

New Zealand Blood Service Teaching Units

Level 6:
Science, Health and
Physical Education



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NZBLOOD
Te Rauanga Toto O Aotearoa

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Introduction

New Zealand Blood Service (NZBS) has developed a range of education resources linked to *The New Zealand Curriculum*. These resources provide engaging learning experiences on NZBS topics for teachers to use in the classroom.

The resources support teachers to develop their students' knowledge and understanding of blood and blood donation. They provide students with opportunities for personal development, social interaction, and contribution to their community as an active member of society.

This unit is for teachers and students of Year 11 science and health and physical education, and is positioned at level 6 of *The New Zealand Curriculum*. It corresponds with Achievement Standard 90949 – *Investigate life processes and environmental factors that affect them*.

FOCUS OF LEARNING

The focus of this teaching resource has two main strands:

1. Equipping students with an understanding of the constituents and function of blood – both in the contexts of their own bodies and in helping others through blood donation.
2. Helping students to use this knowledge to understand the importance of maintaining healthy blood and to explore ways they can achieve this, particularly in the contexts of the physiological demands of puberty and pre/post blood donation.

Emphasis is given to the maintenance of adequate iron levels in recognition of the fact that iron deficiency anaemia is a very common problem (both globally and in New Zealand) amongst growing teenagers, menstruating and pregnant women, and those with insufficient iron in their diets.

Links are also made to the influences of cultural diversity and lifestyle choices in relation to diet and how they impact upon our ability to maintain adequate iron homeostasis.

Curriculum alignment

Level 6 of *The New Zealand Curriculum*

| Context for learning | My Blood – Keeping Healthy and Helping Others |
|-------------------------|---|
| Vision | This resource focuses on students being: <ul style="list-style-type: none">■ confident decision makers■ actively involved in their personal health. |
| Principles | This resource supports the principles of: <ul style="list-style-type: none">■ community engagement – connecting to their wider lives, families, whānau and communities■ future focus – by exploring the future-focused issues of sustainability and citizenship. |
| Values | This resource models and explores the key values of: <ul style="list-style-type: none">■ community and participation for the common good■ respect – for themselves and others. Through their learning experiences, students will learn about and develop their ability to: <ul style="list-style-type: none">■ explore their own values and the values of others■ critically analyse values and actions based on them■ make ethical decisions and act on them. |
| Key Competencies | This resource fosters in students the key competencies of: <ul style="list-style-type: none">■ relating to others – listening actively, recognising different points of view, and sharing ideas■ participating and contributing – being active in their communities. |

Achievement objectives

The following are achievement objectives, relating to this unit, from the science and health and physical education areas of the curriculum.

| | Level 6 | |
|--------------------------------------|---|---|
| Science | Nature of Science <ul style="list-style-type: none"> ■ Understanding about science ■ Investigating in science ■ Communicating in science ■ Participating and contributing | Students will: <ul style="list-style-type: none"> ■ understand that scientists' investigations are informed by current scientific theories and aim to collect evidence that will be interpreted through processes of logical argument ■ develop and carry out more complex investigations, including using models ■ show an increasing awareness of the complexity of working scientifically, including recognition of multiple variables ■ apply their understandings of science to evaluate both popular and scientific texts (including visual and numerical literacy) ■ develop an understanding of socio-scientific issues by gathering relevant scientific information in order to draw evidence-based conclusions and to take action where appropriate. |
| | Living World <ul style="list-style-type: none"> ■ Life processes | Students will: <ul style="list-style-type: none"> ■ relate key structural features and functions to the life processes of plants, animals, and micro-organisms and investigate environmental factors that affect these processes. |
| Health and physical education | Personal Health And Physical Development <ul style="list-style-type: none"> ■ Personal growth and development | Students will: <ul style="list-style-type: none"> ■ investigate and understand reasons for the choices people make that affect their well-being and explore and evaluate options and consequences. |
| | Healthy Communities And Environments <ul style="list-style-type: none"> ■ Societal attitudes and values | Students will: <ul style="list-style-type: none"> ■ analyse societal influences that shape community health goals and physical activity patterns. |

NCEA Achievement Standard alignment

This resource can also be aligned with the Level 1 NCEA Science Achievement Standard 90949: *Investigate life processes and environmental factors that affect them* (4 Credits: Internal)

The achievement standard aligns with the “Investigating in science” strand of Nature of Science. The information gathered needs to come from a variety of sources: examples given include resource sheets, photos, Internet sources, texts, and direct observation.

