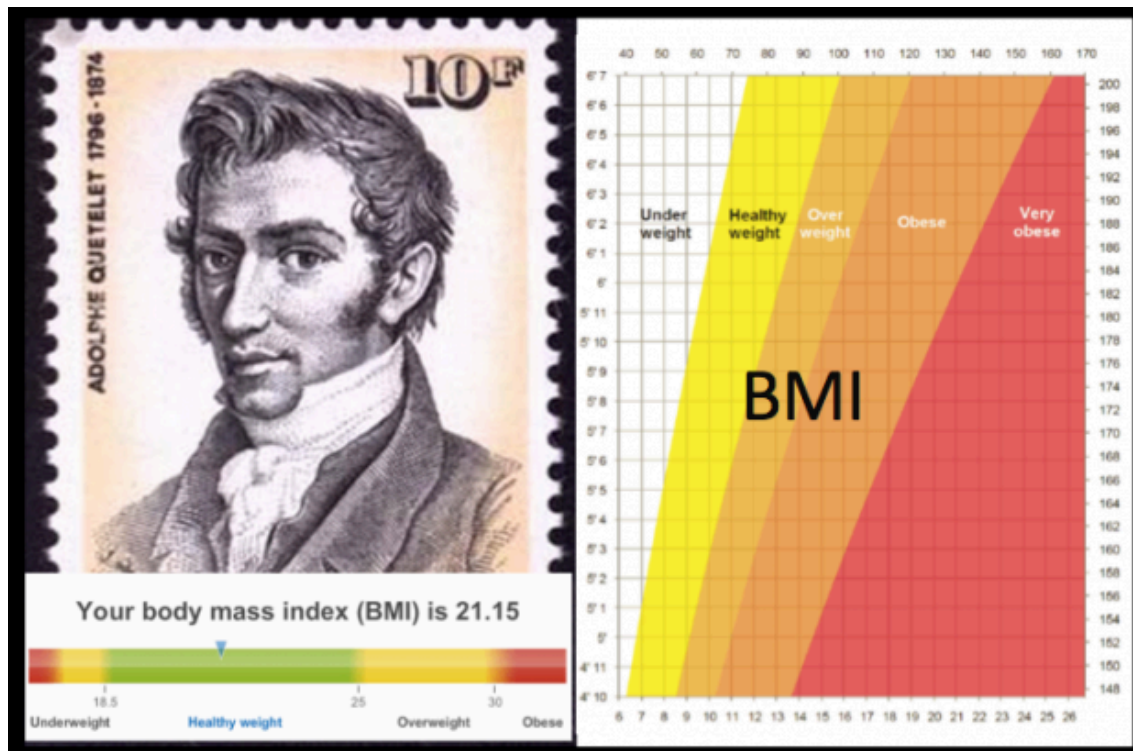


Body Mass Index (BMI)



A Spire Maths Activity

<https://spiremaths.co.uk/>

BODY MASS INDEX (BMI)

Teacher Notes: page 2 of 16

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Body Mass Index (BMI) Activities

Interactive whiteboard file information

For an ActivInspire (Promethean) flipchart file

<https://spiremaths.co.uk/wp-content/uploads/BMI.flipchart>

For an ActivStudio flp (Promethean) file

<https://spiremaths.co.uk/wp-content/uploads/BMI.flp>

For a Smart Notebook file

<https://spiremaths.co.uk/wp-content/uploads/BMI.notebook>

For this pdf file

<https://spiremaths.co.uk/wp-content/uploads/BMI.pdf>

BMI or the Quetelet Index: activities and ideas

BODY MASS INDEX (BMI)

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BMI or the Quetelet Index (after its inventor) is measured differently for adults (over 18) and children. Information about this is provided.

BMI uses mass (kilograms) and height (metres) in its formula, though all references in the literature in the formula refer to weight. This could be a point of discussion. I have used weight since it is universally applied. Many of the calculators for this accept imperial measurements (where the formula has conversion constants within it).

For adults a formula is used to calculate BMI and the value then is used as a measure of health. However there is discussion whether this is the most appropriate measure and in early 2013 the Daily Telegraph reported on a suggestion of a different formula. According to an adult's BMI he or she is judged to be on a seven point scale varying from 'Very severely underweight' to 'Very obese'.

Many countries and websites offer interactive BMI calculators, this resource includes those for

- the National Health Service (NHS)
- the BBC,
- the Poodwaddle website
- the National Heart, Lung and Blood Institute (NHLBI) in the USA
- the new BMI calculator using a different formula

The NHS and the NHLBI offer iPhone APPs.

Also there is a chart (from the NHS) and a table (from NHLBI) where you can read off BMIs.

For children (i.e. under 18 in the UK) NHS charts are used to give a result stating 'your body mass is in the ?? centile for this age' and a statement is made about the weight of the child (over, under, healthy).

The UK charts are complicated to use and understand, and there are several of them. So I have not used them here, though they can be found as follows:

<http://bit.ly/2-18charts>

Royal College of Paediatrics and Child Health Resources – links to their charts for children

<http://bit.ly/2-18girls>

UK 2- 18 growth chart for girls (part is used here)

<http://www.rcpch.ac.uk/PCHR>

Personal Child Health Record or the 'Red Book' is now used for all children (ebook version under trial)

The NHS resources also link to health, life style and medical issues.

