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Have you ever heard that you should eat the colours of the rainbow? Have you wondered what gives food its colour?

A healthy diet has been famously summed up with this simple phrase: “Eat food, not too much, mostly plants” (Michael Pollan). We have long known that plant foods, like fruits, vegetables, legumes, nuts and seeds are essential for good health, largely because of their abundant vitamin, mineral and fibre content. We now know that plant foods have other powerful compounds called polyphenols that give fruits, berries and vegetables their vivid and diverse range of colours. They also add to the flavour of food and have numerous health benefits.

Polyphenols give many fruits and vegetables their vibrant colour, which is why it has been suggested that we should eat the colours of the rainbow

What are polyphenols?

Polyphenols, or phytochemicals, are thousands of different molecules found in plants, including edible plant food, which are chemically made up of hydroxyl groups on aromatic rings. Plants make them to protect themselves from ultraviolet radiation and predators. More than 8,000 polyphenols have been found in different plants. They are classified according to their chemistry (the number and interaction of phenol rings) into four broad classes: phenolic acids, flavonoids, stilbenes and lignans (Manach et al., 2004). Spices and herbs are the richest sources of polyphenols, which might explain why they have traditionally been used for medicinal purposes over the centuries. Cocoa powder, chocolate and dark berries also have particularly high concentrations of polyphenols.

Flavonoids are the most abundant and most studied class of dietary polyphenols, boasting more than 4,000 different varieties. Because of that, polyphenols have often been classified as flavonoids or nonflavonoids. Flavonols (e.g. catechins, proanthocyanidins) and anthocyanins are the most abundant flavonoids. Many flavonoids give flower, fruit and leaves their attractive colours. The highest concentrations are found in onions, curly kale, leeks, broccoli and blueberries. Other fruits, vegetables, legumes, cereals, red wine, dark chocolate and green tea also contain flavonoids (see Table 1 for more details). The concentrations depend on the amount of sunlight the plant is exposed to. Therefore, they can vary between fruit on the same tree and even different sides of the same fruit.

Phenolic acids comprise about a third of dietary polyphenols, and are further divided into hydroxyl benzoic and hydroxyl cinnamic acids. There are seven subclasses and 168 polyphenols in this group. Caffeic acid is thought to be the most abundant phenolic acid, comprising 75-100% of the total cinnamic acids in most fruit. Some foods that contain phenolic acids are certain red fruits, onions, tea, blueberries, plums, apples, cherries – and as you may have guessed, cinnamon. Ferulic acid, another cinnamic acid, is present in cereal grains such as wheat, oats and rice.

The stilbene content of the human diet is low. The most well-known polyphenol from this class is resveratrol, which is found in red grapes, wine that is produced from the grapes, and peanuts. Because levels are relatively low, we are unlikely to get major health benefits from dietary resveratrol alone. However some researchers have investigated its health effects when it is concentrated as a dietary supplement. Altogether there are 27 polyphenols in this class.

Lignans have by far their highest concentration in linseeds and linseed oil, and smaller amounts are found...
in sesame seeds, legumes, cereals, grains, fruits, algae and some vegetables. This class contains a total of 53 polyphenols.

Some polyphenols are found in a variety of foods while others tend to be more specific to one food. For instance, the flavonol quercetin is found in almost all plant products while soy only contains isoflavones. Most foods contain complex combinations of polyphenols; for instance, extra virgin olive oil contains at least 36 different polyphenols. Their presence may differ according to the part of the food they are in (e.g. skin or flesh), and how the food is processed, stored and cooked. For instance, the polyphenol content of apples can range from 0.1 to 5 grams per kg, and some types of cider apples contain up to 10 grams per kg.

In 2010, a group of researchers identified the 100 richest dietary sources of polyphenols using the most updated database at the time (Pérez-Jiménez et al.). The concentrations varied from as much as 15,000 mg per 100 grams in cloves to 10 mg per 100ml in rosé wine. The top twenty most concentrated sources identified were:

- cloves
- dried peppermint
- star anise
- raw cacao
- dried Mexican oregano
- celery seed
- black chokeberry
- dark chocolate
- flaxseed meal
- black elderberry
- chestnut
- dried sage
- rosemary
- spearmint
- thyme
- blueberries
- blackcurrants
- capers
- black olives
- hazelnuts
- pecans

Some foods haven’t been tested yet, so this list may change with more updated information. It is also important to note that serving sizes of these foods vary (for instance, we tend to have small amounts of herbs and spices), so if they were organised according to the amount that we eat, the concentrations from foods in our diet would be different. The bioavailability (amount that we absorb in our digestive tract) and biological activity of different polyphenols also varies, so this will also influence any effects that different sources have on our health.