Requirements also include:

- two life processes – in this case nutrition and energy (and indirectly, growth)
- two environmental factors – in this case nutrient supply in relation to diet and mineral levels in relation to blood loss through donation or growth spurts.

The biological ideas in this resource are structural features, functioning of components and the processes they carry out, and how our environment (or our actions in it) influences them.

In addition, the focus of learning has been extended beyond the biology of human blood to the area of blood donation. This deepens the students’ understanding of the function of blood as they investigate how the components of blood can be used as products to treat some illnesses or severe bleeding.

Environmental factors, (such as diet, iron reserves in the body, and the choice to donate blood) and how they affect our life processes of nutrition and energy provision, are studied in different contexts, including:

- societal influences and altruistic choice to donate blood
- assessment of risks and benefits of blood donation – including the concept of immunological compatibility
- managing our environment to maintain personal health.

Assessment for learning

Formative assessment opportunities

While a number of the activities are stand alone, they also provide opportunities for formative assessment of students’ progress as follows:

- observation of students as they collate diagrams/fact cards onto a PowerPoint or poster
- completion of tables – using knowledge gained from interpreting web-based resources
- answering questions at the end of learning activities or inquiry
- extrapolation of ideas from one context and applying them in another, particularly the context of people from the community giving blood donations and providing the means for medical treatments
- creating concept diagrams – using logical analysis to demonstrate interpretation of ideas/knowledge
- practical activities, for example, model making/choosing, and cooking and rating appropriate recipes.

Summative assessment opportunities

Students will be able to demonstrate their investigations, and learning of the life processes (nutrition and energy) and environmental factors that influence them (in this case, blood donation and diet), by collating their work into a PowerPoint presentation or poster covering the three areas of learning below.

My blood

- transport system
- components of blood
- functions of these components.

Using blood

- blood products and their uses in clinical settings
- screening procedures to ensure safe donation for donor and recipient (managing risk)
- extension opportunities to investigate personal and societal factors that influence the choice to be a blood donor.

Keeping my blood healthy

- demonstrate key facts about iron as a mineral in our diet and how it is essential for healthy people and healthy blood
- demonstrate understanding (using bar graphs/full blood counts/concept diagrams/recipes) of how blood donation, and other clinical and dietary factors, affect iron levels.

Unit: My Blood – Keeping Healthy and Helping Others

Section 1: Me and my blood

Suggested learning experiences

| Teaching and learning activities | Assessment opportunities | What you need |
|---|--|--|
| <p>Learning outcomes</p> <p>Students will be able to describe:</p> <ul style="list-style-type: none"> ■ the main components of blood and explain their basic functions ■ the main cellular constituents of blood, and their production and function. | | |
| <p>Activity 1: My blood – in vivo and ex vivo</p> | | |
| <p>Discuss the terms in vivo (in the living body) and ex vivo (outside the body, for example, in a test tube) with the class.</p> <p>Have the students read NZBS digital teaching resource <i>Amazing Blood</i>. This could be done as a shared-reading activity – scaffolding the students to think critically and to understand the text. Accessing <i>Amazing Blood</i> on an interactive whiteboard allows use of the pop-ups and hyperlinks to expand the information (see teacher notes accompanying this resource).</p> <p>Ask: “Why do we need blood in our bodies?” Have the students brainstorm until the main functions listed on teacher factsheet 1A have been covered. The students should record and keep this brainstorm for later use.</p> <p>Using graphic organiser 1, have the students read the fact cards and match the correct blood components to those in the test tube diagram.</p> <p>Have students stick the graphic organisers in their books to refer to when creating their presentations. Alternatively, give second copies of the graphic organiser to students if needed when preparing their internal assessment presentation.</p> | <p>Diagnostic</p> <p>Formative – teacher observation</p> | <ul style="list-style-type: none"> ■ Teacher factsheet 1A ■ NZBS digital teaching resource: <i>Amazing Blood</i>, available at: https://www.nzblood.co.nz/knowledge-hub/digital-resources/ ■ Graphic organiser 1 |