This could therefore become a substantial mathematics and PSHE module, but you need to look at all resources and links to make sure that you are happy following things through.

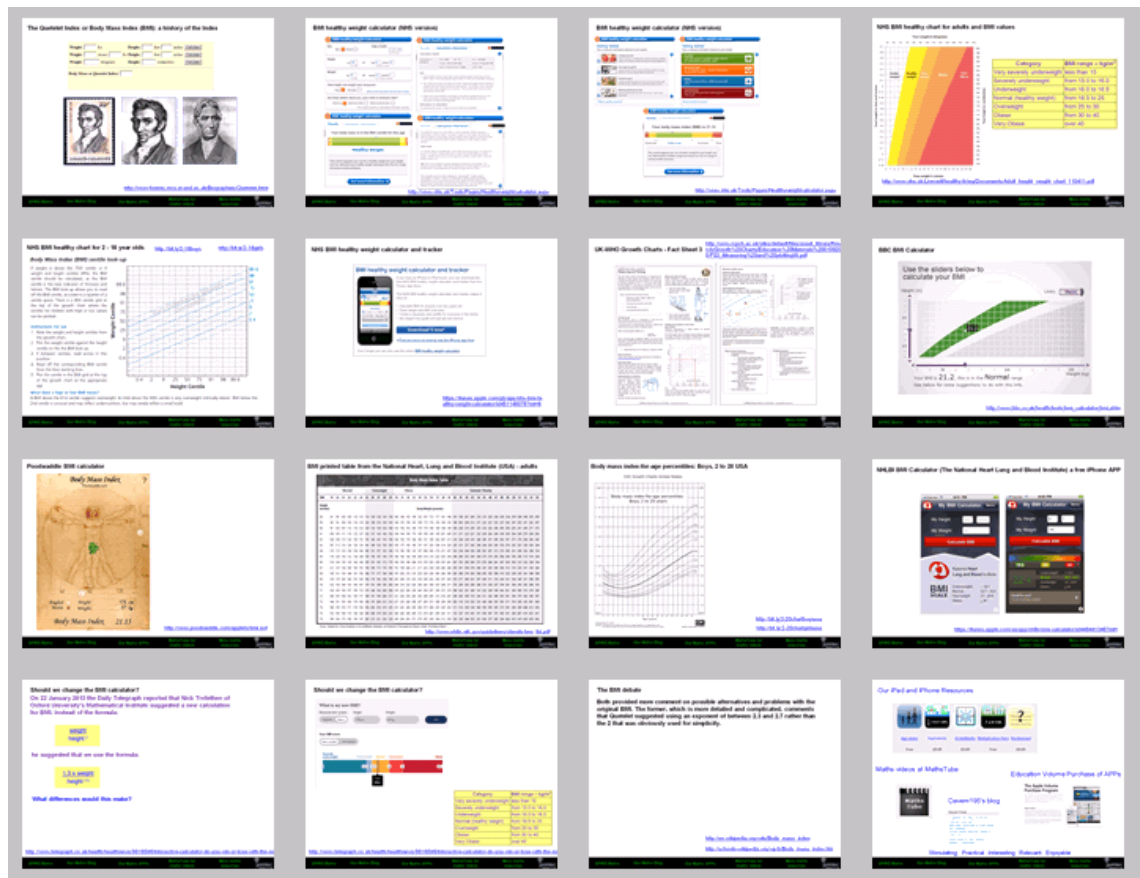
Approaches all set within the context of the real world:

- compare standard formula of BMI with new formula – where does it make a difference
- look at and interpret these different charts
- part of PSHE mathematics module on healthy lifestyles

BODY MASS INDEX (BMI)

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Diagrams below are IWB pages each linked to an idea, lesson or resource.



Here are the activity titles that follow in order here.

The Quetelet or BMI Index: a history of the Index	BMI healthy weight calculator (NHS version) 1	BMI healthy weight calculator (NHS version) 2	NHS BMI healthy chart for adults and BMI values
NHS BMI healthy chart for 2 – 18 year olds	NHS BMI healthy weight calculator and tracker	UK-WHO Growth Charts - Fact Sheet 3	BBC BMI Calculator
Poodwaddle BMI calculator	BMI printed table from the National Heart, Lung and Blood Institute (USA) - adults	CDC Growth Charts USA: Body mass index-for-age percentiles for boys, 2 to 20 years	NHLBI BMI Calculator (The National Heart Lung and Blood Institute) a free iPhone APP
Should we change the BMI calculator 1?	Should we change the BMI calculator 2?	The BMI debate	Our Other Mathematics Resources

BODY MASS INDEX (BMI)

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The Quetelet or BMI Index: a history of the Index

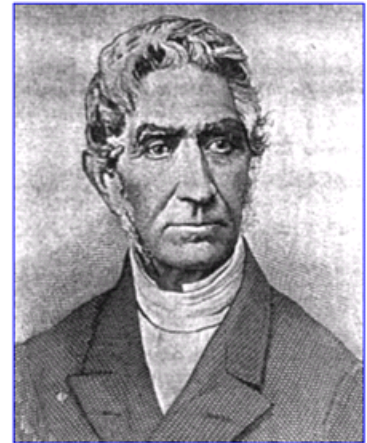
<http://www-history.mcs.st-and.ac.uk/Biographies/Quetelet.html>

Lambert Adolphe Jacques Quetelet (1796 – 1874) was the first person to have a concept of the 'average man' (1835) and one of the earliest people to work on social statistics.

