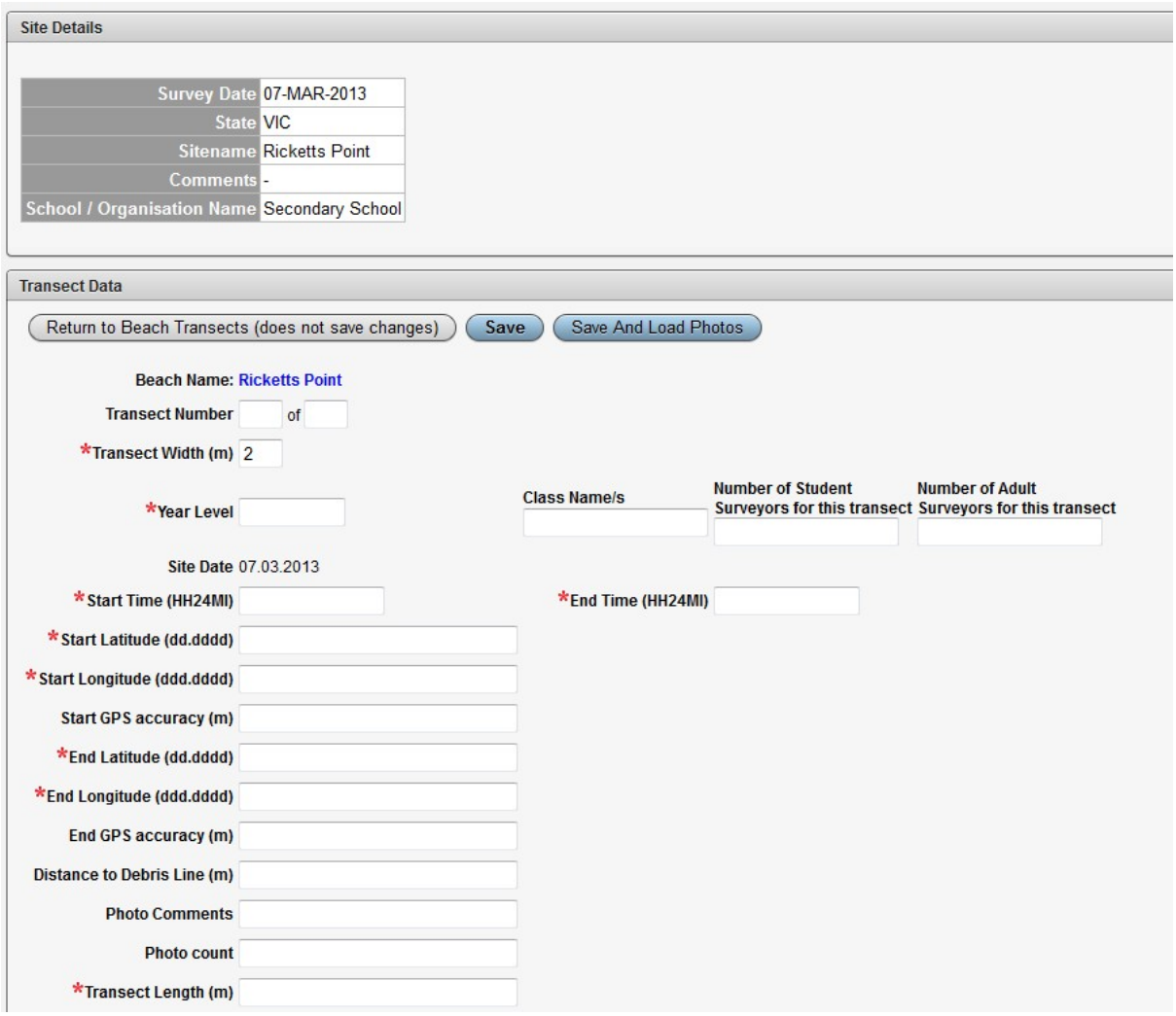



| Go To Transects | Edit | State | Beach Name | Latitude (DD) | Longitude (DD) | GPS Accuracy (m) | Total Transects | Trip Leader | Weather | Wind Speed | Wind direction (compass) | Wind direction (relaticve to shore) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | VIC | Ricketts Point | -37.59637 | 145.01957 | - | - | SEAWK | Clear | 0 - calm (flat ocean) | S | - |
| | | VIC | Cape Woolamai | -38.54617 | 145.34106 | 2 | 3 | TJL | Clear | 2 - moderate breeze (small waves breaking crests, 10-25km/h, 6-20 knots) | SE | side shore |