Table 1. Broad overview of foods containing polyphenols

<table>
<thead>
<tr>
<th>Polyphenol group</th>
<th>Food sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phenolic acids</td>
<td>Blueberries, kiwi fruit, plums, cherries, apples, coffee, blackberries, raspberries, strawberries, blackcurrants, potato, cinnamon, mango, St John’s wort, oregano, extra virgin olive oil</td>
</tr>
<tr>
<td>Stilbenes</td>
<td>Grapes, grape juices, wine, peanuts, European cranberry, lingonberry</td>
</tr>
<tr>
<td>Flavonoids</td>
<td></td>
</tr>
<tr>
<td>Polyphenol group</td>
<td>Food sources</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Flavonols</strong></td>
<td>Onion, kale, leek, cherry tomatoes, broccoli, blueberries, blackcurrants, apricots, apples, green beans, black grapes, tomatoes, black tea, green tea, saffron, goji berry, arugula, asparagus, bay leaves, broad beans, Brussel sprouts, raw Chinese cabbage, chives, coriander, cress, endive, fennel, garlic, ginger, horseradish, kale, leeks, lovage, mustard greens, nalta jute, okra, spring onion, chilli peppers, radish leaves, wild rocket, tree spinach, turmeric, turnip greens, watercress, chia seeds, almonds, kidney beans, carob, buckwheat</td>
</tr>
<tr>
<td><strong>Flavones</strong></td>
<td>Parsley, celery, capsicum, oregano, sage, celery seed, juniper berries, vine spinach</td>
</tr>
<tr>
<td><strong>Flavanones</strong></td>
<td>Oranges, orange juice, grapefruit, grapefruit juice, raw lemons, tomatoes, mint, oregano, rosemary, kumquats, limes, globe artichokes, cherry tomatoes</td>
</tr>
<tr>
<td><strong>Flavanols</strong></td>
<td>Cocoa/chocolate, green tea, beans, black tea, apricots, cherry, grape, peach, capers, blackberries, apples, red wine, cider, dill weed, Swiss chard</td>
</tr>
<tr>
<td><strong>Anthocyanins</strong></td>
<td>Eggplant, blackberries, blackcurrants, blueberries, black grapes, cherries, rhubarb, acai berry, bilberry, cranberries, plums, elderberries, raspberries, strawberries, red cabbage, radicchio, radishes, purple sweet potato, hazelnuts, pecan nuts, pistachios, walnuts, red wine, sweet dessert wine, black beans</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Polyphenol group</th>
<th>Food sources</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Isoflavones</strong></td>
<td>Soy flour, soy beans, miso, tofu, tempeh, soy milk, black bean sauce, red clover, mung bean sprouts, pistachios, adzuki beans, chick peas</td>
</tr>
<tr>
<td><strong>Lignans</strong></td>
<td>Linseeds, linseed oil, sesame seeds, lentils, raisins, apricot, nectarine, peach, melon, triticale, wheat, pears, prunes, algae, garlic, asparagus, carrots, raw kale, sweet potato, buckwheat, cashews, broccoli, Brussel sprouts, green capsicum, zucchini, cabbage, sauerkraut</td>
</tr>
</tbody>
</table>

Health benefits of polyphenols

Since the 1990s, large population studies have shown that foods rich in polyphenols are associated with lower risk of inflammation and diseases like heart disease, stroke, diabetes, osteoporosis, dementia and cancer. For example, many studies have found that fruits and vegetables that are rich in polyphenols are protective against bowel cancer. There is some evidence that polyphenols in green tea protect against a variety of different cancers and heart disease. Polyphenols may also improve brain function and protect against psychiatric and cognitive disorders. For instance some studies have shown that berries and resveratrol extracted from grapes may protect against cognitive decline with aging.

This research has attracted considerable scientific and public interest, with a strong focus on their antioxidant effects. What does this mean?