At http://schools-wikipedia.org/wp/b/Body_mass_index.htm the Schools Wikipedia Selection for BMI gives the date of invention between 1830 and 1850 by Quetelet, comments on its initial popularity in the early 1950s and 60s (when obesity first started to be an issue) and continues with a brief commentary on its shortcomings.

Weight:	<input type="text"/>	lbs	Height:	<input type="text"/>	feet	<input type="text"/>	inches	<input type="button" value="Calculate"/>		
Weight:	<input type="text"/>	stones	<input type="text"/>	lbs	Height:	<input type="text"/>	feet	<input type="text"/>	inches	<input type="button" value="Calculate"/>
Weight:	<input type="text"/>	kilograms	Height:	<input type="text"/>	centimetres	<input type="button" value="Calculate"/>				

Body Mass or *Quetelet* Index:



BODY MASS INDEX (BMI)

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BMI healthy weight calculator (NHS version)

<http://www.nhs.uk/Tools/Pages/Healthyweightcalculator.aspx>

The top four pictures are concerned with BMI, its calculation and interpretation. The next two offer advice about diet and health. Slides 3, 5 and 6 will vary according to age of adult (over 18)

BMI healthy weight calculator

Sex: Male ☒ Female ☐ Date of birth: 3 4 96
e.g. dd-mm-yy

Height: cm 178 or feet 5 inches 10
e.g. 170cm e.g. 5 feet 7 inches

Weight: kg 67 or stones 10 pounds 7
e.g. 65kg e.g. 10 stone 5 pounds

Date height and weight were measured: Today ☒ Not today ☐ [Why is this being asked and why does it matter?](#)

Are these details about you, your child or someone else?
About me ☒ About my child ☐ About someone else ☐
This is used to provide you with relevant information and links

BMI healthy weight calculator

Results Calculation information [Print results](#)

Calculation details

Calculated on: 27/2/2013	Sex: male	Age: 16	Born: 3/4/1996
	Height: 178 cm (5ft 10in)	Weight: 67 kg (10st 7lb)	
	Date of measurement: Today	About: You	

Note:

- Interpretation of body mass index varies between people depending on their ethnic origin if they are going through puberty or if they are particularly muscular.
- Your result will be less accurate if you enter height and weight measurements in imperial (feet and inches and stones and pounds). You will get a more accurate result using metric measures (cm and kg). This is particularly important when calculating a child's BMI.
- Please also note that BMI is calculated using metric measurements so if you enter your details in imperial, the calculator will automatically make this conversion in order to calculate BMI.


Information on calculation

To understand the results, it helps to know how they are calculated.

BMI healthy weight calculator

Results Calculation information [Print results](#)

Your body mass is in the 60th centile for this age



Healthy weight

This result suggests you may be a healthy weight for your height and sex. Maintaining a healthy weight decreases the risk of a range of serious health problems.

[Get more information](#)

BMI healthy weight calculator

Results Calculation information [Print results](#)

For adults, the body mass index (BMI) is used to calculate whether a person is underweight, a healthy weight, overweight or obese for their height. BMI allows for natural variations in body shape, giving a healthy weight range for a particular height. The calculation divides the adult's weight in kilograms by their height in metres squared.

Child results

For children, BMI is used differently, as the child's age and sex have to be taken into account. To do this, a child growth chart is used to convert the 'BMI' into a 'BMI centile'. The BMI centile can be used to determine whether a child's BMI is within the healthy range or not.

Note




There are a number of growth references available for this purpose. This calculator uses the British 1990 Growth Reference for children aged four and over, and the WHO Growth Standards for children younger than four years.

This calculator uses the clinical categories: "underweight", "healthy weight", "overweight" or "obese". Obese is a medical term used by doctors and health professionals. If you have received your child's results from the National Child Measurement Programme, you may notice that the term "very overweight" was used instead of "obese", but the results were calculated in the same way.

BMI healthy weight calculator

Getting started

Here is relevant information tailored to your results

-  **A balanced diet**
When it comes to a healthy diet, balance is the key to getting it right. This means a variety of foods in the right proportions.
-  **Ten ways to get fit**
Exercise doesn't have to mean torturing yourself at the gym. Here are 10 ways to get fit while you have fun.
-  **Food for sport**
A sports nutritionist shares her tips on how to eat well to get the best results, whatever your favourite activity or sport.
-  **Hip-hop dancing for kids**
Hip-hop dancing gets kids active and it's fun. Learn some basic steps.

