

THE

**F.R.O.U.D.**

PROGRAMME

# TEACHER TOOLKIT



# THE P.R.O.U.D. PROGRAMME

## TEACHER TOOLKIT

The activities which you and your students will be involved within in the Plastic Reduction Organisation's Ultra Detective (P.R.O.U.D.) Programme focus on quantifying the waste in your school, and relating this information back to the monetary cost of disposing of this waste. It also aims to determine where this waste is coming from, and how much of it is single use plastic.

Each of the activities within the overall Programme can be carried out over a number of weeks (for example, why not let your detectives work on these during play or free time each week?), and will focus on the following areas:

1. Estimating the waste produced by visual observation
2. Determining specific sources and quantities of waste
3. Relating the weight of waste to its volume by experimenting with and using density information
4. Estimating the current financial cost of waste disposal in your school, and sharing best practices to reduce that cost whilst increasing the amount of waste that is recycled

This Teacher's Toolkit aims to provide you with more information about how you and your pupils can carry out each of these activities, and make major improvements in each of the areas described above!

We hope you find it useful! Good luck to you and your detectives!

# THE ACTIVITIES

## Activity 1: Crime Scene Investigation

Pupils are encouraged to investigate the number and type of bins in your school, and how often these are emptied.

## Activity 2: Weighing the Evidence

Pupils investigate the locations around the school which contribute to the total volume and weight of waste being generated. This allows pupils to determine which areas should be targeted to reduce the quantities being generated.

## Activity 3: How Dense is That?

Pupils are encouraged to relate weight to volume through simple density experiments. This experimentation will help them understand the relationship between these two values and could help identify solutions which could help save the school money, as well as being more environmentally friendly.

## Activity 4: The SPLIT

Pupils split wastes into different types and measure these using the tools developed in earlier activities. This may have already been done within the school.

## Activity 5: Money in the Bin?

Finally, in activity 5 pupils use their investigation to calculate the overall costs. Data is provided in the worksheets to estimate these. The school can estimate the cost per pupil as this is one way of measuring the success of any activities the school may introduce.

Activities 1 and 5 are directly linked, and can be carried out simultaneously – both are relatively quick tasks. Activity 2 is more time consuming, but is designed to be relatively simple, yet informative, and links to activity 4. Activity 3 encourages experimentation to connect the other parts and should reinforce the overall learning and encourage innovation in terms of addressing the problem.

# THE PHYSICAL EVIDENCE TOOLKIT

The Menace of Plastic Waste has many co-conspirators who often stick together (sometimes quite literally) to commit environmental crimes through creating a bigger Waste Menace.

In our schools and homes, we see the evidence of these crimes – all kinds of waste including paper, plastics and food. Sometimes we can separate them into different types to help levels of recycling, but sometimes they stay together to fill our general waste bins – meaning many items miss out on being recycled!

Waste collection is not free – it has a cost in terms of our environment, but also costs real money that teachers and schools could use to fund other more useful things – how much waste your school produces, and how much it recycles impacts on these costs.

The investigations carried out as part of the P.R.O.U.D. Programme, will involve finding out how much waste is being generated throughout your school, where it is coming from and where it is going to.



# THE PHYSICAL EVIDENCE TOOLKIT – TOP TIPS



One reason that the Menace of Plastic Waste causes so many problems, is that it is very good at hiding, which allows it to sneak into general waste, and go to landfill, where it causes lots of problems, and avoids being recycled! Because of this, you and your students must be extra vigilant to keep the Menace of Plastic Waste in your sights!

Let's look at a common hiding spot for the Menace of Plastic Waste as an example:



The Menace can still hide away easily though, making the most of a lack of awareness of what can be recycled – in this case, this yoghurt pot is going to waste too, but could be recycled in the same way as a plastic bottle!

Sometimes, the Menace of Plastic Waste can be found easily, appearing as things we are used to, like plastic bottles!



Not sure of all the things that can be recycled? Why not use your detective skills?

When trying to find the Menace of Plastic Waste, we need to look for clues to help us!

Logos like these...



...can help us identify if anything can be recycled, and help us to catch the Menace – you can search for them easily online!

# GUIDANCE NOTES:

## "ACTIVITY 1: CRIME SCENE INVESTIGATION"

Your students will be provided with information about this task within the Activity Card that you can see below. While this task is straightforward, it does require lots of organisation, and your detectives to work together to ensure that they don't miss any of the waste bins within your school!

