



ADVANCED FOOD

Defence bars for peak performance

STEM Education Kit

for teachers, school students and parents



LOWER SECONDARY

Food:
DIFFERENT
By Design



Welcome

STEM in Defence

The Australian Department of Defence's mission is to defend Australia and its national interests. The people that work for Defence want to keep Australia and Australians safe and protect our health, freedoms and ways of living.

The Department of Defence includes:

- members of the Australian Defence Force (ADF) within the Navy, Army and Air Force; they're the ones in uniforms
- the government agency staff supporting the ADF, veterans and their families.

The Defence Science and Technology Group is part of the Department of Defence and includes scientists, engineers, project managers, mathematicians, technologists and many others focused on innovation. Plus they employ people with expertise in business; finance; human resources; occupation health, safety and environment; education and communication.

The future workforce for all Defence areas will change as technology advances and the needs of Australian society change. What is certain is that a diverse workforce with STEM skills will be more in demand.

Food research

A crucial aspect of Defence research is related to the food it provides ADF personnel. Realising that ADF members were often not getting the energy and nutrients they needed when out in the field or doing heavy exercise, Defence began exploring solutions. Researchers and technical experts collaborated with industry and university experts in universities to develop a high-energy, gut-friendly snack bar for ADF personnel. This advanced food bar is the focus of these STEM Education Kits.

Pick your education kit

Three kits have been designed for different age ranges. The kits contain engaging information, activities, design tasks and related learning. The age levels can be identified on the front cover and by the colour schemes. While these kits have been designed for teachers, school students and parents, we hope they will be interesting to all.

Connections to the Australian Curriculum are highlighted throughout using relevant codes*. When just the front of the codes is listed, for example 'ACSYS', it indicates that the information is relevant to all the specific sub-codes for the relevant year groups.

Upper primary

Key theme: food bar packaging and its relationship to the chemical properties of materials. The main activities provide opportunities to link to ACSSU074, ACSYS, ACSHE, ACTDE.

Lower secondary

Key theme: getting enough energy through food we eat and its relationship to the physical properties of energy transformation. The main activities provide opportunities to link to ACSSU179, ACSYS, ACSHE, ACTDE.

Upper secondary

Key theme: designing food to meet our different needs, including essential vitamins and minerals. This relates to nutritional requirements of living things. The main activities provide opportunities to link to ACSBL031, ACSBL034, ACSBL036, ACSBL039.

*Source: Australian Curriculum, Assessment and Reporting Authority (ACARA, July 2021)

Teaching and learning approach

These resources use an inquiry and investigative approach underpinned by the 5Es instructional model (Bybee, 2015) which outlines the phases Engage, Explore, Explain, Elaborate and Evaluate. They are also informed by the 21st Century Fluencies (Crockett et al., 2011), with the phases Define, Discover, Dream, Design, Deliver and Debrief.

Acknowledgements

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Lasting energy

KEY CURRICULUM CODES: ACSSU179, ACSIS, ACSHE, ACTDE

Energy bars

One of the reasons we eat food is to get energy to function. Food contains energy in the form of organic compounds like sugars, proteins, fats and carbohydrates. We also eat food because it's yummy, it looks good, it makes us feel good and it takes away our hunger.

In Australia we use kilojoules (kJ) to quantify the energy in food. It is the international unit for energy named after James Joule, an eminent physicist. In some countries, like the United States of America, they use calories. The number of kilojoules divided by 4.2 gives you the number of calories.

So, why are only some foods labelled as “energy bars” or “energy drinks”?



- Brainstorm some common sentences or sayings that use the word ‘energy’
- Which form of energy is described, for example, in science it could be thermal, potential, kinetic, electrical, nuclear or chemical energy?
- What might some products actually mean by ‘energy’?
- Can you think of some better/more accurate ways to describe these products?



Investigate the energy transfers and transformations of a food item in your pantry. How much energy did it take to produce and transport? How much energy do you get from eating it?

CURRICULUM CODE: ACSSU155

Energy to burn

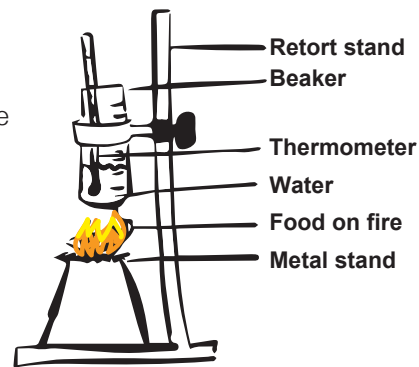
How much energy is in food? A fun (but please be safe) way to observe how much energy is in something is to burn it. Here we'll use a potato chip and safely set it on fire.



Source: doodlewash.com.

You will also need:

- stable surface
- long match or electric gas lighter
- a fireproof dish



Did you know you can quantify the energy released by measuring the temperature change in water it heats?
Source: Kathryn Carter.