[Need to speak to someone?](#)

BMI healthy weight calculator

Getting started

Here is relevant information tailored to your results

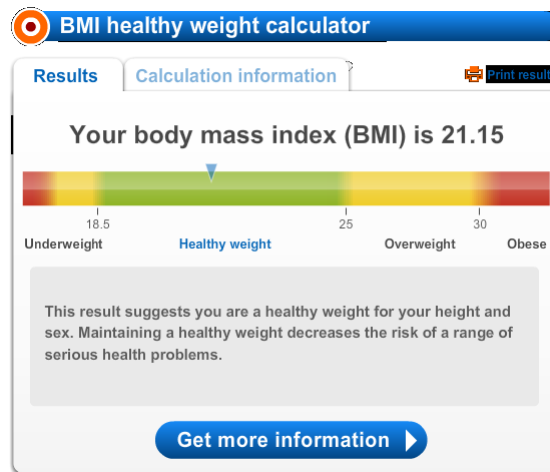
-  **Live Well**
Read more advice and information on eating a balanced diet, keeping fit and managing your weight.
-  **Interactive tools**
Try out more tools, quizzes, calculators and planners to improve diet and fitness.
-  **Videos**
Watch more videos on fitness, nutrition and other health issues.
-  **Local Services**
Find your nearest sport centre, swimming pool or fitness group.

[Need to speak to someone?](#)

BODY MASS INDEX (BMI)

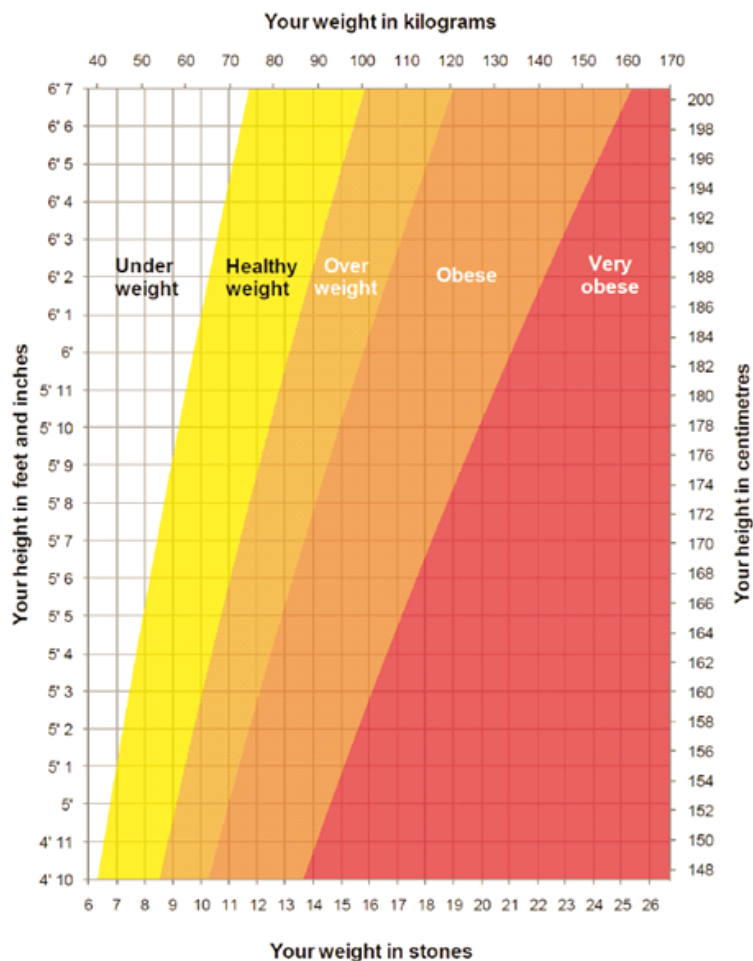
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Version for adults



NHS BMI healthy chart for adults and BMI values

<http://bit.ly/bminhsadultchart>



BODY MASS INDEX (BMI)

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Category	BMI range – kg/m ²
Very severely underweight	less than 15
Severely underweight	from 15.0 to 16.0
Underweight	from 16.0 to 18.5
Normal (healthy weight)	from 18.5 to 25
Overweight	from 25 to 30
Obese	from 30 to 40
Very Obese	over 40

NHS BMI healthy chart for 2 – 18 year olds

<http://bit.ly/2-18boys>

<http://bit.ly/2-18girls>

Body Mass Index (BMI) centile look-up

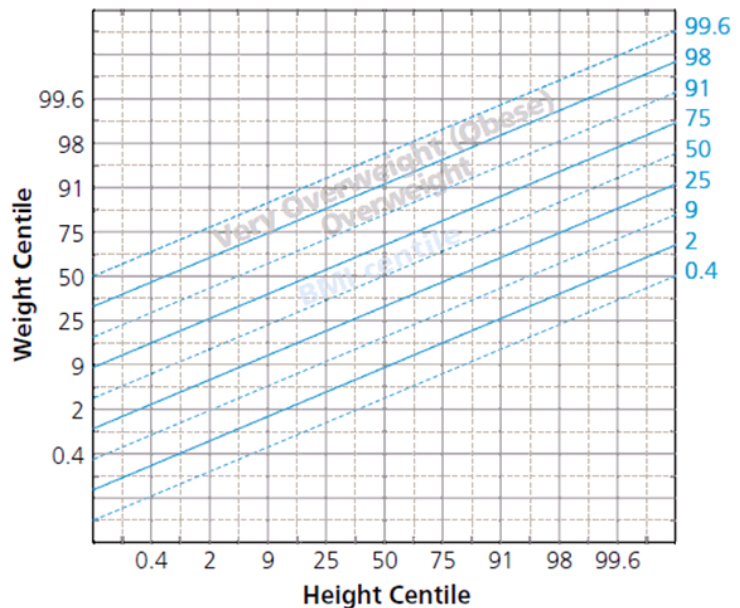
If weight is above the 75th centile or if weight and height centiles differ, the BMI centile should be calculated, as the BMI centile is the best indicator of thinness and fatness. The BMI look-up allows you to read off the BMI centile, accurate to a quarter of a centile space. There is a BMI centile grid at the top of the growth chart where the centiles for children with high or low values can be plotted.

