WORK-IT-OUT WORKSHEET REFERENCES FOR FACTS

Did you know “Soft fruits, like strawberries, are flown across the world so we can eat them fresh in the winter, which contributes to climate change.” Read all the details about how fruits contribute to climate change from the original research paper by Angelina Frankowska (Takeabitecc Team member) and colleagues
https://doi.org/10.1016/j.jenvman.2019.06.012

- Did you know “A thin plastic film (weighing just 1.5 grams) makes cucumbers last for 14 days longer!”? The film causes 4.56 gCO2e for 1.5g of LDPE film while growing a cucumber emits 696 gCO2e for one cucumber (300g)
  - Main source here: http://www.packagingfedn.co.uk/images/reports/Packaging%20in%20Perspective%20-%20November%202008.pdf
  - LDPE (low density polyethylene) packaging film: 3.04 kg CO2e/kg product from Ecoinvent 3.6 Database.
  - Cucumber emissions from Frankowska et al. 2019
https://doi.org/10.1016/j.scitotenv.2019.04.424

WORK-IT-OUT WORKSHEET REFERENCES FOR NUMBERS

- “Growing and selling a large handful (80g) of fresh strawberries causes 140 grams of greenhouse gases (gCO2e)”. Growing and storing fresh strawberries in the UK causes about 2.23 kg CO2e / kg strawberries - from Figure S32 “The environmental impacts of UK strawberries by product category” of https://doi.org/10.1016/j.jenvman.2019.06.012, of which 1.7 kg CO2e / kg are from farm and retail (we ignore transport and waste here). 1.7 kg CO2e / kg strawberries is the same as 1.7 gCO2e / g strawberries. Therefore 80g of local fresh strawberries causes 1.7 gCO2e / g strawberries * 80g strawberries = 1.7 * 80 gCO2e = 136 gCO2e, which we round to 140 gCO2e in the worksheet.

- “A lorry might travel 250 miles across the UK, causing 4 grams of CO2e for 80g of strawberries.” Trucks cause about 0.05 kg CO2e / kg for a 400 km journey. This comes from DEFRA 2018 https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2018), using their number of 0.133 kg CO2e / tonne km for HGV refrigerated all diesel, average load. To get the value for 400 km for 1 kg of food we need to multiply by 400 km and divide by 1000 kg per tonne i.e. 0.133 kg CO2e / tonne km * 400 km / 1000 kg / tonne = 0.133 * 400 / 1000 kg CO2e / kg = 0.0532 kg CO2e / kg of produce. This is the same as 0.0532 g CO2e / g produce, which we round to 0.05 gCO2e / g. Therefore 80 grams of food cause 80 g * 0.05 gCO2e / g = 4 gCO2e.

- “An aeroplane from Morocco might fly 1500 miles to the UK, causing 280 gCO2e for your 80 gram portion.” Based on DEFRA 2018 Transport emissions factors
0.7640 kg CO2e / tonne / km (long haul dedicated cargo flights, table 40).
“1 gram of beef causes 46 grams of greenhouse gas emissions (gCO2e)” See the references document for Theme 2 for more details on where this number comes from.

- So 46 gCO2e / g beef * 100g beef = 46 * 100 gCO2e = 4600 gCO2e. Truck for 400 km: 0.05 gCO2e / g beef * 100g beef = 0.05 * 100 gCO2e = 5 gCO2e. Thus, the GHG emissions of beef transported by truck in the UK (400km) is: 4600gCO2e + 5gCO2e = 4605gCO2e
- In the case of transporting by ship: we considered a trip by ship from “the other side of the world” as 20000 km away from the UK, which means 0.26 kg CO2e / kg of food or 0.26g CO2e / g of food. So for 100 of beef the emissions of shipping is 26g (0.26g CO2e / g of beef * 100g beef = 0.26 * 100 = 26g CO2e) which in total adds up: 4600g CO2e + 26g CO2e = 4626g CO2e
- Technically the beef emissions number already includes the transportation, but this is only approximately 0.6 gCO2e / g (see Poore & Nemeck 2018 “full database” available from https://josephpoore.com/) out of the 46 gCO2e / g so we ignore this double counting as it makes little difference to the results. Also this correction is small compared to the range of emissions for beef.

Either way, the transportation makes a minor difference compared to raising the beef.
“Growing and cooking beans at home causes about 1 gram of greenhouse gas emissions (gCO2e) for 1 gram of cooked beans.” The global average emissions for beans and pulses from Poore & Nemeck 2018 is 1.8 kg CO2e / kg dry beans. Using a rehydration factor of 0.349 from Durlinger et al 2017 this is 1.8 kg CO2e / kg dry beans * 0.349 g dried beans / 1 g rehydrated beans = 1.8 * 0.349 / 1 kg CO2e / kg rehydrated beans = 0.62 kg CO2e / kg rehydrated beans = 0.62 gCO2e / g rehydrated beans.

Allowing 5 minutes of cooking time per 200g portion of rehydrated beans, at 2 kW using an energy mix causing 0.5 kg CO2e / kWh (as used in Theme 1), adds 5 / 60 hours * 2 kW * 0.5 kg CO2e / kWh * 1000 g / kg = 5 / 60 * 2 * 0.5 * 1000 gCO2e = 83 gCO2e for a 200g portion i.e. 83 gCO2e / 200 g = 0.42 gCO2e / g. Adding the beans and the cooking together gives 0.62 gCO2e / g + 0.42 gCO2e / g = 1.04 gCO2e / g for cooked beans, which we round to 1 gCO2e / g.

So, 1 gCO2e / g cooked beans * 100 g cooked beans = 1 * 100 gCO2e = 100 gCO2e beans * 100g beans = 0.05 * 100 gCO2e = 5 gCO2e. Thus, the GHG emissions of beans transported by truck in the UK (400km) is: 100gCO2e + 5gCO2e = 105gCO2e.

In the case of transporting by ship: we considered a trip by ship from “the other side of the world” as 20000 km away from the UK, which means 0.26 kg CO2e / kg of food or 0.26g CO2e / g of food. So for 100 of beans the emissions of shipping is 26g(0.26g CO2e / g of beans * 100g beans = 0.26 * 100 = 26g CO2e), which in total adds up: 100g CO2e + 26g CO2e = 126g CO2e.

Technically this number already includes the transportation of the beans. Poore & Nemeck 2018 (“full database” available from https://josephpoore.com/) uses a value of 0.1 kg CO2e / kg dried beans for the transport emissions, which modifies our above value to (1.8 - 0.1) * 0.349 / 1 kg CO2e / kg rehydrated beans = 0.59 gCO2e / g rehydrated beans. Adding this to the cooking assumed above gives 0.59 gCO2e / g + 0.42 gCO2e / g = 1.01 gCO2e / g for cooked beans. This is the same as the previous value to within the rounding we apply for the worksheet.

In the above we have assumed the beans are transported after hydration, however in the more common case of transporting dry beans the numbers would be even lower.