



National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Exemplar for Internal Achievement Standard

Biology Level 3

This exemplar supports assessment against:

Achievement Standard 91602

**Integrate biological knowledge to develop an informed response to a
socio-scientific issue**

An annotated exemplar is an extract of student evidence, with a commentary, to explain key aspects of the standard. It assists teachers to make assessment judgements at the grade boundaries.

New Zealand Qualifications Authority

To support internal assessment

	Grade Boundary: Low Excellence
1.	<p>For Excellence, the student needs to integrate biological knowledge to develop a comprehensive informed response to a socio-scientific issue.</p> <p>This involves:</p> <ul style="list-style-type: none"> • developing a reasoned informed response by explaining why a personal position and proposed action(s), at a personal and/or societal level, have been chosen • justifying the personal position and proposed action(s) by analysing and evaluating the biological knowledge (EN 5) related to the issue. This may include: <ul style="list-style-type: none"> • comparing the significance of implications • considering the likely effectiveness of the proposed action(s) • commenting on sources and information, considering ideas such as validity and bias. <p>This student has described and explained relevant biological concepts and processes (1), and biological implications relating to the issue of fortifying bread with folic acid (2).</p> <p>A social implication is considered (3).</p> <p>Two differing opinions or viewpoints about the issue are given – one against (4) and one for (5).</p> <p>A personal position (6) and a proposed societal action (7) are chosen and explained with supporting evidence.</p> <p>The student has made an attempt to justify the personal position and proposed societal action by comparing the significance of biological and social implications (8).</p> <p>For a more secure Excellence, the student could:</p> <ul style="list-style-type: none"> • explain the social implications more thoroughly • justify the personal position and proposed action by including more detail on why arguments concerning consumer choice and the uncertainty of biological implications due to fortifying bread with folic acid are significant.

Folate is one of the essential water soluble vitamins (vitamin B9) for growth and development in fetuses. Folic acid is the synthetic form of folate, typically used for supplementation and food fortification, whereas folate is found naturally in fruit, vegetables and grain. Folate is a co-factor for enzymes. When consumed, both folic acid and folate are reduced to the substrate tetrahydrofolate, the biologically active form of folic acid. This is necessary to form methyl-tetrahydrofolate, an essential component for nucleotide synthesis. However up to 50 – 80% of naturally occurring folate is lost after cooking, while folic acid is much more stable.

Folate plays an active role in DNA and RNA synthesis, as our body replicates genetic material through DNA replication. This means that sufficient folate is required for cell division (mitosis, meiosis). RNA synthesis is a significant factor of protein production, necessary for metabolic processes involving enzyme activity. Rapid multiplication of cells requires an increased amount of folate in the blood, for example, for the production of red blood cells and the development of the foetus during pregnancy. The deficiency of folate decreases the amount of oxygen red blood cells carry to other cells, resulting in megaloblastic anaemia. A deficiency may also result in the infant developing neural tube defects (NTD). This happens when the neural tube of the foetus does not close when it should, 3 to 4 weeks after conception. Depending on where the defect is located along the backbone, the defect is most commonly *spina bifida*, which results in nerve damage that causes lower body paralysis. Such defects may also result in anencephaly, where much of the brain of the infant has not formed. These babies will die shortly after birth.

All these conditions have negative consequences for the child, as of the 64% at babies with NTD's born alive, 100% of babies with anencephaly will die within the month, and 90% of babies with spina bifida will have severe thoracic or lumbar lesions. Those with a thoracic lesion have a life expectancy of 40 years, and a low quality of life.

The ample consumption of folic acid around 4 weeks prior to conception, optimally around 400mcg per day, has been proven to reduce neural tube defect incidence by 70%. It is recommended that women who plan to become pregnant should have an extra 400 mcg a day on top of the already recommended 400mcg. This is because a high level of folate will allow effective cell proliferation as the embryo develops.

Fortification is the addition of one or more essential nutrients in a food, whether or not it is normally contained in the food for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups. There has been speculation on the role of folate in decreasing the occurrence cardiovascular disease and strokes. In conjunction with vitamins B6 and B12, folate has been proven to regulate the levels of homocysteine in blood, an amino acid independently linked to cardiovascular disease. It is still unclear as to whether low homocysteine levels will result in fewer occurrences of these diseases, but they have notably declined in both USA and Canada immediately after mandatory fortification of flour. However, there are large concerns about the increased intake of folate in masking B12 deficiency, a problem that affects a considerable proportion of our elderly population.