Instructions for use

1. Note the weight and height centiles from the growth chart.
2. Plot the weight centile against the height centile on the BMI look-up.
3. If between centiles, read across in this position.
4. Read off the corresponding BMI centile from the blue slanting lines.
5. Plot the centile in the BMI grid at the top of the growth chart at the appropriate age.

What does a high or low BMI mean?

A BMI above the 91st centile suggests overweight. A child above the 98th centile is very overweight (clinically obese). BMI below the 2nd centile is unusual and may reflect undernutrition, but may simply reflect a small build.



BODY MASS INDEX (BMI)

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NHS BMI healthy weight calculator and tracker

<https://itunes.apple.com/gb/app/nhs-bmi-healthy-weight-calculator/id451148078?mt=8>

BMI healthy weight calculator and tracker



If you have an iPhone or iPod touch, you can download the free NHS BMI healthy weight calculator and tracker from the iTunes App Store.

The NHS BMI healthy weight calculator and tracker makes it easy to:

- Calculate BMI for anyone over two years old
- Track weight and BMI over time
- Create a separate user profile for everyone in the family
- Set weight loss goals and get tips and advice

Download it now!

➤ [Find out more on how to use the iPhone app here](#)

Don't forget you can also use the online [BMI healthy weight calculator](#)

UK-WHO Growth Charts - Fact Sheet 3

http://www.rcpch.ac.uk/sites/default/files/asset_library/Research/Growth%20Charts/Education%20Materials%201092010/FS3_Measuring%20and%20plottingW.pdf

UK-WHO Growth Charts - Fact Sheet 3
Measuring and Plotting

This fact sheet outlines the essentials of measuring and plotting at all ages. Anyone who measures a child, plots or interprets charts should be suitably trained, or be supervised by someone qualified to do so. If you have never been formally taught, this fact sheet will introduce you to what you need to know. If you have been taught you can use it to refresh and check on your knowledge.

Topics covered in this fact sheet include:

- ✓ Measuring weight, length, height and head circumference
- ✓ Plotting measurements on the chart
- ✓ Calculating age
- ✓ Understanding centile positions

Calculating age
Age calculation errors or misplotting of age are the commonest mistakes made when plotting charts. To prevent errors in calculating age, calculate in weeks for at least the first 6 months, then in calendar months.

When calculating age in weeks use a ...

- ✓ Calendar
- ✓ Date wheel

When calculating age in calendar months use the day of the birth date. If a child's date of birth was 23/1/10 then the child will be 9 calendar months old on 23/10/10, 10 months old on 23/11/10 and so on ...

- ✓ Remember there are 13 weeks per 3 calendar months

How to measure
(Video clips of proper measuring technique are available at: www.growthcharts.rcpch.ac.uk)

Measuring weight
Babies should be weighed without any clothes or nappy. Children older than two years can be weighed in vest and pants, but without shoes, footwear, and any dolls or teddies in hand. Only class III clinical electronic scales in metric setting should be used, to give accurate readings.

Measuring head circumference
Head circumference should be measured using a narrow plastic or disposable paper tape and measurement should be taken where the head circumference is widest. It is good practice to take three measurements and use the average. Any hat or bonnet should be removed.

Measuring length and height
Proper equipment is essential for both. Always remove shoes or other footwear. Length should also be measured without nappy using a length board or mat. It is good practice to take three measurements and use the average.

- ✓ Under two years of age, measure length using a length board or mat
- ✓ Over 2 years, measure height using a rigid upright measure with a T piece or a stadiometer

Plotting measurements on the chart
Basic plotting
Whatever measurement is being plotted an accurate calculation of age is needed. The chart section below indicates correct plotting using age and weight. The point on the graph is marked with a small but noticeable dot * drawn with a pencil, not an ink pen.

This chart section also shows the plotted weight of a child who is 16 weeks old and weighs 5.5 kg. This child is described as being between the 9th and 25th centile for weight.

© 2009 Royal College of Paediatrics and Child Health www.growthcharts.rcpch.ac.uk

What do centiles show?

Finding the right centile
There are centile labels at both ends of each curve. The 50th centile does not stand out on the new charts to avoid suggesting to parents that all children should be on or near this line. However the 50th centile is easily identifiable as the curve label ("weight", "length" etc) always sits on the 50th centile.

Understanding centile positions
Once plotted on a chart, a child's measurement will be described as being on a centile or between two centiles.

Remember: Growth monitoring is a process of taking measurements and plotting to see the changes over time. It is important that each measurement is accurate and plotted correctly so that the pattern of growth can be properly assessed.

A centile space is the distance between two of the marked centile lines (C), or equivalent distance if midway between centiles (D).