| | | VIC | Summer land bay | -38.51021 | 145.15067 | 3 | 4 | TEACHW | Clear | 1 - light breeze (wavelets, <10km/h , <6 knots) | S | side on |
| | | VIC | Smiths beach | -38.5043 | 145.2569 | 3 | 2 | ANTHON | Clear | 1 - light breeze (wavelets, <10km/h , <6 knots) | S | on shore |

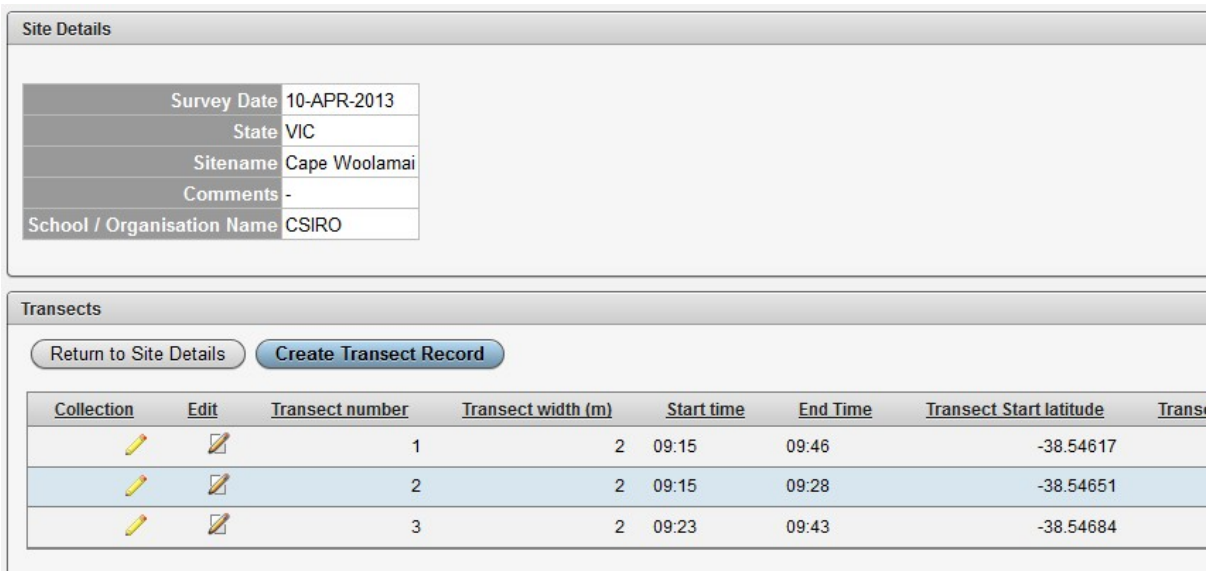
6) To enter transect data, click on the  icon under ‘go to transects’, and then click on the “create Transect Record” button