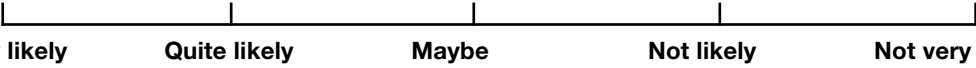
| Teaching and learning activities | Assessment opportunities | What you need |
|---|-----------------------------------|--|
| Activity 2: My blood facts | | |
| <p>Using teacher factsheet 1B, and the students' weights, ask the students to calculate their own blood indices as follows:</p> <p>a. Blood Volume (mL & L)</p> <p>b. Volume of (i) red blood cells (ii) plasma</p> <p>(Examples of calculations are given on the teacher factsheet.)</p> <p>Note: If weighing students may create issues of embarrassment, random allocation of mass numbers using figures between 50–80 kgs could be used as an alternative.</p> | | <ul style="list-style-type: none"> ■ Teacher factsheet 1B ■ scales (or use estimates 50–80 kg if exact mass not known) |
| Activity 3: My blood cells | | |
| <p>Divide the students into small groups and provide each group with an envelope of cell pictures and an envelope of fact cards.</p> <p>Ask the students to look at unlabelled photos of red blood cells, white blood cells, and platelets, paying particular attention to cell shape, and presence/absence/shape of nucleus. Ask them to share some of the features they notice and then to note the specific function of that cell.</p> <p>Ask them to read the descriptions of cells on the fact cards and then match these to the correct cells.</p> <p>Note: Graphic organiser 2 could be reused by students who may wish to use it for their internal assessment presentation.</p> | Formative – teacher/class marking | <ul style="list-style-type: none"> ■ Graphic organiser 2 – cut into sets of cell pictures and fact cards and placed in separate envelopes (one of each per group) |
| Activity 4: My haemoglobin | | |
| <p>Discuss with the students the role and basic structure of a haemoglobin (Hb) molecule (using teacher factsheet 2 and links).</p> <p>Ask them to make a very simple structure representing an Hb molecule (using the ideas and diagrams from the factsheet), so that four coloured polypeptide chains are linked together, with a central space in each into which to insert a “haem” molecule with an exposed Fe atom.</p> <p>Note: Accuracy is not required in these models. The aim is not to demonstrate the quaternary structure of polypeptide chains but to facilitate students' awareness of the complexity of the large molecules, which have to fit into our cells.</p> | Formative – teacher observation | <ul style="list-style-type: none"> ■ Teacher factsheet 2 ■ multi-coloured molymod® model sets or long strips of cards (in 4 colours) for globin (polypeptide) chains ■ square shaped card (Haem molecule) ■ small ball for Fe atom ■ Sellotape®/Blu Tack® |
| <p>Summative assessment</p> <p>Students create a presentation, such as a poster or a PowerPoint, to illustrate knowledge of this section, using the graphic organisers.</p> | | |

