Introduction

Here is what you will learn in this unit:

- Carbohydrates classification
- Good carbs or bad carbs?
- What’s the Glycaemic Index (GI) of foods?
- The GI index and athletic performance
- How to use the Glycaemic Index
- Low GI diets for weight loss

Includes a downloadable Low GI Diet Shopping List (client session handout)
Classification of carbohydrates

What are the sources of carbohydrates?

The main sources of carbohydrates are as follows:

<table>
<thead>
<tr>
<th>Simple (carbohydrates)</th>
<th>Complex (starches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit sugar</td>
<td>Vegetables</td>
</tr>
<tr>
<td>Milk sugar</td>
<td>Bread, grains, and beans</td>
</tr>
<tr>
<td>Table sugar</td>
<td>Beans</td>
</tr>
<tr>
<td>Brown sugar</td>
<td>Fireworks</td>
</tr>
<tr>
<td>Cereal syrup</td>
<td>Potatoes</td>
</tr>
<tr>
<td>Honey</td>
<td></td>
</tr>
</tbody>
</table>

Types of carbohydrates

Now, examine the below table, which provides you with a summary of the types of carbohydrates that we covered so far:

<table>
<thead>
<tr>
<th>Homosaccharide</th>
<th>Heterosaccharide</th>
<th>Nucleo-saccharide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple sugar</td>
<td>Simple sugar</td>
<td>Simple sugar</td>
</tr>
<tr>
<td>Two molecules of carbohydrate linked together</td>
<td>Two molecules of carbohydrate linked together</td>
<td>Two molecules of carbohydrate linked together</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>Carbohydrates</td>
<td>Carbohydrates</td>
</tr>
</tbody>
</table>

[Image of chart with carbohydrate types and their properties]
How are carbs classified?

- Carbohydrates are traditionally classified according to their chemical structure.
- The most simplistic method divides them into two categories:
  - simple (sugars)
  - complex (starches and fibres)
- These terms simply refer to the number of sugar units in the molecule.
What are the sources of carbohydrates?

The main sources of carbohydrates are as follows:

<table>
<thead>
<tr>
<th>Simple (sugars)</th>
<th>Complex (starches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruit sugar</td>
<td>Whole grain seeds</td>
</tr>
<tr>
<td>Milk sugar</td>
<td>Vegetables</td>
</tr>
<tr>
<td>Table sugar</td>
<td>Dried peas and beans</td>
</tr>
<tr>
<td>Brown sugar</td>
<td>Seeds</td>
</tr>
<tr>
<td>Corn syrup</td>
<td>Cereals</td>
</tr>
<tr>
<td>Honey</td>
<td>Potatoes</td>
</tr>
</tbody>
</table>
Simple carbohydrates are very small molecules consisting of 1 or 2 sugar units.

They comprise:

- The **monosaccharides** (1-sugar units):
  - glucose (dextrose)
  - fructose (fruit sugar)
  - galactose

- The **disaccharides** (2-sugar units):
  - sucrose (table sugar, which comprises a glucose and fructose molecule joined together) and
  - lactose (milk sugar, which comprises a glucose and galactose molecule joined together).
Complex carbohydrates (polysaccharides) are much larger molecules, consisting of between 10 and several thousand-sugar units (mostly glucose) joined together. They include:

- Starches
  - Amylose
  - Amylopectin
- Non-starch polysaccharides (dietary fibre), such as:
  - Cellulose
  - Pectin
  - Hemicellulose
Did you know?

- Eating complex carbohydrates to excess is preferable to consuming excess fat (!)

- This is because the process for converting carbohydrate to fat for storage requires energy, whilst the storage of fat does not.
  - For example, if 300 calories of excess carbohydrate is to be converted to fat and stored, the stored fat will only be equivalent to 270 calories.
  - If an excess 300 calories of fat is consumed and stored, there will be 300 calories of fat stored.