To help with this task, why not think of ways that you could help your detectives organise

themselves (for example, by groups of students covering different parts of the school), and also think of inventive ways to record how many of each type of waste bin there is, and how full they are? This can be really useful to get a good overall idea about where most of your school's waste is, and where the Menace of Plastic Waste might be hiding!

## ACTIVITY 1: CRIME SCENE INVESTIGATION

In the first activity, you are going to investigate one of the main crime scenes – where all the bins are located! For this investigative task you should:

- 🗑️ Locate all the large bins in your school and count the number and type of each
- 🗑️ Find out which days the bins are collected and before they are emptied give an estimate for how full each bin is


You could report the evidence you find in a table like this one:

Date: 07/12/2019		
Bin Type	What is the Bin Used For?	How Full is the Bin?
1100 litres	General waste	Completely full
1100 litres	General waste	Half full
1100 litres	General waste	Half full
1100 litres	Recycling	Quarter full
1100 litres	Recycling	Completely full
360 litres	Recycling	Empty
120 litres	Food	Half full

You can also use other creative ways to report how many bins you have in your school and how full they are. You can do this just before they are emptied, or even throughout the week to see how quickly they fill, and determine if there are certain days when the Menace of Plastic Waste has been very active!

By examining this evidence you will get an idea about how large of a problem the Menace is causing. Once you know this, you can move onto the next set of crime scenes which are your classrooms, offices, canteens, and other areas around the school which contribute to this problem.





# GUIDANCE NOTES:

## "ACTIVITY 2: WEIGHING THE EVIDENCE"

This activity seeks your team of detectives to work out the weight of waste that your school is throwing away in total, which will provide your team with lots of useful information that you'll all be able to use in some of the later activities!

The more data that your detectives collect at this stage, the more you'll have to work with at later stages, which will eventually allow you and your team to have a very detailed picture of how your school manages its waste, which will allow you to think of ways to make this better!

In this task, your detectives will need your help with things like:



Adding up total weights per day, etc.



Drawing out detailed tables



Coming up with other interesting ways to record this information

## ACTIVITY 2: WEIGHING THE EVIDENCE

You may need to recruit some friends for this activity, as there are many places where the Menace of Plastic Waste might have been!



**Tip:** The school cleaners and caretakers are very good "witnesses", so try to recruit them to help track down the Menace of Plastic Waste.

You will need a weighing scale to calculate the weight of all the bins in each classroom and around the school:



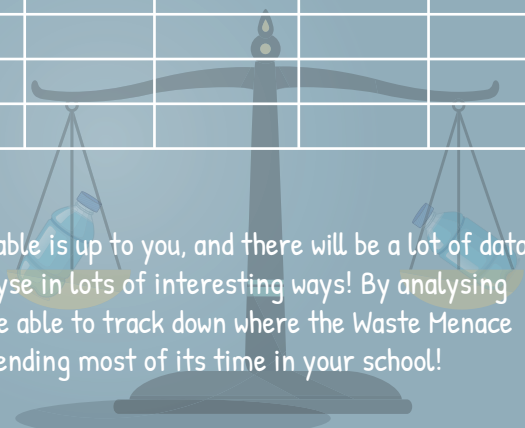
In each location, weigh the bin or container before it is emptied and again after it has been emptied. Make a note of the difference and then add up all the values



You can do this over several days so that you can get more accurate data on how much waste is being produced in the different places. You can even record the differences between year groups or classrooms. Overall you should end up with a table something like the one you can see here!

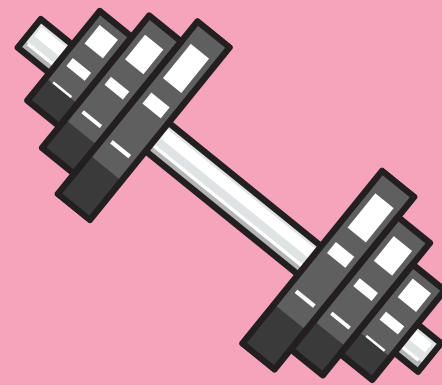
Location	Weight of Waste				
	Monday	Tuesday	Wednesday	Thursday	Friday
Classroom					
Canteen					
Offices					
Playgrounds					
Total					

The design of the table is up to you, and there will be a lot of data that you can analyse in lots of interesting ways! By analysing the data you will be able to track down where the Waste Menace has been spending most of its time in your school!