We need oxygen for our body’s metabolic activities which keep us alive. However this oxidation can create ‘free radicals’. They are unstable molecules with one or more unpaired electrons that can start rampant chain reactions if they exceed our body’s ability to defend itself. These chain reactions involve grabbing electrons from other vulnerable molecules which then leaves them unpaired, and so they grab one from another molecule, and so it continues. Free radicals can also result from environmental exposures like air pollution, cigarette smoke, drugs, pesticides and radiation.
Free radicals can have toxic effects on our health; for instance they can damage our cell membranes (which are rich in lipids, or fats) and cellular activities, proteins, DNA, and even result in cell death (apoptosis). This contributes to chronic, degenerative diseases like heart disease, cancer, and early aging. Our brain is especially vulnerable to oxidative damage because it is very rich in lipids and is metabolically very active. Therefore oxidation has also been associated with mental disorders like schizophrenia, dementia, bipolar disorder, depression, anxiety, substance abuse, autism and attention deficit hyperactivity disorder (ADHD).

Importantly, polyphenols have antioxidant properties. This means that they can donate electrons to free radicals to stabilise them and stop their toxic effects (Image 4). Other nutrients like vitamin C, vitamin E and carotenoids (other health-promoting plant compounds that give many fruit and vegetables their yellow, orange and red colour) are also antioxidants. However, polyphenols are the most abundant dietary antioxidants. For instance, their dietary intake is estimated as 1 gram per day which is ten times higher than Vitamin C and 100 times higher than Vitamin E and carotenoid intake. The antioxidant activities of polyphenols vary according to their chemical structure. Also, the potency of antioxidants increases when they are combined. However, a lot of the studies have been done in petri dishes (‘in vivo’) and antioxidant effects in humans need to be further researched.

There is newer evidence suggesting that polyphenols are beneficial for our health in ways other than through antioxidant effects. For instance, they may be able to affect the activity of enzymes (proteins that catalyse biochemical reactions in our bodies), improve the function of our mitochondria (the energy-generating powerhouse of all our cells), influence the function of neurotransmitters (chemicals that transmit important information throughout our brain and body), improve blood flow, and help our body to get rid of toxins, for instance carcinogens (cancer causing substances) and the byproducts of pharmaceutical drugs.

Polyphenols may also have a two-way interaction with the bacteria in our gut. Only a small percentage of polyphenols appear to be absorbed in our small intestine, and the bacteria in our colon (large intestine) break most of them down into smaller molecules that can be absorbed into our body. Therefore, our ability to absorb and use polyphenols may depend largely on our gut bacteria. In turn, polyphenols may influence the ecology of our gut bacteria by stimulating the growth of beneficial bacteria and inhibiting the growth of pathogenic (disease causing) bacteria. Therefore they may act as prebiotics (food that gut bacteria feed on). In support of this, the metabolism of gut bacteria by dietary polyphenols has been linked to prevention of colon cancer and overall cancer risk. However much more research needs to be done to understand the two-way interaction between polyphenols and gut bacteria, and how that improves our health.

Anti-oxidants, like polyphenols in plant foods, can reverse oxidative damage caused by free radicals by replacing missing electrons.

Concluding thoughts

Unfolding knowledge about the amazingly diverse and complex world of polyphenols sheds more light on the multiple health benefits of eating a diet rich in plant foods. We don’t yet know what the optimal intake of polyphenols is for preventing disease and improving health, nor how to best measure intake. More research is needed to understand these and other questions. However, we do know that traditional diets that are high in plant foods such as fruit, vegetables, legumes, nuts, seeds, wholegrains, olive oil, herbs and spices are associated with better physical and mental health and wellbeing.
Importantly, dietary recommendations advise us to eat a large variety of plant foods so that we can get the full range of nutrients that our body needs. For instance, different vegetables contain different nutrients – orange coloured vegetables like carrots and sweet potato are higher in vitamin A and carotenoids while green coloured vegetables like spinach are higher in iron, folate and Vitamin K. This variety is also important for us to derive health benefits from polyphenols: different foods contain different combinations of the thousands of polyphenols; their activities vary; and they interact so that they are more potent when combined with each other and with other antioxidant nutrients. Bon appetit!