Now, this doesn’t mean that you should only eat complex carbs and avoid fats. All nutrients are needed, but anything in excess is bad!
Now, examine the below table, which provides you with a summary of the types of carbohydrates that we covered so far:

<table>
<thead>
<tr>
<th>Monosaccharide</th>
<th>Disaccharides</th>
<th>Polysaccharides</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g. Glucose</td>
<td>e.g. Sucrose</td>
<td>e.g. Bread, pasta etc.</td>
</tr>
<tr>
<td>Simple sugar</td>
<td>Simple sugar</td>
<td>Complex carbohydrate</td>
</tr>
<tr>
<td>A single molecule of carbohydrate</td>
<td>Two molecules of carbohydrate bound together</td>
<td>Many molecules of carbohydrate bound together</td>
</tr>
<tr>
<td>Quickly absorbed into the bloodstream</td>
<td>Slightly delayed absorption into the bloodstream</td>
<td>Slowly absorbed into the bloodstream</td>
</tr>
</tbody>
</table>
Simple carb, or complex carb?

In practice, many foods contain a mixture of both simple and complex carbohydrates, making the traditional classification of foods into ‘simple’ and ‘complex’ very confusing!

For example, biscuits and cakes contain flour (complex) and sugar (simple).

Bananas contain a mixture of sugars and starches depending on their degree of ripeness.
Glucose polymers in sports drinks

In between simple and complex carbohydrates are glucose polymers and maltodextrin, which comprise between 3 and 10 sugar units.

- They are made from the partial breakdown of corn starch in food processing.
- These carbohydrates are widely used as bulking and thickening agents in processed foods, such as sauces, dairy desserts, baby food, puddings and soft drinks.
- They are popular ingredients in sports drinks and engineered meal-replacement products, owing to their low sweetness and high energy density (when compared to sucrose).
Good carbs, or bad carbs?

Not all carbohydrates are created equal!

☞ It’s tempting to think that simple carbohydrates, due to their smaller molecular size, are absorbed more quickly than complex carbohydrates, and produce a large and rapid rise in blood sugar. Unfortunately, that’s not always the case.

☞ For example, apples (containing simple carbohydrates) produce a small and prolonged rise in blood sugar, despite being high in simple carbohydrates.

☞ Many starchy foods (complex carbohydrates), such as potatoes and bread, are digested and absorbed very quickly and give a rapid rise in blood sugar.
Is the carbs classification outdated?

Yes, it is. The old notion about simple carbohydrates giving fast-released energy and complex carbohydrates giving slow-released energy is incorrect and misleading!

- What is more important, as far as sports performance is concerned, is how rapidly the carbohydrate is absorbed from the small intestine into your bloodstream.
- The faster this transfer, the more rapidly the carbohydrate can be taken up by muscle cells (or other cells of the body) and make a positive difference to your client’s training and recovery.
- In fact, the outdated model of ‘simple’ versus ‘complex’ carbohydrates has been replaced by the Glycaemic Index.
- Why? Because the Glycaemic Index provides a more accurate representation of how food impacts blood glucose. We’ll see how it works in a few moments.
Test your knowledge!

Are the following statements true or false? (circle the appropriate answer)

1) Lactose is a protein and not a carbohydrate
   - TRUE - FALSE

2) Glucose and fructose are complex carbohydrates
   - TRUE - FALSE

3) Dietary fibre is a simple carbohydrate
   - TRUE - FALSE

4) Glucose polymers and maltodextrin are popular ingredients in sports drinks and engineered meal-replacement products
   - TRUE - FALSE

5) Simple carbohydrates, due to their smaller molecular size, are absorbed more quickly than complex carbohydrates
   - TRUE - FALSE

6) The faster the carbohydrate is absorbed from the small intestine into your bloodstream, the faster it can be taken up by your muscle cells and help with your training and recovery
   - TRUE - FALSE

* The correct answers to this exercise can be found in the next page.
Do not peek! Try to resolve it yourself first.
Exercise Answers

1) **FALSE.** Lactose is a simple carbohydrate, more specifically, a disaccharide.

2) **FALSE.** Glucose and fructose are simple carbohydrates.

3) **FALSE.** Fibre is a complex carbohydrate – more specifically, a non-starch polysaccharide, such as cellulose, pectin and hemicellulose.