# GUIDANCE NOTES:

## "ACTIVITY 3: HOW DENSE IS THAT?"



This activity will involve your detectives thinking more about how we are not just worried about the weight of waste when it comes to getting rid of the Menace of Plastic Waste, but also the amount of volume that it can take up! This is explained briefly to our detectives in the Activity Cards that you can see on the page after next, and focuses on the importance of density when we think about waste, and what it is made of – it's even mentioned in WRAP's Waste and Resources Action Programme!<sup>1</sup>

When you know density values, a bit of mathematics magic can allow you to calculate the weight of your waste if you know the volume, or the volume if you know the weight. For example, if the density is 22 kg for every m<sup>3</sup>, and you have a full bin which is 1100 L or 1.1 m<sup>3</sup> in volume, then the contents of the bin should weigh:

$$22 \text{ kg per m}^3 \times 1.1 \text{ m}^3 = 24.2 \text{ kg}$$

Density values are very useful for helping you and your detectives to compare different materials. What is possibly even more interesting (if you find money interesting!) is that if we convert the amount of weight to a cost – data from councils tells us that it costs approximately £20 for every large general bin to be collected at a school.<sup>2</sup> Therefore, it would cost £20 to 'lift' a bin which contains just 24.2kg of plastic waste.<sup>3</sup> That is expensive – pretty much the same cost as milk!

Your detectives will need your help to do these calculations, and understand the difference in weight, volume, and density – this will really help them to think about these values, and get more clues!

WHY NOT TRY AND HELP YOUR DETECTIVES TO UNDERSTAND WEIGHT, VOLUME, AND DENSITY A LITTLE BIT MORE BY CARRYING OUT AN EXPERIMENT?! THIS WILL REALLY HELP YOU AND YOUR TEAM TO UNDERSTAND MORE ABOUT HOW WE CAN MEASURE WASTE, AND HOW VARIOUS TYPES OF WASTE CAN BE VERY DIFFERENT! CHECK OUT THE NEXT PAGE FOR AN EXPERIMENT THAT YOU CAN TRY!

Whilst getting rid of the Menace of Plastic Waste is very beneficial for the environment, it's also good for your school's bank balance too – One of the ways to reduce the cost is to recycle and the good news is that the cost to empty a bin is much lower if it is a recyclable bin. The average cost across Northern Ireland is almost £6 per 1100 L bin, so only 30% of the cost of general waste, which is a big saving. Some councils even offer this service for free!

Using this information, and other information that you'll find in this pack, why not help your detectives to calculate how much money your school could save by recycling more materials!



# EXPERIMENT TIME - DENSITY!

Here is a simple experiment you can try out in school or at home to get your own density data - all you need is a box, some plastic bottles, and other typical recyclable materials you can find around your school!

Here is a simple experiment you can try out in school or at home to get your own density data - all you need is a box, some plastic bottles, and other typical recyclable materials you can find around your school!

1. Measure the size of your box (height, length and breadth) in centimetres.
2. Multiply the three values on paper (if your detectives are really clever) or using a calculator, to find the volume in  $\text{cm}^3$  (centimetres cubed). Divide this value by 1000 to get the volume in litres.
3. Next, weigh the box using scales and take note of the value in grams.
4. Then fill the box with the plastic bottles and other plastic waste, and weigh it again - note down the value in grams.
5. Subtract the filled box weight from the empty box weight, and you now have the weight of the plastic.
6. Divide the weight of the plastic (grams) by the volume (L) and you have what is called a 'bulk density' value.
7. This density value which is in grams per litre is the same as saying  $\text{kg per m}^3$  ( $1 \text{ kg} = 1000 \text{ grams}$  and  $1 \text{ m}^3 = 1000 \text{ L}$ , and since we are dividing one by the other then we have  $1000/1000 = 1$ ).

How does the value that you and your detectives have calculated compare to that of the value reported by WRAP? What does this mean for your school?



# ACTIVITY 3: HOW DENSE IS THAT?

So far, you've thought about how much waste is being produced (number of bins) and the weight of waste being made in different areas of your school. In the next part of your investigation, you should link these two things together and see if they make sense!

Have you ever heard the question, "which is heavier: a kilogram of feathers or a kilogram of steel?" The answer of course is that they are both the same weight, even though we tend to think of feathers being light and steel being heavy!

When we think about it, though, we realise that this "lightness" relates to a different property, called DENSITY, which is really how much the same volume of different materials weigh. This property is why ships made of steel float on water, and why air balloons float into the sky!