Section 2: Using blood

Suggested learning experiences

| Teaching and learning activities | Assessment opportunities | What you need |
|--|--|---|
| <p>Learning outcomes</p> <p>Students will be able to:</p> <ul style="list-style-type: none"> ■ describe the main uses of blood products for treating and preventing illness, and permitting complex surgery to be performed ■ outline some common risk factors for donors and recipients of blood products and how these are screened for at Donor Centres ■ reflect on the varied factors that influence people’s decisions to choose to donate blood. | | |
| <p>Activity 1: Using my blood to help others</p> | | |
| <p>Discuss the concept of blood transfusions.</p> <p>Ask the students to write down their own or others’ experiences of blood transfusions and the reason for the transfusion (if known), and to post this anonymously in the post box. Add these experiences to the left column on graphic organiser 3 before providing to the students.</p> <p>Have the students use the above knowledge of blood cells and components to suggest possible medical uses for blood products, and complete the middle column in graphic organiser 3.</p> <p>Ask the students to read the two NZBS links and fill in the uses of blood in New Zealand in the final column.</p> <p>Students may wish to work individually and arrange the list in order of frequency. Alternatively, they may wish to work in pairs, one listing uses of red blood cells and one listing uses of either platelets or plasma.</p> | <p>Diagnostic</p> <p>Formative – teacher/class collaboration</p> | <ul style="list-style-type: none"> ■ post box, for example, an ice cream carton with slit in lid ■ small cards ■ Graphic organiser 3 ■ access to these websites: https://www.nzblood.co.nz/about-blood/what-blood-is-used-for/ https://www.nzblood.co.nz/about-blood/ |
| <p>Activity 2: Using my blood to help others</p> | | |
| <p>Provide a hard copy of the poster “Ever wonder what happens to blood?”and/or “Where does your blood go?” for each student (if it is going to be used as a homework activity) and ask them to use it to complete the table on graphic organiser 4.</p> | <p>Suggested use as homework to demonstrate students’ understanding about uses of blood products (or as extension activity).</p> | <ul style="list-style-type: none"> ■ “Ever wonder what happens to blood” resource poster, available at: https://www.nzblood.co.nz/knowledge-hub/posters-and-brochures/ ■ Graphic organiser 4 |

| Teaching and learning activities | Assessment opportunities | What you need |
|---|--|--|
| Activity 3: Using blood safely – what does the term compatible mean? | | |
| <p>Discuss the blood groups that are known by students. Complete a bar chart on the whiteboard to demonstrate blood groups on the X axis and numbers of students with each blood group on the Y axis. (Adapt to discuss most frequent or most rare groups if students' blood groups are not known).</p> <p>Check the students' understanding of words such as “donor”, “recipient”, “universal” and “compatibility”. Create a glossary that can be added to during the activities.</p> <p>There are three options for this activity depending on the abilities of your students and their prior immunological knowledge of antigens and antibodies.</p> <ol style="list-style-type: none"> 1. No prior knowledge required. Have students cut up the blood group cards and place face down. Ask them to work in pairs, picking up one card each and using the completed table to check if these two groups are compatible or not. 2. Extension work (or if students have prior immunology knowledge). Ask students to complete their own compatibility table using their knowledge of antigens and antibody interaction and the facts and questions provided on graphic organiser 5B. 3. The information and game on the Nobel Prize website can be used as a fun activity to consolidate this learning. Although some prior knowledge of antigen/antibody interaction is helpful, the nature of the game does support students' learning in this area as the game proceeds. <p>At the end of the activity, students should be able to answer the following questions:</p> <ul style="list-style-type: none"> ■ Which blood group is the universal donor and why? ■ Which blood group is the universal recipient and why? ■ What is in the blood of some people that may make transfused red cells incompatible? ■ Red cell components have almost all of the plasma removed for use in other products. How does this contribute to compatibility for transfused red cells? | <p>Diagnostic</p> <p>Formative assessment – answering questions using knowledge gained</p> | <ul style="list-style-type: none"> ■ whiteboard ■ glossary ■ Graphic organiser 5A ■ Teacher factsheet 3 ■ Graphic organiser 5B ■ https://educationalgames.nobelprize.org/educational/medicine/bloodtypinggame/ |