4) **TRUE.** Glucose polymers and maltodextrin are a mixture of simple and complex carbs. They are used in sports drinks and also as bulking and thickening agents in processed foods.

5) **FALSE.** Simple carbohydrates aren’t absorbed more quickly than complex carbohydrates despite their molecular size. For example, apples (containing simple carbohydrates) produce a small and prolonged rise in blood sugar, despite being high in simple carbohydrates.

6) **TRUE.** What is more important as far as sports performance is concerned is how rapidly the carbohydrate is absorbed from the small intestine into your bloodstream. The faster the carbohydrate can be taken up by muscle cells, the better for your training and recovery.
Using the GI index

Low GI Diet Shopping List!

- Better佛陀 (try yams, taro, and sweet potatoes)
- Beans (great in puddings and stir-fries)
- Cereal (look for wholemeal)
- Grains (brown rice, quinoa)
- Low GI fruit (blueberries, blackberries)
- Leafy vegetables (kale, spinach)
- Nuts (almonds, walnuts)
- Non-dairy milk (soy, almond)
- Pasta (wholemeal)
- Seeds (flax, chia)
- Yogurt (low-fat, unsweetened)

To read and interpret GI tables:

- Use the GI index to choose foods that will keep your blood sugar stable.
- Aim for foods with a GI of 55 or less.
- Avoid foods with a GI of 70 or higher.
- Consider the glycaemic load (GL) for a more accurate measure.
- Include fibre-rich foods to slow digestion.

Make healthy, balanced choices.
To describe more accurately the effect different foods have on our blood sugar levels, scientists developed the glycaemic index (GI).

While the GI concept was originally developed to help diabetics control their blood sugar levels, it can benefit regular exercisers and athletes too.

It is a ranking of foods from 0 to 100 based on their immediate effect on blood sugar levels, a measure of the speed at which you digest food and convert it into glucose.

The faster the rise in blood glucose, the higher the rating on the index.
How the Glycaemic Index works

- Blood sugar and insulin levels rise every time you eat something containing carbohydrates.
- How high they rise, and how fast, depends on the food.
- A serving of white rice has almost the same effect as eating pure glucose — a quick, high spike in blood sugar and insulin.
- The same serving of lentils, for example, has a slower, smaller effect.
- The glycaemic index (GI) captures these changes by rating the effect of a specific amount of a food on blood sugar compared with the same amount of pure glucose.
- Food with a glycaemic index of 28 boosts blood sugar only 28% as much as pure glucose. But food with a glycaemic index of 95 acts almost like pure glucose.
- Over the past few decades, researchers have measured the glycaemic index of several thousand foods.
GI and the rise of glucose levels

- High glycaemic foods result in a quick spike in insulin and blood glucose.
- Low glycaemic foods have a slower, smaller effect.
- Analyse the graph on the right and compare the glucose spike of low vs. high GI foods.
Where can I find a GI table?

- You can see the GI and GL values for over 100 commons foods in this resource published by Harvard Medical School (click HERE).

- A comprehensive GI search in foods can be found in the website maintained by The University of Sydney. Visit it here: www.glycemicindex.com
How to use the Glycaemic Index

Using the glycaemic index is easy: Choose foods in the low GI category instead of those in the high GI category, and go easy on those in between!

Using the glycaemic index would be much easier if food makers put a symbol on low GI foods, as they do in Australia.

- **Low glycaemic index** (GI of 55 or less): Most fruits and vegetables, peas, beans (Dr Jennie Brand-Miller, a long-time glycaemic researcher at the University of Sydney, calls beans “star performers”), minimally-processed grains, quinoa, pasta, noodles, oats, rye, brown rice, low-fat dairy, nuts, seeds.

- **Moderate glycaemic index** (GI 56 to 69): Rye crackers, beets, couscous, breakfast cereals like Special K and Weetabix.