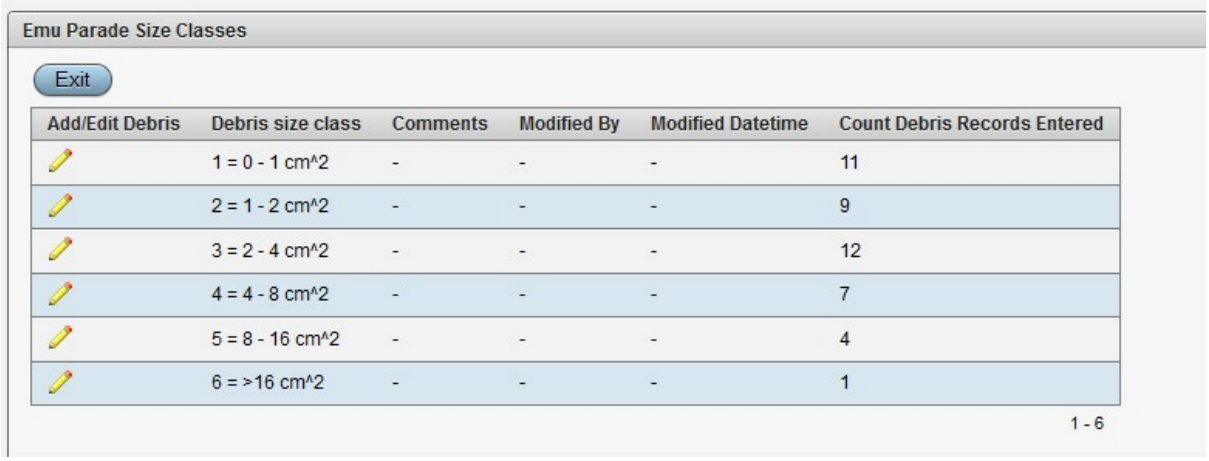

7) Enter in all the ‘transect details’ noting that these are the same details on your “Transect Data” data sheet – NOTE: Again the “latitude (Decimal Degrees) must be negative (e.g. -35.12546)




8) Click either the “save” or “save and load photos” button
   a. If you clicked the “save and load photos” button, do the same steps as you did previously
   b. Clicking “save” will take you back to the transect data screen where you can enter your collection data



9) To enter your collection data, click on the  icon under ‘emu parade’, then click on the same icon next to the size category you want to enter



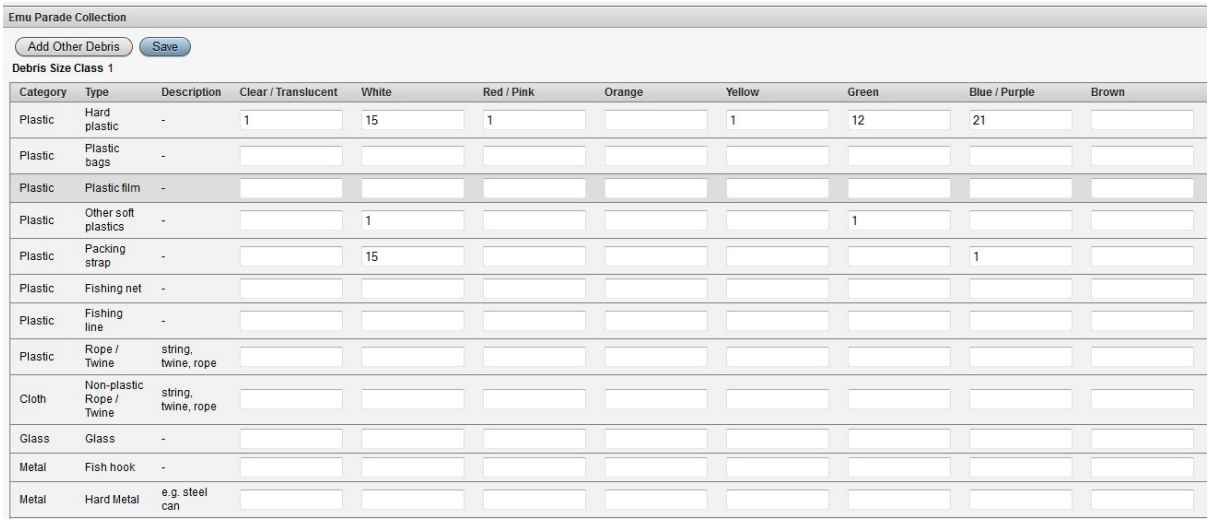
Emu Parade Size Classes

Exit

| Add/Edit Debris | Debris size class | Comments | Modified By | Modified Datetime | Count Debris Records Entered |
|---|---|---|---|---|---|
| | 1 = 0 - 1 cm^2 | - | - | - | 11 |
| | 2 = 1 - 2 cm^2 | - | - | - | 9 |
| | 3 = 2 - 4 cm^2 | - | - | - | 12 |
| | 4 = 4 - 8 cm^2 | - | - | - | 7 |
| | 5 = 8 - 16 cm^2 | - | - | - | 4 |
| | 6 = >16 cm^2 | - | - | - | 1 |