Socially, mandatory fortification will result in families being saved the emotional strife of having a child with a NTD. They will be able to live without having the costs, care and

difficulty involved with their child's well-being. It will also save the potentially affected children from a lifetime disability, allowing them to experience life as a normal citizen rather than spending up to months in hospital. However, this is at the sacrifice of consumer choice to the population. As the biological implications of fortification are also not completely certain, mandating it to the population is ethically questionable.

3

There is a strong conflict of opinion concerning the announced fortification of folic acid in bread in New Zealand. The main group against the legislation includes the NZ Bakers Association, NZ Food & Grocery Council, Organics NZ and the Green Party. These groups argue that they value consumer choice and that each individual has a right to choose their own nutritional diets. In a 2005 NZ Food Safety survey, 84% of New Zealanders were opposed to the mandatory fortification. The NZ Food & Grocery Council believes fortification would not result in significant further reduction as the incidence of NTDs has already decreased during the past 20 years, a claim that has been backed by some scientists also opposing the idea (Tim Green, Jim Mann, 2003).

4

The main groups advocating mandatory fortification include the NZ Paediatric Society, most scientists, the Labour party and families affected by NTDs. Rosemary Marks states that such a deferral will result in "perhaps up to 20 preventable NTD pregnancies per year in NZ and up to 15 preventable terminations." (Paediatric Society, 2009). Scientists like Murray Skeaff (Otago University) and Joanne Dixon (Clinical Geneticist of Wellington Hospital) advocate fortification, arguing that scientific research shows that folate fortification is safe for the whole population. Such as the opposition, however, these opinions would be spurred by a bias.

5

Arguments concerning consumer choice and uncertainty of biological implications due to fortification are significant. The majority of our national scientists state that an increased intake of folate from fortification is safe for the whole population. Opposing parties say each individual has a right to choose their own nutritional needs, but the reality is that many simply are not informed of these. Most will not take supplements daily on the slim chance of pregnancy if they are not planning on bearing children. Therefore reduction on consumer choice is, I believe, not as heavy as the prevention of 10 -15 NTD children, especially as this number will build up in the years after fortification.

6

After analysing the research and opposing opinions, I believe that the benefits of folic acid fortification outweigh the potential risks involved in exposing the whole population to higher levels of folate. Voluntary fortification is not efficient as women likely to consume the fortified bread are those that are also likely to take supplements. The unplanned mothers and the uninformed, which are the targets for mandatory fortification, will not be reached. Following the introduction of voluntary fortification in 1996 a study in 2003 (Hazel Fowler, 2006) shows the average folate intake of woman increasing by only 17mcg per day.

7

Although I welcome mandatory fortification of folic acid to bread, I believe that flour would be much more suitable as the vehicle. According to the NZ Food Safety Authority, fortifying bread directly "gives the industry the flexibility to add folic acid at any point in the manufacturing process". However, this simply adds more work for the bakers, costs more, is more difficult to monitor and adds a liability to human error. Although the upfront costs of purchasing equipment are higher, fortification of flour is estimated to cost \$29.3 million per year ongoing (Access Economics, 2006), almost 20 million less than bread. This will reach even the women that do not regularly consume bread.

8

	Grade Boundary: High Merit
2.	<p>For Merit, the student needs integrate biological knowledge (EN 5) to develop a reasoned informed response to a socio-scientific issue.</p> <p>This involves explaining why a personal position and proposed action(s) at a personal and/or societal level have been chosen.</p> <p>This student has described and explained relevant biological concepts and processes (1), and biological implications relating to the issue of fortifying bread with folic acid (2).</p> <p>A social implication is considered (3).</p> <p>Two differing opinions or viewpoints about the issue are given – one against (4) and one for (5).</p> <p>A personal position (6) and proposed societal action (7) are chosen and explained with supporting evidence.</p> <p>The student has begun to justify the personal position and proposed societal action by considering the likely effectiveness of the proposed action (8).</p> <p>To reach Excellence, the student could justify the personal position and proposed action by including more detail on the likely effectiveness of the proposed action.</p> <p>Alternatively, the student could provide evidence to:</p> <ul style="list-style-type: none"> • compare the significance of biological and social implications, or • comment on the sources and information used by considering ideas such as validity and bias.