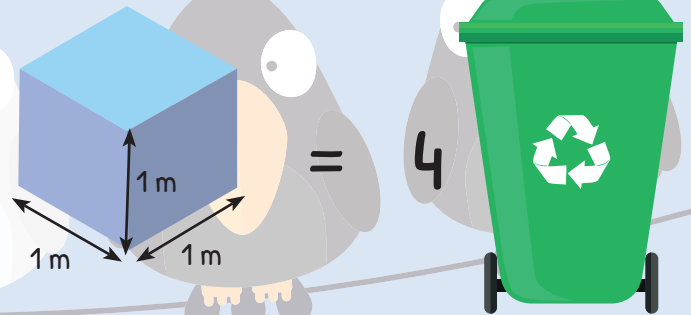
Density is important to our investigation as we tend to say, "how full is our bin?", and not "how heavy is our bin?".

To convert between heavy and full we need to use our detective science skills to convert weight to volume, and to do that we need to know the density.

This property of a material is so important that the Waste and Resources Action Programme (WRAP) have published their own

investigation into the density of different wastes.

In the WRAP report, we can find that mixed plastic waste has a density of 22 kg for every  $m^3$  – a  $m^3$  is a box where the length, depth and height are all 1 meter long – which is quite big! A big wheeled bin is just 10% larger than this – and it is almost the same size as four of the wheelie bins found in many homes.



Your teachers will be able to show you how you can use the density value and mathematics to calculate the weight of your waste if you know the volume, and the volume of your waste if you know the weight – these are the kind of calculations that professional scientists do every day! Your teachers will also be able to show you how to carry out your own experiment so that you can calculate your own density data, and use these in your calculations!



**Did you know?**

It could cost the same amount of money to empty a bin full of plastic waste as buying the equivalent weight in fresh milk?

For this part of the investigation, Gather your evidence on the density of typical waste plastics around your home and school. Get lots of samples and then average these out. If there are big differences between the different experiments write down why this happened. Present your data within your final investigation case notes as a table or chart and describe the clever ways that you could use to reduce the volume of the plastic waste being produced.

## ADDING UP THE COSTS OF WASTE!



Getting rid of waste costs money! Using the data you have obtained already, and the information that your teacher will be able to give you about the cost of removing waste, you should be able to convert the weight of the waste collected from the various parts of your school into an estimated volume, and use this to work out how much this will cost your school in a year!



# GUIDANCE NOTES:

## "ACTIVITY 4: THE SPLIT"

Your detectives have been issued with the Activity Card which you can see below – this activity asks your team to think about how much of each type of waste is produced by your school – this will give your team a much better understanding of how much of each type of waste is being thrown away, which links in with the previous activities – you'll be able to assist your detectives with things like calculating new density values for example, or think about how much boxes containing different types of waste can cost very different amounts of money to be taken away from School!

This is also a real opportunity to work with your detectives to see if they've noticed any trends after they start this activity – has setting up special boxes/bins for each type of waste led to more or less being thrown away? Is this overall, or are you seeing less of certain types of waste being thrown away? You can work with your detectives to see how this might be useful when it comes to getting rid of the Menace of Plastic Waste!

This activity also allows you to help your detectives to think of new ways to record this information – you'll all be creating lots of data, so what is the best way to do it?!

## ACTIVITY 4: THE SPLIT

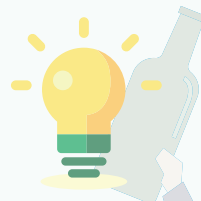
Depending on your school, the Menace of Plastic Waste may have been separated into its own bin, or maybe it has been mixing with paper and other recyclables, or maybe it is just mixed into the general waste bin.



From the last activities, you should know how much waste is generated in your school total, where it is coming from, and how to convert the amount of waste between weight and volume – is a very useful skill! We now need to investigate how much of each type of waste is produced, so we can narrow down our search for the Menace of Plastic Waste!

How will you do this? To start with, if your school does not have separate bins for different types of waste, ask if you can bring in some boxes and label these for people to use to throw away things like paper, plastic, general waste, and others!

Once you've done this, weigh the contents at the end of the day (before and after emptying) to get the weight of each type of waste collected during the day.

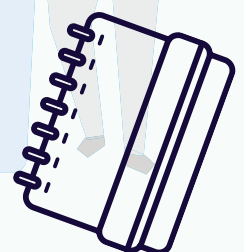


**Tip:** You could use this opportunity to get new density data for each of these types of waste. This is also very useful evidence to have!