*Eat a wide variety of plant foods to get the health benefits of polyphenols (as well as other nutrients and fibre)*

**Student activities:**

1. What are polyphenols?
2. What sorts of foods contain polyphenols?
3. What factors affect the amount of polyphenols in food?
4. In what ways might polyphenols affect our health?
5. Explain the process of oxidation and what causes it.
6. What are antioxidants and why are they important?
7. Keep a food diary for one week, recording everything you eat and drink. Count (a) how many meals/snacks in your diet contain polyphenols and (b) how many different foods contain polyphenols (i.e. variety).
8. Design a week-long food plan that includes as many polyphenols as possible (see Table 1 and [https://www.nature.com/ejcn/journal/v64/n3s/pdf/ejcn2010221a.pdf](https://www.nature.com/ejcn/journal/v64/n3s/pdf/ejcn2010221a.pdf)) and make a list of foods that contain stilbenes, organised from highest to lowest content.
9. Go to Phenol-Explorer: Database on polyphenol content in foods ([http://phenol-explorer.eu/](http://phenol-explorer.eu/)) and make a list of foods that contain stilbenes, organised from highest to lowest content.
10. Make two lists of the top twenty foods with highest concentrations of (a) phenolic acids and (b) flavonoids.

**References**


Druker, S. M. 2015. Altered genes, twisted truth: how the venture to genetically engineer our food has subverted science, corrupted government, and systematically deceived the public. Clear River Press: Salt Lake City UT.


Food Standards Code in Australia can be found at: http://www.foodstandards.gov.au/thecode/foodstandardscode.cfm (GM food regulations are given as Standard 1.5.2, Food Produced Using Gene Technology)

Public Health Association of Australia (PHAA) policy on GM foods can be found at: https://www.phaa.net.au/advocacy-policy/policies-position-statements.


You know that feeling when you open the fridge and are met with something ‘on the nose’. You’ve been trying to ignore it for days, but it’s gotten so bad that something needs to be done. A search uncovers a slimy bunch of spinach, curdled milk or last week’s mouldy leftovers lurking in the back. You reluctantly pick it up and dash outside to dump it in the bin before it can drip on the carpet and permeate the house.

We all know what food waste looks - and smells - like. But food waste stinks in more ways than one. It is expensive, costing the average Australian household over AUS$2200 a year. It also puts a strain on scarce resources such as land and water, and produces significant greenhouse gas emissions, undermining the resilience and sustainability of our food system.

A quarter of the food wasted globally would be enough to feed all the hungry people in the world – and overall would feed 10 billion people.

But there is hope. Studies from similar countries such as the UK have shown that it’s possible to significantly reduce food waste. For meaningful change however, we need to look not just at household food waste, but structural change throughout the food system.

Food waste and food security

Food security is a significant global issue. Recent studies suggest that food production would need to roughly double to keep pace with projected demands from population growth, dietary changes and increasing bioenergy use. Serious questions have been raised, however, about whether we’ll have enough land, water and other resources to do so.

Food production also generates greenhouse gas emissions that contribute to climate change and will impact our ability to produce food in the future. Rising temperatures will increase heat stress on livestock and crops, so more water will be required to produce the same amount of food. Warmer conditions will also increase evaporation from water sources and reduce water availability. It is becoming increasingly apparent that we need to reduce the resource used and emissions produced for agricultural production to ensure future food security.

A large proportion of food gets wasted because supermarkets have strict specifications about how perfect fruit and vegetables look

Part of the solution to this problem is to reduce food waste. Globally, one-third of edible food produced is wasted. In developed countries food waste is typically generated in households and due to factors such as strict supermarket appearance standards for fresh produce. In developing countries, the majority of food waste is caused by post-harvest losses due to poor storage facilities.

Producing and disposing of this wasted food uses dwindling resources and is a significant source of
greenhouse gases – not just from production but also from disposal in landfill. Globally, the carbon footprint of wasted food that is produced and not eaten is 3,300 million tonnes of greenhouse gases per year. If food waste were a country, it would have the third-highest emissions after China and the US (Figure 1).

![Figure 1 – Global food waste emissions compared to national emissions by country (Source: FAO)](image)

Just a quarter of this wasted food would be enough to feed the hungry worldwide, and overall there would be enough for 10 billion people. Although there are still significant issues with getting food to people who need it (having enough food available won’t be sufficient on its own to address the complex issue of food security – both accessibility and affordability also need to be considered), we actually already produce enough to meet our needs in 2050. Reducing food waste is a way to address the dilemma of having enough food available to meet future needs and mitigating the environmental impact of food production.