Measurement Summary

- ✓ All measurers should be trained
- ✓ Weighing:
 - Use only class III electronic scales
 - Weigh babies naked, toddlers in vest and pants, without shoes
- ✓ Head circumference:
 - Use narrow, paper or plastic tape round widest part of the head?
 - average of three?
- ✓ Length (up to age 2):
 - Proper equipment essential (length board or mat)
 - Shoes and nappy removed
- ✓ Height (after age 2):
 - Rigid rule with T piece, or stadiometer
 - Shoes removed
- ✓ Never measure or weigh in shoes

Plotting Summary

- ✓ Record measurement and date in ink
- ✓ Plot in pencil
- ✓ Age errors are commonest source of plotting mistakes
- ✓ Centile describes the percentage expected to be below that line
- ✓ A child is:
 - on a centile if within 1/4 space of line
 - between the two centiles if not
- ✓ A centile space is the distance between two centile lines

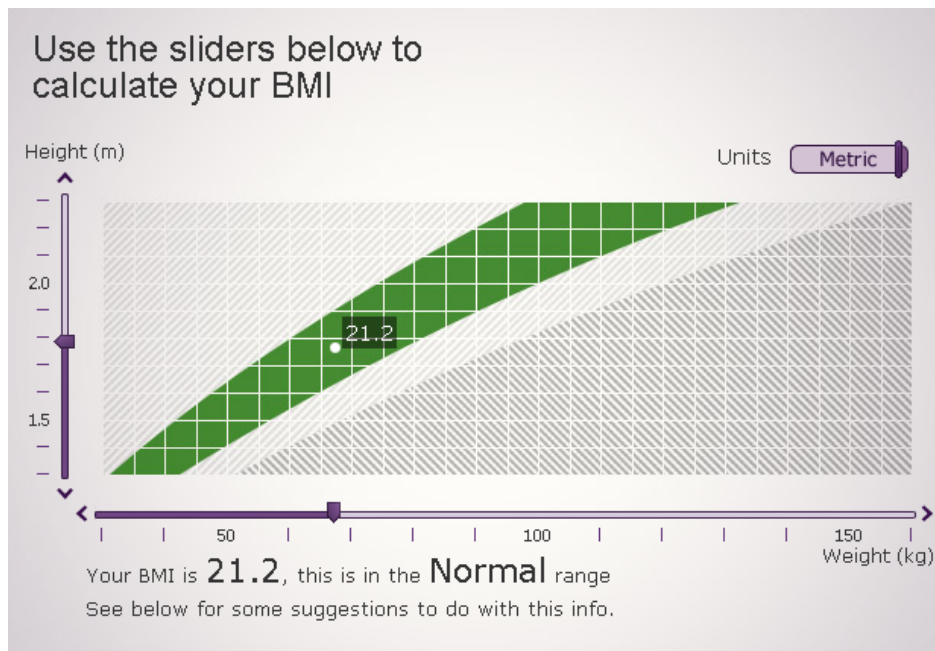
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BODY MASS INDEX (BMI)

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BBC BMI Calculator

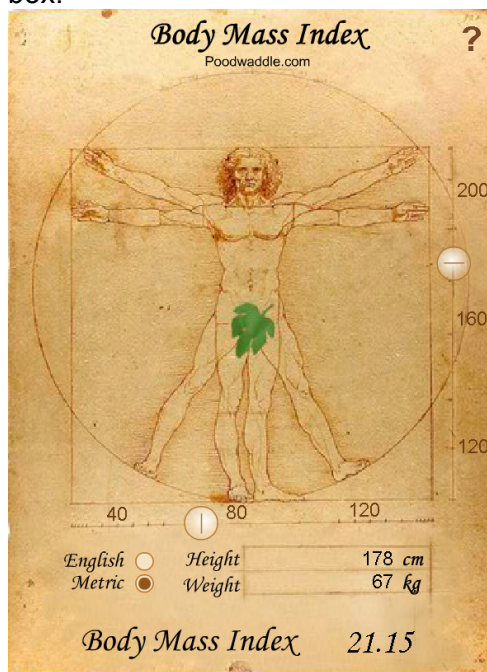
http://www.bbc.co.uk/health/tools/bmi_calculator/bmi.shtml



Poodwaddle BMI calculator

<http://www.poodwaddle.com/applets/bmi.swf>

Move the sliders below and on the right of the Vitruvian Man or type figures into the box.



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BMI printed table from National Heart, Lung and Blood Institute (USA) - adults