Folate is one of the essential water soluble vitamins (vitamin B9) for growth and development in foetuses. Folic acid is the synthetic form of folate, typically used for supplementation and food fortification, whereas folate is found naturally in fruit, vegetables and grain. Folate is a co-factor for enzymes. When consumed, both folic acid and folate are reduced to the substrate tetrahydrofolate, the biologically active form of folic acid. This is necessary to form methyl-tetrahydrofolate, an essential component for nucleotide synthesis. However up to 50 – 80% of naturally occurring folate is lost after cooking, while folic acid is much more stable. ①

Folate plays an active role in DNA and RNA synthesis, as our body replicates genetic material through DNA replication. This means that sufficient folate is required for cell division (mitosis, meiosis). RNA synthesis is a significant factor of protein production, necessary for metabolic processes involving enzyme activity. Rapid multiplication of cells requires an increased amount of folate in the blood, for example, for the production of red blood cells and the development of the foetus during pregnancy. The deficiency of folate decreases the amount of oxygen red blood cells carry to other cells, resulting in megaloblastic anaemia. A deficiency may also result in the infant developing neural tube defects (NTD). This happens when the neural tube of the foetus does not close when it should, 3 to 4 weeks after conception. Depending on where the defect is located along the backbone, the defect is most commonly *spina bifida*, which results in nerve damage that causes lower body paralysis. Such defects may also result in anencephaly, where much of the brain of the infant has not formed. These babies will die shortly after birth. ①

All these conditions have negative consequences for the child, as of the 64% at babies with NTD's born alive, 100% of babies with anencephaly will die within the month, and 90% of babies with spina bifida will have severe thoracic or lumbar lesions. Those with a thoracic lesion have a life expectancy of 40 years, and a low quality of life. ①

The ample consumption of folic acid around 4 weeks prior to conception, optimally around 400mcg per day, has been proven to reduce neural tube defect incidence by 70%. It is recommended that women who plan to become pregnant should have an extra 400 mcg a day on top of the already recommended 400mcg. This is because a high level of folate will allow effective cell proliferation as the embryo develops. ②

Fortification is the addition of one or more essential nutrients in a food, whether or not it is normally contained in the food for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups. There has been speculation on the role of folate in decreasing the occurrence cardiovascular disease and strokes. In conjunction with vitamins B6 and B12, folate has been proven to regulate the levels of homocysteine in blood, an amino acid independently linked to cardiovascular disease. It is still unclear as to whether low homocysteine levels will result in fewer occurrences of these diseases, but they have notably declined in both USA and Canada immediately after mandatory fortification of flour. However, there are large concerns about the increased intake of folate in masking B12 deficiency, a problem that affects a considerable proportion of our elderly population. ① ②

Socially, mandatory fortification will result in families being saved the emotional strife of having a child with a NTD. They will be able to live without having the costs, care and difficulty involved with their child's well-being. It will also save the potentially affected children from a lifetime disability, allowing them to experience life as a normal citizen rather than spending up to months in hospital. However, this is at the sacrifice of consumer choice to the population. As the biological implications of fortification are also not completely certain, mandating it to the population is ethically questionable.

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There is a strong conflict of opinion concerning the announced fortification of folic acid in bread in New Zealand. The main group against the legislation includes the NZ Bakers Association, NZ Food & Grocery Council, Organics NZ and the Green Party. These groups argue that they value consumer choice and that each individual has a right to choose their own nutritional diets. In a 2005 NZ Food Safety survey, 84% of New Zealanders were opposed to the mandatory fortification. The NZ Food & Grocery Council believes fortification would not result in significant further reduction as the incidence of NTDs has already decreased during the past 20 years, a claim that has been backed some scientists also opposing the idea (Tim Green, Jim Mann, 2003).

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After analysing the research and opposing opinions, I believe that the benefits of folic acid fortification outweigh the potential risks involved in exposing the whole population to higher levels of folate. Voluntary fortification is not efficient as women likely to consume the fortified bread are those that are also likely to take supplements. The unplanned mothers and the uninformed, which are the targets for mandatory fortification, will not be reached. Following the introduction of voluntary fortification in 1996 a study in 2003 (Hazel Fowler, 2006) shows the average folate intake of woman increasing by only 17mcg per day.

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7

This should be coupled by ongoing campaigns for folic acid supplementation, as well as increasing the accessibility of supplements through government subsidy. In order to have a successful campaign an area must have a low amount of unplanned pregnancy and an intensive educational promotion.