| Teaching and learning activities | Assessment opportunities | What you need |
|--|--|--|
| Activity 4: Using blood safely – who can donate? | | |
| <p>Divide students into groups of five or six (or pairs if you have sufficient Internet access). Two students in each group are to work collaboratively as the nurse. Provide the students with access to eligibility criteria from NZBS.</p> <p>Other students in each group are to role-play a potential donor with one of the issues listed in graphic organiser 6. Students should ask the nurse:</p> <ul style="list-style-type: none"> ■ Can I give blood? If not, why not? ■ What tests might the Blood Service do to check if it is safe for me to donate blood? <p>Collaboratively, each group should complete the table on graphic organiser 6. At the end of the activity, ask students to list the ways in which screening is carried out at a donor centre.</p> | Formative – using knowledge gained from the above exercise | <ul style="list-style-type: none"> ■ Access to the following websites: <ul style="list-style-type: none"> https://www.nzblood.co.nz/become-a-donor/am-i-eligible/detailed-eligibility-criteria/ https://www.nzblood.co.nz/become-a-donor/what-to-expect-when-donating/ ■ Graphic organiser 6 |
| Activity 5: Using blood – why people choose to donate | | |
| <p>Begin this activity with a survey to investigate who would be willing to be a blood donor. This could be done as a class continuum. In response to the suggestion “I am willing to be a blood donor”, ask the students to place themselves on the continuum somewhere from “Very likely” to “Not very likely”. Discuss and record some of their reasons.</p> <p>Alternatively, or for homework, the students could take a survey home and ask whānau members to place themselves on the linear scale in response to the same suggestion.</p>  <p>Have the students complete graphic organiser 7 to compare the suitability, validity, and usefulness of the websites given, as part of the inquiry into “Why people may or may not choose to donate blood?”</p> | | <ul style="list-style-type: none"> ■ Access to the following websites: <ul style="list-style-type: none"> http://rationalreactor.com/2010/05/27/why-do-people-donate-blood/ https://www.nzblood.co.nz/about-blood/why-donate-blood/ ■ Graphic organiser 7 |
| Summative assessment | | |
| <p>Students create a presentation, such as a poster or a PowerPoint, to illustrate knowledge of this section. This could include:</p> <ul style="list-style-type: none"> ■ products that can be derived from donated blood (Extension: What or who are these used for?) ■ screening procedures that are in place to ensure donating blood is safe for donors and blood donations are safe for recipients. <p>Students may like to focus on one particular aspect, for example, anaemia, blood group compatibility, or prevention of viral transmission. Students may like to conclude by discussing if/why they would like to be a blood donor.</p> | | |

Section 3: Keeping my blood healthy

Suggested learning experiences

| Teaching and learning activities | Assessment opportunities | What you need |
|---|--|--|
| <p>Learning outcomes</p> <p>Students will be able to:</p> <ul style="list-style-type: none"> ■ describe the factors that affect iron (Fe) levels in their bodies, paying particular attention to dietary influences ■ describe the process by which iron deficiency anaemia develops ■ discuss the implications of too little or too much iron in their bodies. | | |
| <p>Activity 1: Key facts about iron – read and answer</p> | | |
| <p>Ask the students to read one of the given links (in hand-out format or online) and use it to answer the following questions about iron.</p> <ul style="list-style-type: none"> ■ Where is iron found in the body? ■ What is iron used for in the body? ■ Iron is an element, so how do we get iron into our bodies? ■ How might iron be lost from our bodies? ■ What happens if we don't have enough iron in our bodies? ■ Can we have too much iron in our bodies? <p>Note: The third link has detailed content and a high literacy level requirement for reading. It may be best for extension students.</p> | <p>Formative – gathering information from the text</p> | <ul style="list-style-type: none"> ■ Teacher factsheet 4 ■ One of the following links in handout format: <ul style="list-style-type: none"> http://www.nutritionfoundation.org.nz/nutrition-facts/minerals/iron http://www.southerncross.co.nz/group/medical-library/iron-deficiency-anaemia ■ Maintaining Healthy Iron Levels from: <ul style="list-style-type: none"> https://www.nzblood.co.nz/knowledge-hub/digital-resources/ |
| <p>Activity 2: Key facts about iron – Venn diagram</p> | | |
| <p>As a class, complete the Venn diagram on graphic organiser 8 to illustrate factors that influence our iron levels. Have the students keep a record of this, as it will be useful for their summative assessment. You may wish to expand on this by discussing the iron rich foods in Activity 5.</p> | | <p>Graphic organiser 8</p> |