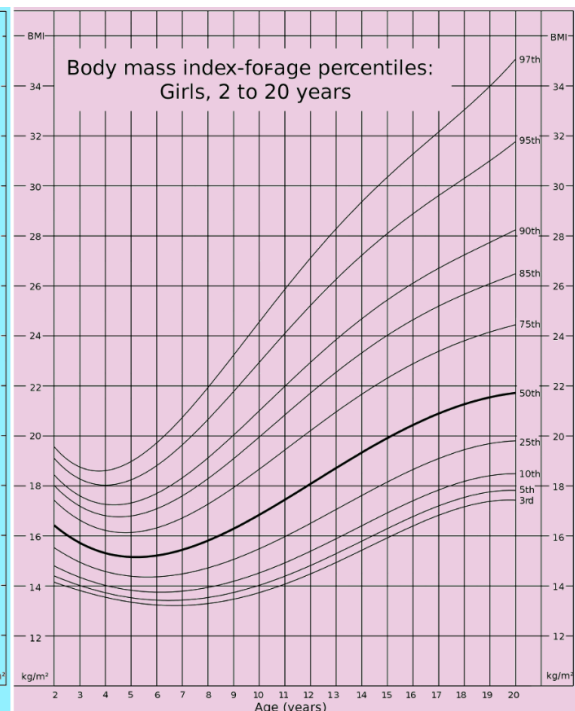
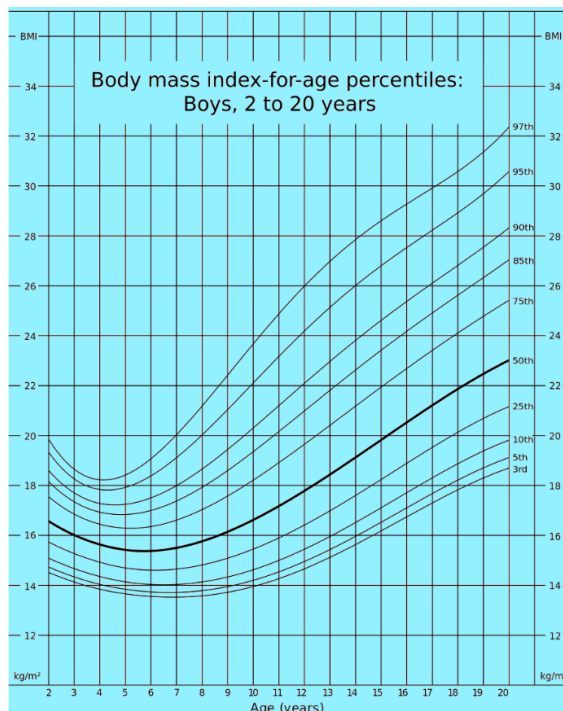
http://www.nhlbi.nih.gov/guidelines/obesity/bmi_tbl.pdf

Body Mass Index Table																																																																																																																																																																															
Normal										Overweight										Obese										Extreme Obesity																																																																																																																																																	
BMI	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54																																																																																																																																											
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CDC Growth Charts USA: Body mass index-for-age percentiles for boys, 2 to 20 years

<http://bit.ly/2-20chartboysusa>

<http://bit.ly/2-20chartgirlsusa>

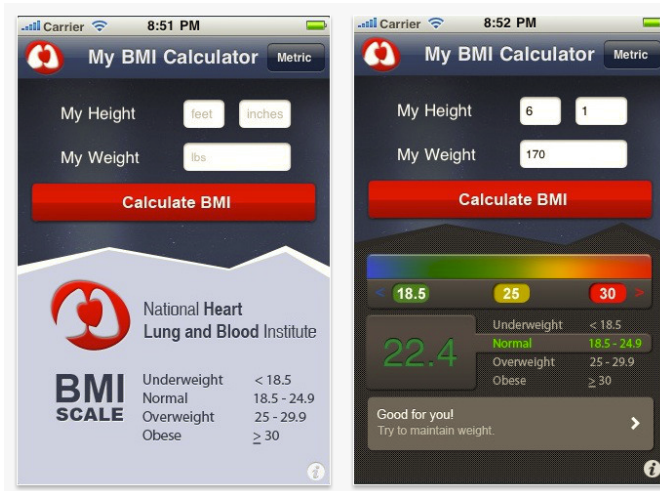


BODY MASS INDEX (BMI)

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NHLBI BMI Calculator: free iPhone APP

<https://itunes.apple.com/us/app/nhlbi-bmi-calculator/id446441346?mt=8>



Should we change the BMI calculator?

<http://bit.ly/newbmi>

On 22 January 2013 the Daily Telegraph reported that Nick Trefethen of Oxford University's Mathematical Institute had suggested a new calculation for BMI. Instead of the formula:

$$\frac{\text{weight}}{\text{height}^2}$$

it was suggested that instead we use:

$$\frac{1.3 \times \text{weight}}{\text{height}^{2.5}}$$

If we did this what does it mean?

Category	BMI range – kg/m ²
Very severely underweight	less than 15
Severely underweight	from 15.0 to 16.0
Underweight	from 16.0 to 18.5
Normal (healthy weight)	from 18.5 to 25
Overweight	from 25 to 30
Obese	from 30 to 40
Very Obese	over 40

BODY MASS INDEX (BMI)

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What is my new BMI?

Measurement system: Height: Weight:

☐ Imperial ☒ Metric 178cm 67kg

Your BMI score

☒ New system ☐ Old system

Severely underweight Underweight Normal Overweight Obese

0 16.5 18.5 25 30 45+

YOU
20.6

The BMI debate

http://en.wikipedia.org/wiki/Body_mass_index

http://schools-wikipedia.org/wp/b/Body_mass_index.htm

Both provided more comment on possible alternatives and problems with the original BMI. The former, which is more detailed and complicated, comments that Quetelet suggested using an exponent of between 2.3 and 2.7 rather than the 2 that was obviously used for simplicity.