8

	Grade Boundary: Low Merit
3.	<p>For Merit, the student needs integrate biological knowledge (EN 5) to develop a reasoned informed response to a socio-scientific issue.</p> <p>This involves explaining why a personal position and proposed action(s) at a personal and/or societal level have been chosen.</p> <p>This student has described and explained some relevant biological concepts and processes (1), and biological implications relating to the issue issue of fortifying bread with folic acid (2).</p> <p>A social implication is considered (3).</p> <p>Two differing opinions or viewpoints about the issue are given – one against (4) and one for (5).</p> <p>A personal position (6) and proposed societal action (7) are chosen and explained with some supporting evidence.</p> <p>For a more secure Merit, the student could:</p> <ul style="list-style-type: none"> • explain the social implications of fortifying bread with folic acid more thoroughly • use biological knowledge to explain why the personal position and proposed action by fortifying bread with folic acid have been chosen with more related supporting evidence.

Folate is one of the essential water soluble vitamins (vitamin B9) for growth and development in foetuses. Folic acid is the synthetic form of folate, typically used for supplementation and food fortification, whereas folate is found naturally in fruit, vegetables and grain. Folate is a co-factor for enzymes. When consumed, both folic acid and folate are reduced to the substrate tetrahydrofolate, the biologically active form of folic acid. This is necessary to form methyl-tetrahydrofolate, an essential component for nucleotide synthesis. However up to 50 – 80% of naturally occurring folate is lost after cooking, while folic acid is much more stable. ①

Folate plays an active role in DNA and RNA synthesis, as our body replicates genetic material through DNA replication. This means that sufficient folate is required for cell division (mitosis, meiosis). RNA synthesis is a significant factor of protein production, necessary for metabolic processes involving enzyme activity. Rapid multiplication of cells requires an increased amount of folate in the blood, for example, for the production of red blood cells and the development of the foetus during pregnancy. ①

The deficiency of folate decreases the amount of oxygen red blood cells carry to other cells, resulting in megaloblastic anaemia. A deficiency may also result in the infant developing neural tube defects (NTD). This happens when the neural tube of the foetus does not close when it should, 3 to 4 weeks after conception. Depending on where the defect is located along the backbone, the defect is most commonly *spina bifida*, which results in nerve damage that causes lower body paralysis. Such defects may also result in anencephaly, where much of the brain of the infant has not formed. These babies will die shortly after birth. ①

All these conditions have negative consequences for the child, as of the 64% at babies with NTD's born alive, 100% of babies with anencephaly will die within the month, and 90% of babies with spina bifida will have severe thoracic or lumbar lesions. Those with a thoracic lesion have a life expectancy of 40 years, and a low quality of life. ①

The ample consumption of folic acid around 4 weeks prior to conception, optimally around 400mcg per day, has been proven to reduce neural tube defect incidence by 70%. It is recommended that women who plan to become pregnant should have an extra 400 mcg a day on top of the already recommended 400mcg. This is because a high level of folate will allow effective cell proliferation as the embryo develops. ②

Fortification is the addition of one or more essential nutrients in a food, whether or not it is normally contained in the food for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups. There has been speculation on the role of folate in decreasing the occurrence cardiovascular disease and strokes. In conjunction with vitamins B6 and B12, folate has been proven to regulate the levels of homocysteine in blood, an amino acid independently linked to cardiovascular disease. It is still unclear as to whether low homocysteine levels will result in fewer occurrences of these diseases, but they have notably declined in both USA and Canada immediately after mandatory fortification of flour. However, there are large concerns about the increased intake of folate in masking B12 deficiency, a problem that affects a considerable proportion of our elderly population. ① ②

Socially, mandatory fortification will result in families being saved the emotional strife of having a child with a NTD. They will be able to live without having the costs, care and difficulty involved with their child's well-being. It will also save the potentially affected children from a lifetime disability, allowing them to experience life as a normal citizen rather than spending up to months in hospital. However, this is at the sacrifice of consumer choice to the population. As the biological implications of fortification are also not completely certain, mandating it to the population is ethically questionable. ③

There is a strong conflict of opinion concerning the announced fortification of folic acid in bread in New Zealand. The main group against the legislation includes the NZ Bakers Association, NZ Food & Grocery Council, Organics NZ and the Green Party. These groups argue that they value consumer choice and that each individual has a right to choose their own nutritional diets. In a 2005 NZ Food Safety survey, 84% of New Zealanders were opposed to the mandatory fortification. The NZ Food & Grocery Council believes fortification would not result in significant further reduction as the incidence of NTDs has already decreased during the past 20 years, a claim that has been backed some scientists also opposing the idea (Tim Green, Jim Mann, 2003). ④