In recognition of the significant challenge that food waste represents to sustainable food systems, the new Sustainable Development Goals set a target to halve the global food waste per person that is generated by retailers and consumers by 2030.

**How much food is wasted in Australia?**

Recent research has estimated that in Australia, 32% of edible food produced is wasted. For an average Australian this amounts to around 207 kg per person per year. For a city the size of Melbourne, that’s a total of 900,000 tonnes every year, which is enough to feed an additional 2 million people.

Of the total edible food waste, around 41% is ‘post consumer waste’ generated by households and in restaurants and cafes. Almost 60% of food waste occurs earlier in the food chain - 24% as pre-farm gate waste (that occurs before food leaves the farm), and 35% during food processing and distribution. Most food waste is made up of highly perishable food types such as fruit, vegetables, dairy and cereals (particularly in the form of bread wasted at the post-consumer stage – Figure 2).

![Figure 2 – Food waste breakdown by food type and stage in the food system (Source: Foodprint Melbourne)](image)

**Environmental impacts of food waste in Australia**

Producing wasted food has significant environmental impacts. The water required is estimated to be around 113 litres per person per day - equivalent to running your shower for an extra 10 minutes a day. It also uses around 41 hectares per person per year - around 20 times the area of the Melbourne Cricket Ground. In total this amounts to around 1006 GL of water and 19 million hectares of land each year for Australia.

This wasted food is also responsible for around 13.5 million tonnes of greenhouse gas emissions. The majority of these emissions - 60% - is generated by food waste rotting in landfill, and the rest in producing the wasted food.

Australia has limited rainfall and fertile land for growing food, and food waste puts a greater strain on our existing resources. Australia is a water-scarce region that is already subject to significant climate variability. According to the IPCC, conditions are likely to become drier and more prone to extreme weather events. In addition to this, although Australia has substantial land available, only 6% of it is suitable for growing crops and is already showing signs of considerable degradation due to unsustainable farming practices. High levels of food waste will only add to the recognised challenge of producing sufficient food
to feed a growing population, another critical reason for reducing them.

**What can be done about it?**

There are many ways to reduce food waste at home. A number of food waste initiatives and online resources give practical advice for reducing household food waste. Top tips include writing meal plans and sticking to them, checking what food you already have before going shopping and storing it all correctly. When cooking, it's important not to over-cater and be conscious of portion sizes, as well as learning how to creatively use up leftovers (or cooking like your granny used to). Eating everything on your plate is not a solution. Overeating – i.e. consuming more than your body needs to be a healthy weight – is also a form of food waste which impacts on our health and productivity.

There are a number of apps that can help you to reduce food waste. They have a range of features that help you track what’s in your pantry and fridge, import recipes, create meal plans on the go, generate shopping lists, and sometimes all of the above. They take a bit of time to set up, but once that’s done they can make your life a lot easier. Menu planning also means fewer trips to the supermarket and less impulse spending, as well as helping you use leftovers more efficiently.

It is possible to reduce emissions from food waste by composting the parts that can’t be avoided (banana peels, nut shells, etc). Along with traditional compost bins, worm farms and bokashi bins are great ways to divert food waste from landfill and reduce the associated emissions.

Supermarkets could assist consumers to reduce household food waste by exploring how to provide a wider range of portion sizes (including more portion sizes appropriate for smaller households). They could also avoid over encouraging ‘bulk buys’ that may mean consumers waste more, and provide information on how to store food appropriately.

**The bigger picture**

While we can all take steps to reduce food waste at home, we need to look at the bigger picture. As mentioned earlier, more than 60% of food waste in Australia is generated before food even reaches your fridge or freezer.

Strict standards defining the shape, size and colour of fresh fruit and vegetables in supermarkets can mean that a significant proportion of a crop never leaves the farm. Low prices for second-grade produce can make it financially unviable for farmers to pick, pack and ship imperfect produce. Pressure to keep supermarket shelves full just to look good, losses during food processing and storage problems also lead to food being wasted.

Initiatives that aim to make more imperfect fruit and vegetables available, such as Woolworth’s Odd Bunch campaign, go some way to reducing this problem, but more needs to be done. There needs to be more focus on buying and using the whole crop from farmers and softening the highly restrictive supermarket standards that define the appearance, shape and colour of ‘top grade’ produce that makes it onto the shelves. Fruit and vegetables don’t grow to standard sizes and shapes, so as consumers we also need to get used to the natural variation in their appearance.