Place the fireproof dish on a stable surface with nothing flammable around it. Put the chip in the middle of the dish and light it (with the long match or electric gas lighter). Make sure you stand well back. What do you observe?

Was it what you expected?

Can you design a test to visually compare the amount of energy in different foods?

Keep it fair! Remember to only change one thing: the type of food.



Be fire safe! Observe standard fire precautions and have something to hand to smother the fire if needed.

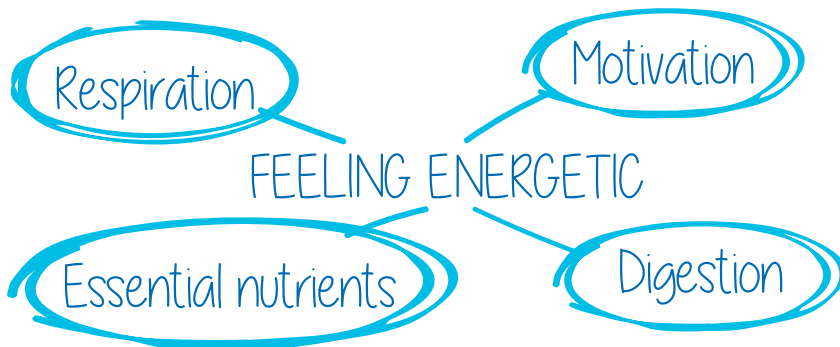


It takes 4,200J to raise the temperature of one kilogram of water by one degree Celsius. What mass of chips would you need to burn to transform 250mL of water at 20°C into vapour? CURRICULUM CODE: ACSSU155

Lasting energy

Feeling energetic, feeling good

Feeling full of energy and enthusiasm is about a lot more than simply consuming enough kilojoules. For a start, the stored energy in the food needs to reach your cells and they need enough oxygen to burn it. You also need to be hydrated (drinking enough water every day) and have enough sleep and not be too stressed.



Create a mind map of things that affect whether you feel energetic or happy. Next, read some fascinating facts on page 6. What can you add to your mind map?

Food packaging tells you how much energy is in a serving. Often it tells you what percentage of a standard daily intake that represents. However, how much energy you need in a day depends on your age, body and how active you are. Defence scientists have developed a specific measure called the Military Recommended Dietary Intake. All foods produced for ration packs are rated against this measure.



How energetic would you feel if you only ate these? Why? Source: Jen Gunter on Unsplash.



Many energy drinks contain stimulants that temporarily make you feel full of energy and less tired. Research what we know about how these affect your whole body and side effects of using them for long periods of time. CURRICULUM CODE: ACSSU175

Dietitians delivering delicious energy snacks

The Defence team is taking snack bars to the next level. They developed an eat-on-the-go, high-energy bar full of nutrients. And it tastes good.

Rosa Peterson, a Dietitian-Nutritionist, asked Navy and Army people to try the bars during physically-demanding training exercises.

Read more about what Rosa does on page 7. What would you ask her if you got the chance?





The scenario

Imagine that a company called Snacks4Youth is developing a new version of the Defence bars for teenagers. What might the packet of the bar look like? How might they market it?



Brief

Create an advertisement for the proposed bar, to be included in magazines commonly bought by teenagers.

Include:

- a one page advertisement, including an image of what the bar's package might look like
- a separate explanation of your choice of messaging, including feedback from potential consumers

Companies are not allowed to make statements that are incorrect or likely to create a false impression. When it comes to health and nutrition claims, companies need to be even more careful and show evidence. Read more about it on the [Australian Competition and Consumer Commission's \(ACCC\) website \(https://www.accc.gov.au/consumers/advertising-promotions/false-or-misleading-claims\)](https://www.accc.gov.au/consumers/advertising-promotions/false-or-misleading-claims).



Source: Start Digital on Unsplash.