The main groups advocating the mandatory fortification include the NZ Paediatric Society, most scientists, the Labour party and families affected by NTDs. Rosemary Marks states that such a deferral will result in "perhaps up to 20 preventable NTD pregnancies per year in NZ and up to 15 preventable terminations." (Paediatric Society, 2009). However, many scientists like Murray Skeaff (Otago University) and Joanne Dixon (Clinical Geneticist of Wellington Hospital) advocate fortification, arguing that scientific research shows that folate fortification is safe for the whole population. ⑤

I believe that the benefits of folic acid fortification outweigh the potential risks involved in exposing the whole population to higher levels of folate. Voluntary fortification would probably not work as women likely to eat the fortified bread are those that are also likely to take supplements. Following the introduction of voluntary fortification in 1996 a study in 2003 (Hazel Fowler, 2006) shows the average folate intake of woman increasing by only 17mcg per day. ⑥

My proposed action is to use flour as the way of introducing folic acid in the diet of the NZ population. Although the upfront costs of buying the equipment are higher, fortification of flour is estimated to cost \$29.3 million per year ongoing (Access Economics, 2006), almost 20 million less than bread. This will reach even the women that do not regularly consume bread. Otherwise the mandatory fortification of bread with folate would be the most feasible and inexpensive way to deal with the heavy economic burden on the health system as it only adds about 25 cents to the cost of bread per person per year. ⑦

Many other countries in the world have already passed a folate standard and the decision can be aided with the research done in these countries. Sixty three other countries in the world have already started fortification with folic acid, fifty-seven of them having mandatory folate fortification. Such countries are the United States of America {1998, all cereal/grain flours}, Canada (1998, white flour and pasta), Chile (2000, flour), and Australia (2009, bread making flour). As these dates show, America, Canada, and Chile are way ahead of Australia and New Zealand.

	Grade Boundary: High Achieved
4.	<p>For Achieved, the student needs to integrate biological knowledge (EN 5) to develop an informed response to a socio-scientific issue.</p> <p>This involves:</p> <ul style="list-style-type: none"> • presenting a personal position, developed using relevant biological knowledge • proposing action(s) at a personal and/or societal level. <p>This student has described relevant biological concepts and processes (1), and biological implications relating to the issue of fortifying bread with folic acid (2).</p> <p>A social implication is briefly considered (3).</p> <p>Two differing opinions or viewpoints about the issue are given – one against (4) and one for (5).</p> <p>A personal position (6) and personal proposed action (7) are given.</p> <p>To reach Merit, the student could:</p> <ul style="list-style-type: none"> • explain the biological concepts and processes relating to the issue • explain the social implications of fortifying bread with folic acid more thoroughly • develop a reasoned informed response by using biological knowledge with supporting evidence to explain why the personal position and proposed action by fortifying bread with folic acid is chosen.

Folate is a water soluble form of the B Group vitamins (vitamin B9) found naturally in foods. It is needed for growth and development in foetuses. Folic acid is the synthetic form of folate, typically used for supplementation and food fortification, whereas folate is found naturally in fruit, leafy vegetables, dried beans, peas, nuts, eggs and orange juice. Folate is a necessary part for enzymes to carry out their functions. When eaten in food as part of the diet, both folic acid and folate are changed to tetrahydrofolate, the active form of folic acid. This is necessary to make an essential component for nucleotide synthesis. Up to 50 – 80% of naturally occurring folate is lost after cooking, while folic acid is much more stable. Fortification is the addition of one or more essential nutrients in a food, whether or not it is normally contained in the food. It is known that New Zealand has successfully fortified salt with iodine since the 1920's to prevent goitre and cretinism, and milk with Vitamin D to prevent rickets in the 1930's. The New Zealand Government has been debating over the issue of fortifying bread with folic acid as this may lead to implications that will affect our daily lives deeply. ①

There are researches about the danger of megadoses of folic acid, saying that overdose of folate will cause cancers. There are dual effects seen in colorectal, breast and prostate cancers making society concerned about it. In fact, folate deficiency may promote initial stages of carcinogenesis, whereas high doses of folic acid may enhance growth of cancer cells. ②

Folate plays an active role in DNA and RNA synthesis. Tetrahydrofolate is involved in the synthesis of amino acids. Folate is required for cell division - mitosis and meiosis. The multiplication of cells during growth and development requires an increased amount of folate in the blood to make of red blood cells for the development of the foetus. The deficiency of folate decreases oxygen in red blood cells resulting in megaloblastic anaemia. ①