1 - 6

10) Simply enter the number of items you collected in that size category for that type/colour of debris



Emu Parade Collection

Add Other Debris | Save

Debris Size Class 1

| Category | Type | Description | Clear / Translucent | White | Red / Pink | Orange | Yellow | Green | Blue / Purple | Brown |
|---|---|---|---|---|---|---|---|---|---|---|
| Plastic | Hard plastic | - | 1 | 15 | 1 | | 1 | 12 | 21 | |
| Plastic | Plastic bags | - | | | | | | | | |
| Plastic | Plastic film | - | | | | | | | | |
| Plastic | Other soft plastics | - | | 1 | | | | 1 | | |
| Plastic | Packing strap | - | | 15 | | | | | 1 | |
| Plastic | Fishing net | - | | | | | | | | |
| Plastic | Fishing line | - | | | | | | | | |
| Plastic | Rope / Twine | string, twine, rope | | | | | | | | |
| Cloth | Non-plastic Rope / Twine | string, twine, rope | | | | | | | | |
| Glass | Glass | - | | | | | | | | |
| Metal | Fish hook | - | | | | | | | | |
| Metal | Hard Metal | e.g. steel can | | | | | | | | |

11) Repeat steps 6 to 10 for each emu parade

## What Now?

By undertaking marine debris surveys your school is helping to make a difference by create awareness of the marine debris problem. There are numerous sustainability actions your school can become involved in to help combat marine debris further.

These include-

- School Clean ups- organise your whole school to do regular clean ups around the school grounds.

Control litter-

- Encourage students to bring a litter free lunch. This means no plastics aside from the lunchbox and a drink bottle just "nude" food.
- Make better use of materials; reuse waste where possible such as milk bottles to surround young seedlings in the school garden.
- Support initiatives such as the Take 3 campaign where you take 3 pieces of rubbish with you when you leave the beach, waterway or anywhere.
- Hold a waste challenge competition in class where students from each year are asked to cut back on their waste and document it. The class who has generated the least amount of waste is the winner and is known as the waste champions throughout the school; hold a presentation for the winners at the schools assembly. The winning class is to tell the assembly some of their top tips for cutting down on waste in their classroom.
- Follow the 3 R's- Reduce, Re-use and Recycle at school and at home.

Campaign for the cause-

- Develop a section in the schools newsletter dedicated to the environment, looking at a different issue affecting the marine environment per issue.
- Develop an environment committee at school.
- Get students to write a letter to their local MP or newspaper about the marine debris issue and point out what could be done on a local level to help combat the problem.
- Students can showcase some of what they have learnt about marine debris as a poster, these posters can be hung around the school and the community to promote awareness.
- Tell 2, ask students to tell two people they know about the marine debris problem, students are to specify two facts about marine debris to that person and request that they tell those facts to two people they know and so on.

You can also link up with some existing schools initiatives such as the Australian Sustainable Schools Initiative (AuSSI).
http://www.environment.gov.au/education/aussi/

## Acknowledgements

Earthwatch is proud to provide this comprehensive marine debris education kit in partnership with CSIRO and Shell Australia.

Earthwatch Australia is the coordinating partner of TeachWild. Its global mission is to engage people in scientific field research and education in order to promote the understanding and action necessary for a sustainable environment. Since 1971, 100,000 citizen scientists have contribute 11 million hours to conservation science - equivalent to more than 5,000 years of solid hard work.

CSIRO, the Commonwealth Scientific and Industrial Research Organisation, is Australia's national science agency and one of the largest and most diverse research agencies in the world. The CSIRO Wealth from Oceans Flagship focuses on understanding Australia's oceans: their biodiversity, resources and relationships with the climate system. The flagship delivers practical science that enables governments, industries and communities to make informed decisions about the sustainable management of marine and coastal resources. It provides CSIRO's contribution towards national challenges in which oceans play a central role.

CSIRO is at the forefront of marine debris research; their assistance in implementing the program is invaluable to students and teachers. The CSIRO Scientists in Schools program enables scientists to share their passion for science and enhance science education in their classrooms. CSIRO are teaming up with Earthwatch in the field to bring students and teachers an active learning experience surveying marine debris.