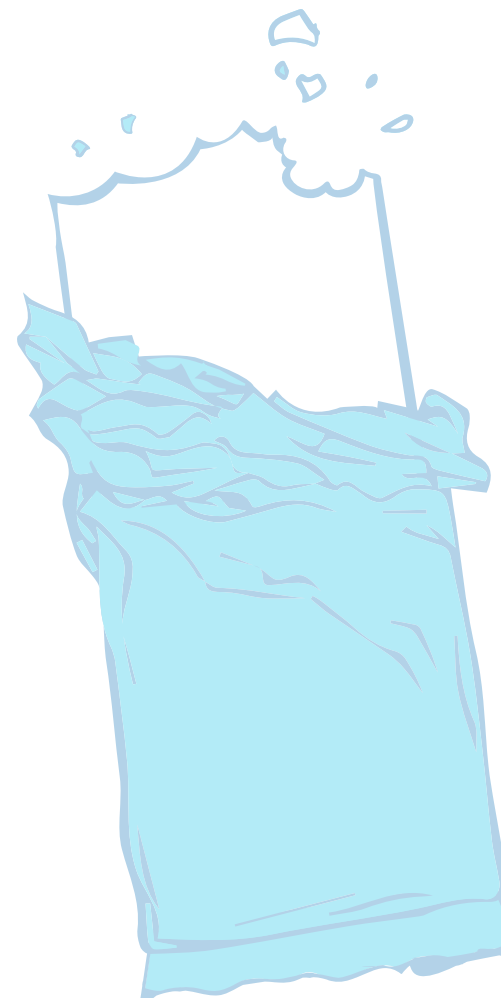


TIP You don't have all the dietary information, but assume it will be similar to the Defence bar with levels adjusted for teenagers.

Nutrition information of the Defence bar

Ingredients: Green banana resistant starch, brown rice Syrup, raisins, rice crisps (rice flour, rice bran), vegetable fat, dark compound choc (sugar, vegetable fat, cocoa powder, milk solids, soy lectin), cocoa powder, Cocoa liquor, vitamin and mineral premix, whey protein, glycerine, natural flavour, rosemary antioxidant

	AVG QTY PER SERVE (70g)	AVG QTY PER 100G
Energy (kJ)	1106	1580
Protein (g)	3.0	4.3
Fat (total, g)	7.5	10.7
Fat, Saturated (g)	7.1	10.2
Carbohydrate (total, g)	45.7	65.3
Sugars (g)	17.6	25.2
Dietary Fibre (g)	3.5	5.0
Sodium (mg)	16	23
Fortified with 20% of MRDI		
Vitamin B ₃ (mg)	11	15.6
Vitamin B ₆ (mg)	1	1.5
Vitamin B ₁₂ (µg)	0.34	0.48
Folate (µg)	56	80
Vitamin D (µg)	0.7	1
Vitamin E (mg)	1.4	2
Calcium (mg)	182	260





Checking claims

Evaluating existing designs is a great way to do research and work through your own ideas.

Look at advertisements and packages of food intended for teenagers. You can find these in your home, school or shops. Ask yourself:

- What about the design is interesting?
- What could be improved?
- What claims (e.g. nutrition) are they making?
- Why do you think they have advertised those claims?
- Is there other information you think they should have provided?

Record your notes and ideas. Share your ideas with others and ask them questions.



What claims are made on this packaging? Source: Claire Harris.



Investigate the evolving standards around labels such as 'Made in Australia', 'Free range', 'Organic' or 'Environmentally friendly'. How and why have they changed?

CURRICULUM CODE: ACELY1739



Test your design

- Create your draft design: Bring your ideas together to create your design for the advertisement.
- Get feedback: Show it to consumers to get feedback. What do they think of the look of the package? Have they understood the claims? Are they likely to buy the bar? Why or why not?
- Incorporate feedback: What could you change to better communicate the best attributes of the product? What do customers actually want?



Review the brief and make sure you deliver what's needed.



Create a multimedia version of your advertisement for digital channels. Have a look at other ads for Australian products on social media. What positive attributes are they promoting? What problems are they solving?

CURRICULUM CODE: ACTDIP043, ACTDEK040

After you have finished, take a moment to think about your design process. What went well? What did you find difficult? How might you do things differently next time?



Creating better snack bars



Image left: "Young Diggers" - soldiers from the 2nd Cavalry Regiment assist Litchfield Christain School students. Nine-year-old Liam (left) and eight-year-old Sam find out firsthand how to wear a soldier's webbing and field pack, as part of an ASLAV display at Fred's Pass in the Northern Territory. Image right: Combat ration pack laid out on a table. Source: Australian Department of Defence.

Packs and their perfect packaging

Carrying food while out in the bush or away from towns and cities is something many people in the ADF need to do. The ration packs can be exposed to heat, cold, water and lots of movement. These various stressors could potentially affect the integrity and shelf-life of the food. That's why the ration packs are so carefully created and packaged. The packaging is very important! It needs to withstand extreme environments and protect the food inside.

The packaging is:

- composed of multiple layers of various materials such as polyester, aluminium and polyethylene
- made from materials with varied thickness and important properties such as providing a barrier for flavour and aroma, gas, light, moisture and oxygen
- safe: free from toxicological products
- classified as 'food grade', meaning they are OK to be in contact with food

What happens with bad packaging? Food can be spoiled!

So that's why Defence tests packaging to make sure it won't: tear, puncture, burst or get squashed.



You want your packaging as light as possible while keeping its contents safe.