Another deficiency that may result is the infant developing neural tube defects (NTD). This happens when the neural tube of the foetus does not close when it should, 3 to 4 weeks after conception. Depending on where the defect is located along the backbone, the defect is most commonly spina bifida, which results in nerve damage that causes lower body paralysis. Such defects may also result in anencephaly, where much of the brain of the infant has not formed. These babies will die shortly after birth. ①

All these conditions have negative consequences for the child, as of the 64% at babies with NTD's born alive, 100% of babies with anencephaly will die within the month, and 90% of babies with spina bifida will have severe thoracic or lumbar lesions. Those with a thoracic lesion have a life expectancy of 40 years, and a low quality of life. ②

Many other countries in the world have already passed a folate standard and the decision can be aided with the research done in these countries. Sixty three other countries in the world have already started fortification with folic acid, fifty-seven of them having mandatory folate fortification. Such countries are the United States of America {1998, all cereal/grain flours}, Canada (1998, white flour and pasta), Chile (2000, flour), and Australia (2009, bread making flour). As these dates show, America, Canada, and Chile are way ahead of Australia and New Zealand. There have been researches done with excellent results from the long period of folate fortification. In the United States, the folate fortification resulted in a 25% drop in the rate of Neural Tube Defects. Also Lydia Buchtman, a spokesperson for Food ②

Standards Australia commented, "Mandatory fortification of folic acid has taken place in the USA for over 12 years and during this period neural tube defects have been reduced and there is no other evidence of ill health." In Canada, they have seen decreases in the birth prevalence of severe congenital heart defects. Even in the short time that Australia had the mandatory fortification; research has shown that there has been some decrease in NTD rates of new-born babies and expect to reduce numbers of neural tube defects-affected pregnancies up to 14%.

2

There has been speculation on the role of folate in decreasing the occurrence cardiovascular disease and strokes. In conjunction with vitamins B6 and B12, folate has been proven to regulate the levels of homocysteine in blood, an amino acid independently linked to cardiovascular disease. It is still unclear as to whether low homocysteine levels will result in fewer occurrences of these diseases.

1

Folate deficiency has economic implications. The rate of NTDs is approximately 9.1 per 10000 pregnancies (including live births, stillbirths and abortions) in New Zealand. This rate may seem low and has been dropping over time, but it still causes significant costs to the government. About \$355,000 is needed over a 20-year period to treat and care for a sufferer of spina bifida, and each year approximately \$5 million is spent on caring for New Zealanders with spina bifida.

3

There are differences of opinion concerning the fortification of folic acid in bread in New Zealand. The main group against the legislation includes the NZ Bakers Association and the Green Party. These groups argue that they value consumer choice and that each individual has a right to choose their own nutritional diets. The NZ Food & Grocery Council believes fortification would not result in significant further reduction as the incidence of NTDs has already decreased during the past 20 years.

4

The main groups for the mandatory fortification include the NZ Paediatric Society, the Labour party and families affected by NTDs. Rosemary Marks states that such a deferral will result in "perhaps up to 20 preventable NTD pregnancies per year in NZ and up to 15 preventable terminations." (Paediatric Society, 2009). Scientists like Murray Skeaff (Otago University) advocate fortification, arguing that scientific research shows that folate fortification is safe for the whole population.

5

From all the above points, I think the mandatory fortification of bread with folic acid is the most feasible method and I strongly support it. Voluntary fortification would probably not work as women likely to eat the fortified bread are those that are also likely to take supplements.

6

My proposed personal actions are to maintain a healthy diet, learn more about folate and other nutrients' implications on us, and to persuade others to support mandatory fortification of bread with folate. By having a balanced and healthy diet, I could ensure my intake of folate and other nutrients is sufficient and appropriate when looking up the nutrient labels on food and eating the right amount. Eating fortified bread could aid me doing the action and reduce the risk of NTDs. As for what the society can do for the mandatory fortification of bread with folate, they should join educational campaigns and watch relative TV programmes about the importance of folate and other nutrients on us so that they can eliminate their bias on the issue.