- **High glycaemic index** (GI of 70 or higher): White bread, white rice, rice cakes, white potatoes (peeled), instant mash, biscuits, most crackers, bagels, cakes, doughnuts, croissants, most packaged breakfast cereals, banana (over-ripe).
### How to read a GI table

**Did you notice?** Corn Flakes have over TWICE the GI value of apples! However . . . did you also notice that table sugar has a LOWER GI than Corn Flakes, bread, potatoes, and white rice?

This should **NOT** encourage you to eat table sugar freely! Excessive sugar consumption is a source of health issues, including obesity, diabetes, and tooth decay *(SACN, 2015)*.

<table>
<thead>
<tr>
<th>Food</th>
<th>Glycaemic Index (GI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dates (dried)</td>
<td>42</td>
</tr>
<tr>
<td>Corn Flakes</td>
<td>93</td>
</tr>
<tr>
<td>Jelly beans</td>
<td>80</td>
</tr>
<tr>
<td>Puffed rice cakes</td>
<td>82</td>
</tr>
<tr>
<td>Peeled white potato (boiled)</td>
<td>82</td>
</tr>
<tr>
<td>Doughnut</td>
<td>76</td>
</tr>
<tr>
<td>Soda crackers</td>
<td>74</td>
</tr>
<tr>
<td>White baguette bread</td>
<td>95</td>
</tr>
<tr>
<td>Table sugar (sucrose)</td>
<td>65</td>
</tr>
<tr>
<td>Pancake</td>
<td>67</td>
</tr>
<tr>
<td>White rice (boiled)</td>
<td>89</td>
</tr>
<tr>
<td>Brown rice (boiled)</td>
<td>50</td>
</tr>
<tr>
<td>White spaghetti</td>
<td>46</td>
</tr>
<tr>
<td>Whole-wheat spaghetti</td>
<td>42</td>
</tr>
<tr>
<td>Orange (raw)</td>
<td>40</td>
</tr>
<tr>
<td>Apple (raw)</td>
<td>39</td>
</tr>
<tr>
<td>All-Bran cereal</td>
<td>55</td>
</tr>
<tr>
<td>Kidney beans (boiled)</td>
<td>29</td>
</tr>
<tr>
<td>Barley kernels (boiled)</td>
<td>25</td>
</tr>
<tr>
<td>Banana (over-ripe)</td>
<td>70</td>
</tr>
</tbody>
</table>

Table: TheHealthSciencesAcademy.org; Data: Harvard.edu and glycemicindex.com
GI and its effect on health

The glycaemic index of a diet can affect health in various ways. Some of the latest studies suggest that:

- a low glycaemic diet helps manage food cravings and promote sustainable weight loss
- a low glycaemic diet helps prevent energy dips, fatigue, irritability, a lack of concentration, and mood issues
- a high glycaemic diet increases the risk of developing breast, prostate, colorectal, and pancreatic cancers, heart disease, and type 2 diabetes
The GI index and performance

- The glycaemic index (GI) is a more useful way of categorising carbohydrates for athletes than the traditional ‘complex’ versus ‘simple’ classification.

- The GI is a ranking of carbohydrates based on their immediate effect on blood glucose (blood sugar) levels. Remember:
  - Carbohydrates with a high GI produce a rapid rise in blood sugar.
  - Those with a low GI produce a slow rise in blood sugar.

- Low GI foods consumed 2-4 hours before exercise may help improve endurance and delay fatigue.

- High GI foods consumed pre-exercise benefit some athletes but may produce temporary hypoglycaemia at the start of exercise in those athletes sensitive to blood sugar fluctuations.
A low GI diet and weight loss

- While a low GI diet is important for regular exercisers for promoting glycogen recovery, it also has numerous health benefits and is widely promoted to the general population for weight loss.