- Each combat ration pack is designed to sustain a person for 24 hours, providing three meals, as well as snacks.
- The ration packs weigh just under 2kg making them easy to carry and store.
- Ration packs are designed to be consumed by all personnel during field exercises or while deployed on operations overseas.
- The number of ration packs produced each year depends on ADF requirements. It can be over 350,000 units per year.
- Are ration packs all the same? No. There are a number of different menu options available to provide variety.



The contributors to innovation

An innovative food bar didn't come about on its own. A lot of different people were involved in creating it. Nutritionists; food scientists; experts in food processing, manufacturing, technology; and end users (with experience eating from the ration packs, logistics, storage and environmental conditions). So many people are involved in innovation!



STEM experts within Defence have been conducting food research and providing nutrition advice to Defence for more than half a century.

Meet Rosa Peterson



Good food is linked to excellent health and top physical and mental performance. When you work for the Australian Defence Force—often outdoors on land, sea or in the air—that health and performance is even more important.

When Defence realised that their staff needed better nutrition, Rosa Peterson, a Dietitian-Nutritionist, and her team were straight on the case.

They set about creating an advanced food bar that delivers 1000 kJ of energy and essential vitamins and minerals, including calcium and vitamin D to improve bone health. Additional micronutrients are included to improve energy and protein metabolism, brain function and immune and nervous system function.

“We know that when our Defence Force members are out in the field it's easy for them to run out of energy,” said Rosa.

“Also, they are often lacking the nutrients that promote good gut health and microflora, the good bacteria. So, that's why we added the green banana flour. It helps promote the good microorganisms in the gut,” she said.

We asked Rosa: How might you modify the bars to suit the needs of teenagers?

“Increase the nutrients in the bar to meet the needs of growing and active teenagers as recommended by the Australian Dietary Guidelines such as protein, carbohydrates, iron, calcium and vitamin D,” she said.

Meet Jaydan Hoult



Jaydan Hoult, a Telecommunications Technician with the Australian Army, works with advanced military satellite and radio systems. He builds these systems out in the field and also tests and maintains them while on base in Townsville.

A big part of Jaydan's job is physical. From doing regular fitness training to travelling and working out in the rugged, Australian bush or overseas. Jaydan can be out in the field for up to seven months in a year. This means he is using Combat Ration packs (also known as 'rat packs') a lot.

“When we are out in the field, it's 24/7 work. It's hard and tiring work, but there is a really good feeling when you have been working on faults, or improving the network for a few days or a week with little sleep, and then you get it all working,” Jayden said.

“We use the ration packs every time we deploy to the field environment or when deployed overseas where standard catering isn't available.

“The packaging is good because when out in the field you want to know that your food hasn't been infested with ants or other bugs. Also, you can rely on the packaging to keep the food preserved for a very long time,” he said.

It's not just the food in the ration pack that Jaydan appreciates.

“The FRED (Field Ration Eating Device) is my favourite thing in a rat pack. It's a can opener, a spoon and a bottle opener. You can put it on your keychain too,” he said.



The Field Ration Eating Device otherwise known as 'FRED' from the 1950's through to today, which are held at the Australian Army Museum, Duntroon, Canberra.

Source: Australian Department of Defence.

The contributors to innovation

Meet the Combat Rations Team

Food is crucially important for Defence personnel when they are out in the field, both in Australia or overseas. The Combat Rations Team is a specialist team making sure that the combat ration packs are nutritious and enjoyable to eat.

Creating ration packs that are nutritious, will not spoil and that people enjoy (not only how it tastes, but also how it looks, smells and feels) is important. The Combat Rations Team is continually researching new and innovative technologies and processes to ensure the packs are meeting needs of the troops.

“In consultation with the soldiers, we are always looking at ways to improve the combat ration pack,” said Emma Roccasalva, Technical Specialist in Food with the Combat Rations Team.

Some of the new innovations that the team is looking at include providing greater variety in the menu, devising simpler cooking methods and reducing the weight of the pack to make it easier for soldiers to carry.

What factors do they consider when they are revising packaging?

Emma said: “We only include packaging that meets food safety and quality standards. Depending on the product, the level of protection needed is determined by understanding the properties of the food, including shelf-life.”

Some examples of the foods with different properties:

- dried products need to be protected from moisture so packaging is thicker
- brittle products like biscuits need physical protection against being crushed so there is extra air in their packets
- main meal pouches are heated to ensure they last a long time in ration packs plus the packaging provides a light-weight alternative to canned foods and can be heated so the food can be eaten directly from the packaging
- spreads (like vegemite and jam) and sweetened condensed milk are packed in tubes so they can be used and then resealed for later use.



Image left: Analytical Chemist Liisa Trimble, examines samples of ration pack food to see how it changes over time. Image right: A vegemite and jam sandwich created from a ration pack. Source: Australian Department of Defence.



Visit the Defence website

<https://www.dst.defence.gov.au/event/national-science-week-2021>

to read the full stories.