7

	Grade Boundary: Low Achieved
5.	<p>For Achieved, the student needs to integrate biological knowledge (EN 5) to develop an informed response to a socio-scientific issue.</p> <p>This involves:</p> <ul style="list-style-type: none"> • presenting a personal position, developed using relevant biological knowledge • proposing action(s) at a personal and/or societal level. <p>This student has described some relevant biological concepts and processes (1), and biological implications relating to the issue of fortifying bread with folic acid (2).</p> <p>A social implication is briefly considered (3).</p> <p>Two differing opinions or viewpoints about the issue are given – one against (4) and one for (5).</p> <p>A personal position (6) and proposed societal action (7) are given.</p> <p>For a more secure Achieved, the student could develop the relevant biological concepts and processes relating to the issue more thoroughly to support the personal position taken, and proposed societal action, of fortifying bread with folic acid.</p>

Folate is one of the B Group vitamins (vitamin B9) found naturally in foods. Folic acid is the synthetic form of folate, typically used for supplementation and food fortification, whereas folate is found naturally in fruit, leafy vegetables, dried beans, peas, nuts, eggs and orange juice. Up to 50 – 80% of naturally occurring folate is lost after cooking, while folic acid is much more stable.

Fortification is the addition of one or more essential nutrients in a food. New Zealand has fortified salt with iodine since the 1920's to prevent goitre and cretinism, and milk with Vitamin D to prevent rickets in the 1930's. The New Zealand Government has been debating over the issue of fortifying bread with folic acid as this may lead to implications that will affect our daily lives.

Folate is essential for the synthesis of nucleic acids RNA and DNA. The causes of folate deficiency are not eating enough food that contains folic acid. Humans need to take folate, as we are not capable of synthesising folate in the body, which means that they depend on sufficient levels of it in their diet. When eaten in food as part of the diet, both folic acid and folate are changed to tetrahydrofolate, the active form of folic acid. ①

Folate acts as a co-factor for enzymes. It helps prevent defects that are due to low folate intake needed by body. Folate is needed for growth and development in foetuses. It is especially important to women who are pregnant during their first six weeks to prevent neural tube defect (NTD). The neural tube is part of an embryo that develops into the spine and brain. Depending on where the defect is located along the backbone, the defect is most commonly *spina bifida*, which results in nerve damage that causes lower body paralysis. Such defects may also result in anencephaly, where much of the brain of the infant has not formed. These babies will die shortly after birth. ①

Though folic acid is good for the body there has also been research done saying benefits of folic acid will vary depending on the individuals and their health conditions. As folate helps rapid cell division people with pre-cancer or cancer are at risk as cancer cells DNA replication and cell division occur at a very fast rate, and this will only speed the growth of cell tumours. ②

Many other countries in the world have already passed a folate standard helped with research. Sixty three other countries in the world have already started fortification with folic acid, fifty-seven of them having mandatory folate fortification. Such countries are the United States of America {1998, all cereal/grain flours}, Canada (1998, white flour and pasta), Chile (2000, flour), and Australia (2009, bread making flour). As these dates show, America, Canada, and Chile are way ahead of Australia and New Zealand.

There have been researches done on long periods of folate fortification. In the USA, the folate fortification resulted in a 25% drop in the rate of Neural Tube Defects. Also, Lydia Buchtman (Food Standards Australia) commented, "Mandatory fortification of folic acid has taken place in the USA for over 12 years and during this period neural tube defects have been reduced and there is no other evidence of ill health." In Canada, they have seen decreases in the birth prevalence of severe congenital heart defects. Even in the short time that Australia had the mandatory fortification; research has shown that there has been some ②

decrease in NTD rates of new-born babies and expect to reduce numbers of neural tube defects-affected pregnancies up to 14%.

While the cost fortifying bread with bread with folate is a large one for many baking businesses in the long run it may actually turn out to be a more cost effective. Currently the government funding for children with spina bifida is about \$1 million dollars. Since spina bifida is preventable with a larger intake of folate in expecting mothers, it would be more economical to introduce mandatory folate law reducing cases of over the following years. If the cases reduce perhaps more previously allocated money to the people with spina bifida can be reallocated to a cure. About \$355,000 is needed over a 20-year period to treat and care for a sufferer of *spina bifida*, and each year approximately \$5 million is spent on caring for New Zealanders with spina bifida.

3

There are differences of opinion concerning the fortification of folic acid in bread in New Zealand. While many countries have introduced mandatory fortification of folate in bread, Laurie Powell (President of the Association of Bakers) finds it inadvisable "to overlook international concerns being raised about the long term effects of higher concentration of folic acid... Though fortifying bread with folate is beneficial to prevent Neutral Tube Defects in pregnant women but what about the other effects on everyone else? The government's decisions should have a good understanding, researched and also know that the other children who may not need it or it may be unbeneficial to them. People need to have choices, as supporters who want mandatory folate law may not fully understand the effects of it on children who do not have this rare disease and actually cause dysfunctional brain development. As bakers are now seen as the centre of attention for the cases of Spina Bifida which is not true as... dosing every slice of bread is not a magical cure."