Shell is a global group of energy and petrochemicals companies. With around 93,000 employees in more than 90 countries and territories, Shell helps to meet the world's growing demand for energy in economically, environmentally and socially responsible ways. Shell has a long history of involvement with the community across more than a century of business operations in Australia. As Shell's business in Australia grows, so too does its country social investment program which now focuses solely on education, including projects such as the TeachWild program which encourage an interest in science and technology.

Earthwatch would like thank the following for their input into the development and review of the kit- Geraldine Davis and Andy Donnelly from Earthwatch, Britta Denise Hardesty and Chris Wilcox from CSIRO, Jenny Odgers from Shell and Southern Cross University, National Marine Science Centre, Coffs Harbour.

Primary Writer, Chantelle Burns.

## Glossary

**Bioaccumulation**- refers to the accumulation of substances, such as pesticides, or other organic chemicals in an organism.

**Benthic-** is the ecological region at the lowest level of a body of water such as an ocean or a lake, including the sediment surface and some sub-surface layers.

**Biodegradable**- materials that are capable of decomposing back into natural elements. These materials are capable of being decomposed by bacteria or other biological means.

**Degradable**- materials that are capable of being decomposed chemically or biologically.

**Decomposition-** is the process by which organic substances are broken down into simpler forms of matter.

**Degrade**- (*Chemistry)* to decompose or be decomposed into atoms or smaller molecules.

**Food Chain**- The feeding of one organism upon another in a sequence of food transfers.

**Ghost net-** fishing nets that have been left or lost in the ocean can entangle marine life. These nets, often nearly invisible in the dim light, can be left tangled on a rocky reef or drifting in the open sea.

**GPS**- **Global Positioning System** (**GPS**) is a space-based satellite navigation system that provides location and time information where there is an unobstructed line of sight to four or more GPS satellites.

**Gyre**- is any large system of rotating ocean currents, particularly those involved with large wind movements.

**Habitat**- is an ecological or environmental area that is inhabited by a particular species of animal, plant or other type of organism.

**Ingestion-** is the consumption of a substance by an organism.

**Invertebrate**- any animal lacking a backbone, including all species not classified as vertebrates. Corals, insects, worms, jellyfish, starfish, and snails are invertebrates

**Marine Debris**- any human-made object that can be intentionally or unintentionally discarded, disposed of or abandoned that enters our marine environment

**Methodology-** is generally a guideline system for solving a problem. It can include specific components such, tasks, methods, techniques and tools.

**Monofilament (line)-** is fishing line made from a single fibre or plastic.

**Non degradable-** waste that will not break down or will continue to persist for many years. Examples are plastics, metal and glass.

**Non-recyclable-** not capable of being used again.

**Oceanography-** the branch of science that deals with the physical and biological properties and of the sea.

**Pollutant**- is a substance or energy introduced into the environment that has undesired effects.

**Plankton-** the small and microscopic organisms drifting or floating in the sea or fresh water, consisting chiefly of diatoms, protozoans, small crustaceans, and the eggs and larval stages of larger animals. Many animals are adapted to feed on plankton, especially by filtering the water.

**Primary consumer**- an animal that feeds on plants; a herbivore.

**Primary producer**- any green plant or any of the various microorganisms that can convert light energy or chemical energy into organic matter.

**Quaternary Consumer**- a carnivore is at the topmost level of the food chain and has little or no natural enemies. Feed on tertiary consumers.

**Recyclable-** material that is capable of being used again.

**Secondary consumer**- a carnivore that feeds only upon herbivores.

**Substrate-** is the surface where a plant or animal lives upon and grows on. A substrate can include biotic or abiotic materials and animals.

**Tertiary consumer**- feeds on other carnivores; an animal that feeds only on secondary consumers.

**Trophic Level**- the position in a food chain or Ecological Pyramid occupied by a group of organisms with similar feeding mode.

**Vertebrate**- any chordate animal of the subphylum *Vertebrata,* characterized by a bony or cartilaginous skeleton and a well-developed brain: the group contains fishes, amphibians, reptiles, birds, and mammals