A focus on local processing of fruit and vegetables is also necessary, so there are more markets for produce that doesn’t meet the top grade. More and more of our processed (canned and frozen) fruit and vegetables are now imported, and this has limited the available markets for ‘non-standard’ fruit and vegetables.

Structural change is necessary across our food system to effectively reduce waste and improve sustainability. This requires both bottom-up action from consumers and retailers and strong government leadership and targets from the top down.

**Targets and initiatives to reduce food waste for sustainability**

Other countries and some states in Australia have already begun to take steps to address food waste. The UK government has been an early mover in taking action to tackle food waste. In 2007, it launched the WRAP Love Food Hate Waste program aimed at reducing food waste. An evaluation in 2012 showed that avoidable waste of food and drink (that could have been eaten) had fallen by 21% in five years following the launch of the program.

Most of this reduction has been in household food waste. The WRAP program is now working with the food industry to reduce waste in other sectors. The successful UK Love Food Hate Waste program aimed at reducing household food waste has been taken up by state governments in Victoria and New South Wales.

In Denmark government regulations have enabled food banks, food waste kitchens and a food waste supermarket to thrive.
Denmark is another leader in this area. It has more initiatives against food waste than any other country in Europe and has cut food waste by 25% since 2010. Like in the UK, these initiatives initially focused on post-consumer waste with a campaign by lobby group “Stop Spild Af Mad” (Stop Wasting Food) to reframe attitudes to leftovers by consumers and highlighting retail wastage. Prevention of food waste has now become a core strategy for all Danish supermarket chains in their competition for market share. Changes in national regulations and taxation around food donations have made it easier and more attractive for retailers to donate to charity. As a result food banks, food waste kitchens and even a food waste supermarket, WeFood, in the capital Copenhagen have been able to thrive. Smartphone apps have also been developed so that businesses like bakeries and restaurants can alert customers when they want to sell any excess products before closing time each day.

In April 2015, Denmark set a national target to reduce avoidable food waste in every part of the food chain. Partnerships have been established between actors from agriculture to industry, retail, commercial kitchens and consumer organisations to identify barriers in existing regulations and develop new ideas to reduce food waste. The United States government has set a national target to reduce food waste by 50% by 2030. It has also established a cross-sector partnership of stakeholders across the food system to tackle the problem. Australia is developing a national food waste strategy – the Food Waste 2025 Strategy. In mid 2016 stakeholders from across the food supply chain met with the government to discuss how to reduce food waste, and a commitment has been made to halve food waste by 2030. A National Food Waste Summit is planned for the end of 2017 to determine how this may be achieved. Based on previous research, it is estimated that if food waste were halved across the food supply chain, Australia could save 9.7 million hectares of land, 485 million litres of water and avoid 7 million tonnes of greenhouse gases each year.

Conclusion

Based on increasing food needs, resource scarcity and impacts of climate change on food production, it’s clear that wasting edible food simply can’t continue if we want to avoid future food insecurity and ensure the sustainability of our food system. This is particularly important in Australia due to high levels of food waste, resource intensive production methods and particular threats to food production from extreme weather and land degradation. Steps to address food waste need to be taken across all parts of the food chain to enable significant reductions to occur. Other countries have had success in reducing food waste by using both bottom up and top down initiatives, making it clear that commitment from actors across agriculture, industry, retail and consumer groups is required. Australia should follow the examples set by the UK and US in setting and sticking to targets to halve food waste across the food supply chain to put Australia’s food system on a more sustainable footing.

Student activities:

1. Describe the sources of food waste globally and the impact this is having.
2. In what ways is climate change impacting on food resources?
3. What are some of the problems that addressing food waste could help to solve?
4. What measures could governments, supermarket chains and food outlets take to reduce food waste?
5. Define and give examples of ‘top down, bottom up’ initiatives.
6. What are some of the ways that we can reduce food waste in our own homes and communities?
7. Define food security and investigate whether this is an issue in Australia (considering all states and territories, metropolitan and regional areas).
8. How does food waste relate to the Universal Declaration of Human Rights?
9. How could food waste be harnessed to address the problem of food insecurity?
10. How does food waste and food waste solution differ between developed and developing countries?
References