4

The main groups for the mandatory fortification include the NZ Paediatric Society, the Labour party and families affected by NTDs. Rosemary Marks states that such a deferral will result in "perhaps up to 20 preventable NTD pregnancies per year in NZ and up to 15 preventable terminations." (Paediatric Society, 2009). Scientists like Murray Skeaff (Otago University) advocate fortification, arguing that scientific research shows that folate fortification is safe for the whole population.

5

I support mandatory bread fortification with folate as this will reduce kids being born with Spina Bifida and other NTDs. Also because everyone needs folate in their daily diet as low folate can result to other diseases such as anaemia and heart diseases, which are all preventable. The cost associated for those with Spina Bifida can also be deferred to a cure such as cancer.

6

There should be a campaign to guarantee that women understand why folate is vital for the health of them and their children, and encourage women planning to become pregnant to increase their folate intake. The campaign should also advocate eating healthily to increase the amount of folate in the diet, as folate is found naturally in foods such as citrus fruits, vegetables and legumes.

7

	Grade Boundary: High Not Achieved
6.	<p>For Achieved, the student needs to integrate biological knowledge to develop an informed response to a socio-scientific issue.</p> <p>This involves:</p> <ul style="list-style-type: none"> • presenting a personal position, developed using relevant biological knowledge • proposing action(s) at a personal and/or societal level. <p>An overview of what is meant by 'biological knowledge' can be found in Explanatory Note (EN) 5.</p> <p>This student has made an attempt to describe relevant biological concepts and processes (1), and biological implications relating to the issue of fortifying bread with folic acid (2).</p> <p>A social implication is briefly considered (3).</p> <p>Two differing opinions or viewpoints about the issue are given – one against (4) and one for (5).</p> <p>A personal position is given (6).</p> <p>To reach Achieved, the student could:</p> <ul style="list-style-type: none"> • describe the relevant biological concepts and processes relating to the issue in more detail to support the personal position taken • describe the implications relating to the issue to further develop an informed response • propose an action of fortifying bread with folic acid at a personal and/or societal level.

Folate is one of the B Group vitamins found in foods. Folic acid is the synthetic form of folate used for food fortification, whereas folate is found naturally in fruit, leafy vegetables, dried beans, peas, nuts, eggs and orange juice. Up to 50 – 80% of naturally occurring folate is lost after cooking, while folic acid is much more stable.

Fortification is the addition of one or more essential nutrients in a food. New Zealand has fortified salt with iodine since the 1920's to prevent goitre and cretinism, and milk with Vitamin D to prevent rickets in the 1930's. The New Zealand Government has been debating over the issue of fortifying bread with folic acid as this may lead to implications that will affect our daily lives.

Folate is essential for the synthesis of nucleic acids. The causes of folate deficiency are not eating enough food that contains folic acid. Humans need to take folate, as we are not capable of synthesising folate in the body. When eaten in food as part of the diet, both folic acid and folate are changed to tetrahydrofolate, the active form of folic acid. ①

Folate is needed to aid growth and development in foetuses. It is important to people who are pregnant to prevent neural tube defect. The neural tube is part of an embryo that develops into the spine and brain. Depending on where the defect is located along the backbone, the defect is most commonly Spina Bifida, which results in nerve damage that causes lower body paralysis. Such defects may also result in the brain of the infant not being formed. These babies will die shortly after birth. ①

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A boy who has suffered from Spina Bifida would like to see New Zealand mandatory fortify bread with folate. For 20 years his father Lyall Thurston has been running a campaign to make this possible. Even though his hope for fortified bread has been crushed many times over he has continued to support this cause enthusiastically by getting involved in disability rights and issues in New Zealand and overseas. He also has many experiences dealing with Spina Bifida as a member of the Coalition of parents of children with Spina Bifida and says, "we'll never know but as a parent of a child with a disability you ask yourself, was this ③

preventable?" Though Simon Thurston has been in a wheel chair most of his life; he hasn't given up but has lived a normal life. He has gained multiple degrees, lives independently and is a member of the Rotorua District Council. Although bakers disagree with getting your daily intake of folate from bread, but can get it from other sources like fruits and vegetables, Simon still supports it as 57 other countries have already done it and World Health organisations supports it. 3

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