Once you've done this, total up these weights, compare them to the original data in Activity 1 and report your findings in a table, or something similar, as you've done before!

Sometimes even the asking people to act on their recycling decisions scares the Menace of Plastic Waste. If you did above activity and noticed that the amount of waste decreased through this task then the Plastic Menace may already be affected.

Make sure to document your evidence, as you should now be able to not only identify where the Waste Menace has been, but also how much is due to the Menace of Plastic Waste.





## GUIDANCE NOTES: "ACTIVITY 4: MONEY IN THE BIN?"

A lot of information and skills have now been gained by your team of detectives, and with your help, they'll now know lots more about the types of waste that we produce, how these can be different to each other in things like density, and also about how waste can cost money when we want our councils to take it away! Your team will also have been able to see how making use of different ways to encourage their friends and teachers to throw their waste away in the right way can really help us to capture and defeat the Menace of Plastic Waste!

The detectives have been given some information about this activity in the Activity Card that you can see on the next page – there will be lots of parts of these activities that you'll be able to help the team with, including providing them with the amount of money it costs to empty each type and size of bin (these approximate values are in the table below!), and the hard sums involved in totalling up how much money is spent on emptying each type of waste bin each year! In addition to this, are there any interesting comparisons that you and your team might be able to make? For example, are the volumes of each type of waste similar or different? If they're different, what could you compare that difference to so that it makes more sense?

	Size	Cost to Empty
General Waste Bins	240 litre	£5.30
	360 litre	£7.50
	660 litre	£13.00
	1100 litre	£19.00
Recycled Waste Bins	240 litre	£1.55
	360 litre	£2.25
	660 litre	£4.00
	1100 litre	£6.20

Of course, this activity is focused on the amount of money which is being spent on removing waste from your school – the biggest question for you to answer with your team of detectives is:

HOW MUCH IS THE  
MENACE OF PLASTIC  
WASTE COSTING OUR  
SCHOOL!?





# ACTIVITY 5: MONEY IN THE BIN?



You now have a lot of the evidence and skills in converting weight to volume, and even cost. You now have one more important calculation to do – **how much has the Menace of Plastic Waste actually cost your school each year?**

To do this, use the number of bins in each category (which you found in Activity 1) and find out how many times these bins are emptied each year. Sometimes it is every week, other times it is every two weeks. You can then fill in a table like the one below – your teachers can help you to calculate the total cost for each bin, as well as how much your school spends on getting rid of waste in total each year! You could also try to work out how much your school spends on getting rid of each pupil's waste each year – there are lots of interesting ways to think about this!

	Bin Size	How Many Bins?	Times Emptied Each Year	Cost per Emptying	Total Cost
General Waste Bins	240 litre	3	40	£5.30	£636
	1100 litre	2	40	£19.00	£1520
Recycled Waste Bins	240 litre	4	40	£1.55	£248
	1100 litre	5	40	£6.20	£1240

Your teacher can tell you how much it costs to empty other sizes of bins if you have them in your school!

Once you've done this, you can report to your Principal on the amount of money spent on getting rid of waste per pupil, as well as how much waste was sent away, as well as how much of this was recycled – might you be able to help them save money?

## SUMMARY

All this evidence should be really helpful in not only finding out where your waste is coming from, but also how much it is costing your school and the environment. The detectives can compare your data with WRAP data, which suggests that primary schools in the UK generate around 45kg of waste per pupil each year, whereas secondary schools produce around 22 kg of waste per pupil per year – how does your school compare?

Your detectives should also be able to use your calculations in Activity 5 to estimate how much money your school could save if it recycled more, or reduced the amount of waste it produced altogether. What would you be able to do if the school was able to save this money?

## RESOURCES AND REFERENCES

For a more detailed waste audit lesson plan you can access resources on the recycle now web pages, at <http://bit.ly/PROUD-resource>

<sup>1</sup><http://www.wrap.org.uk/sites/files/wrap/Bulk%20Density%20Summary%20Report%20-%20Jan2010.pdf>

<sup>2</sup>Rounded value based on 10 councils across Northern Ireland for 1100 L Residual waste collection

<sup>3</sup>£20 for 24.2 kg = £0.83 per kg. Milk price taken at £0.85 per L and milk density at 1.026 kg/L = £0.83 per kg.