- Reducing the GI of the diet increases satiety (feelings of satisfaction after eating), improves appetite control, and makes it easier to achieve a healthy body weight (Brand-Miller et al., 2005; Warren et al., 2003).
Take action now

Print our proprietary Low GI Diet Shopping List (on the next page). You can also find it in your downloadable client materials section. Read it thoroughly and get a good sense of each low GI food category. More importantly, make sure to use it to plan your next groceries shopping!
# Low GI Diet Shopping List

<table>
<thead>
<tr>
<th>Fruit</th>
<th>Non-starchy veggies</th>
<th>Low starch veggies</th>
<th>Low GI breads</th>
<th>Low GI cereals</th>
<th>Low GI grains</th>
<th>Beans and lentils</th>
<th>Nuts and seeds</th>
<th>Protein foods</th>
<th>0% fat dairy</th>
</tr>
</thead>
<tbody>
<tr>
<td>The more acidic or unripe the fruit, the lower the GI.</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Lower GI values:</td>
<td>Lime</td>
<td>Lemon</td>
<td>Berries</td>
<td>Apples</td>
<td>Pears</td>
<td>Green kiwis</td>
<td>Plums</td>
<td>Coconuts</td>
<td>Fish</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Cheese</td>
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<td>Yogurt</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td>(plain)</td>
</tr>
<tr>
<td>Higher GI values in tropical fruits:</td>
<td>Pineapple</td>
<td>Banana</td>
<td>Papaya</td>
<td>Mango</td>
<td>Sharon fruit (persimmon)</td>
<td>Watermelon</td>
<td>Melon</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Beware! Peeled white potatoes have a high GI. Eat them unpeeled (clean) or with high-fibre greens, protein or healthy fats to reduce their GI value; or replace them with low GI starchy vegetables.</td>
<td>Sweetcorn (GI 46)</td>
<td>Sweet potatoes (GI 46)</td>
<td>Butternut squash (GI 51)</td>
<td>Carrots (GI 35)</td>
<td>Parsnips (GI 52)</td>
<td>Quinoa</td>
<td>Chickpeas</td>
<td>Flaxseeds</td>
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<tr>
<td>Stoneground wholemeal bread (not ordinary wholemeal bread which has a medium GI)</td>
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<tr>
<td>Wholegrain breads with lots of grainy bits and cracked kernel pieces</td>
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<tr>
<td>Coarse breads containing barley, rye, oats, soy, cracked wheat (bulgar), or good amounts of seeds (e.g. flaxseeds, sunflower seeds, poppy seeds, pumpkin seeds)</td>
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<tr>
<td>Other oat-based or rye-based cereals (unrefined)</td>
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<tr>
<td>High-bran cereals (e.g. All Bran)</td>
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<td>Porridge (coarse oatmeal, with steel-cut oat flakes)</td>
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<tr>
<td>Muesli (100% natural, with unrefined flakes, without dried fruit)</td>
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<tr>
<td>Other oat-based or rye-based cereals (unrefined)</td>
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<tr>
<td>High-bran cereals (e.g. All Bran)</td>
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</tr>
<tr>
<td>Avoid if allergic to nuts!</td>
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</tr>
</tbody>
</table>
Explore low GI recipes by clicking on the links below:

- Low GI meal plans and recipes (Nuffield)
- Low GI Recipes (Glycemic Index Foundation)
- BBC GOOD Food:
  - Low GI Recipes
  - Low GI Dinner Recipes
  - Low GI Lunch Recipes
  - Low GI Party Snacks
- Allrecipes UK – Low GI
Find the GI of your favourite foods!

1. List 3 of your favourite foods with a LOW GI – include their GI ranking:

2. List 3 of your favourite foods with a MODERATE GI – include their GI ranking:

3. List 3 of your favourite foods with a HIGH GI – include their GI ranking:

4. How might the GI in the above foods affect your training and performance?

5. How might the GI in the above foods affect your weight?
Additional Resources

- How Much Added Sugar Are You Consuming? (includes PDF)
- 4 Effective Steps to Help Break the Sugar Habit
- Should Sugar Be Taxed Like Tobacco and Alcohol?
- When a calorie is not a calorie. Harvard Medical School.
- Glycaemic index and glycaemic load for 100+ foods. Harvard Medical School.
- GI Food Search Tool: www.glycemicindex.com/foodSearch.php
  The University of Sydney.

Tip for your web searches: Note that in the UK we write “glycaemic” but in the US and Australia “glycemic”!
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