| Teaching and learning activities | Assessment opportunities | What you need |
|---|--|---|
| Activity 3: Iron stores and anaemia | | |
| <p>Have the students follow the instructions on graphic organiser 9 to draw bar charts (with teacher scaffolding and based on the exemplar of a “normal person’s” iron levels) to demonstrate iron levels and iron stores in the specified scenarios. Use the teacher answer guide to check the results.</p> | <p>Formative – application of ideas using logical analysis</p> | <ul style="list-style-type: none"> ■ Graphic organiser 9 |
| Activity 4: Iron levels and medical management | | |
| <p>This activity could be used as an extension activity. At the bottom of the bar chart on graphic organiser 9, ask the students to record:</p> <ul style="list-style-type: none"> ■ the advice or referrals a nurse could give a person in each of the four situations ■ what a doctor might do for persons (ii) and (iii) and (iv). <p>Encourage the students to think in terms of follow-up, monitoring, and a teamwork/ multidisciplinary approach. For example, a nurse may consider a referral to a dietitian for expert advice and assessment if a teenager is vegetarian. But, if not vegetarian, the nurse may give advice on iron rich foods themselves.</p> <p>Print off the link or teacher factsheet provided on full blood counts (they are also called complete blood counts in some Centres in New Zealand) and a full blood count form from graphic organiser 10. With the students, read the information about full blood counts. Examine the normal values with the students and ask them to mark with arrows whether they think values would go up or down in the following scenarios.</p> <ul style="list-style-type: none"> ■ A person with iron deficiency anaemia ■ A person with haemochromatosis (who absorbs too much iron from their diet). | <p>Formative – applying concepts in different contexts</p> | <ul style="list-style-type: none"> ■ Graphic organiser 10 ■ access to the following websites: <ul style="list-style-type: none"> http://www.southerncross.co.nz/group/medical-library/iron-deficiency-anaemia https://www.southerncross.co.nz/group/medical-library/haemochromatosis |

| Teaching and learning activities | Assessment opportunities | What you need |
|---|--------------------------|--|
| Activity 5: Iron and our diet | | |
| <p>Have the students review NZBS “Iron and You” handout sections on “Iron and Foods” and “Checking your Diet”. You may wish to review Ministry of Health Food and Nutrition Guidelines (see link) and provide the section on iron as extra reading material for the students.</p> <p>Ask the students to pay particular attention to the different iron content of foods, and items that enhance iron absorption (such as Vitamin C containing foods) and items that lower iron absorption (such as cereal-based foods, for example, grains and baking products made from flour, that contain phytates; and tea and coffee that contain polyphenols).</p> <p>Have the students use the links provided to look up either Māori recipes or vegetarian recipes.</p> <p>Divide the students into groups and have each group arrange (with parental permission) to shop for ingredients, and cook one of the high-iron recipes and rate their recipe using the questionnaire provided in graphic organiser 11.</p> | | <ul style="list-style-type: none"> ■ NZBS “Iron and You” PDF available from: https://www.nzblood.co.nz/knowledge-hub/posters-and-brochures/ ■ Access to the following websites: https://www.health.govt.nz/publication/food-and-nutrition-guidelines-healthy-children-and-young-people-aged-2-18-years-background-paper https://www.bbcgoodfood.com/recipes/collection/iron-rich-vegetarian-recipes ■ Graphic organiser 11 |
| Summative Assessment | | |
| <p>Have the students choose an activity (from the first four activities of “Keeping my blood healthy”) that they think best illustrates the iron levels in our bodies, and adapt this to create a presentation, such as a poster or a PowerPoint. Encourage them to use the Venn diagram and bar charts from activities 2 and 3 as a basis for describing iron levels in the body, and then to develop their ideas (using the clinical scenarios and their management, and the recipes they cooked) to demonstrate the different ways that iron levels can be maintained within healthy limits. Have the students illustrate the recipe they cooked on the poster or in the PowerPoint and highlight the factors that make it a high-iron recipe.</p> | | |