Our Other Mathematics Resources

Lesson ideas and resources can be found at

www.spiremaths.co.uk

BODY MASS INDEX (BMI)

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Our iPad and iPhone resources



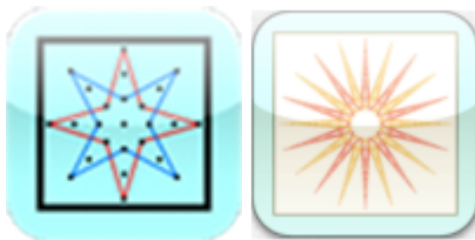
[Age-ulator](#) Free: [Randomised](#) £0.79



[Directed Numbers](#) £0.79: [Equivalents](#) £0.79: [Multiplication Pairs](#) £0.79



[Maths Charts for Jenny Eather](#) Free:
[Maths Charts for Jenny Eather \(Deluxe version\)](#) £3.99



[Grids4Maths](#) £0.79: [GeoDraw](#) £0.79 (iPad only)

Education APPs from Apple

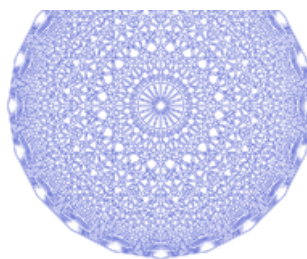
[Half price for volume purchase of some Education APPs](#)



GEO DRAW

Available on iPad iOS 5.0 or later!

(iPad only)



Grids

Circular
Isometric: horizontal
Isometric: vertical
Polar
Square



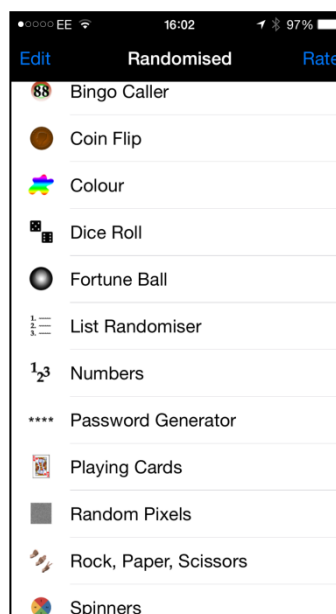
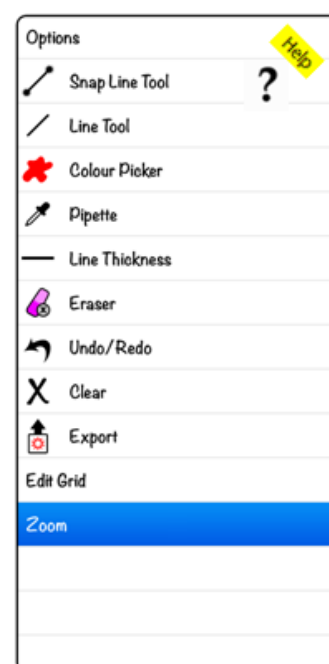
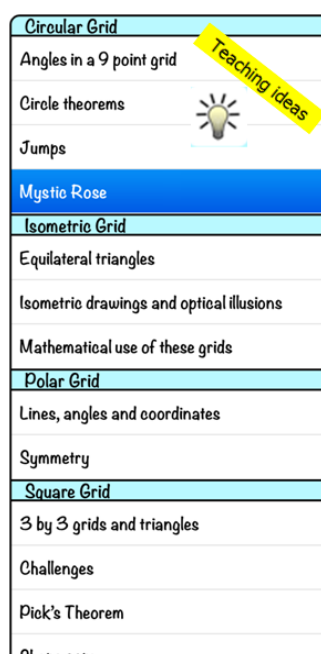
0.79

Change

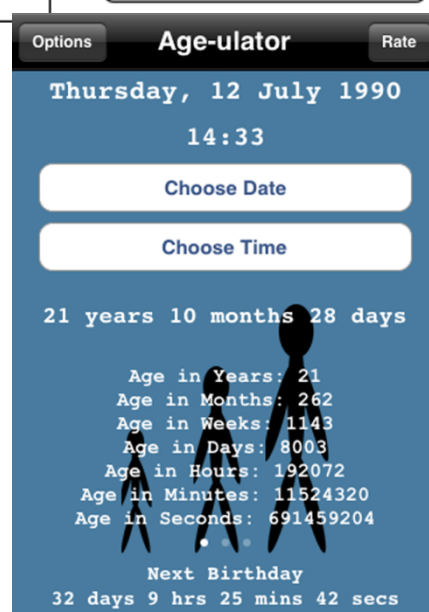
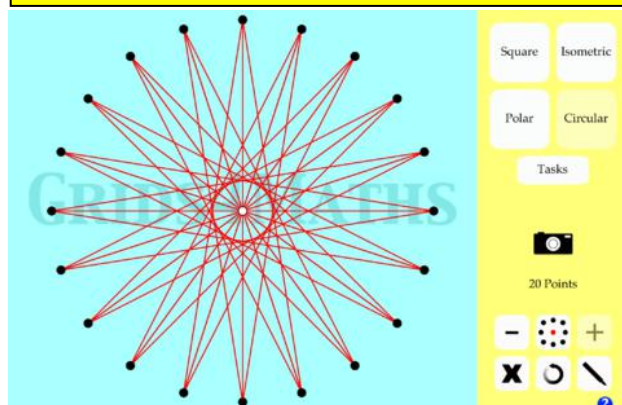
Number of grid points
Grid point size
Line thickness
Line colour

- GeoDraw offers users a choice of 5 grids for use in mathematics and D&T lessons. Send/export images with/without grid using: Bluetooth, Email, Facebook, Twitter and into Pages or Keynote.

Eligible for VPP discount
(see next page).

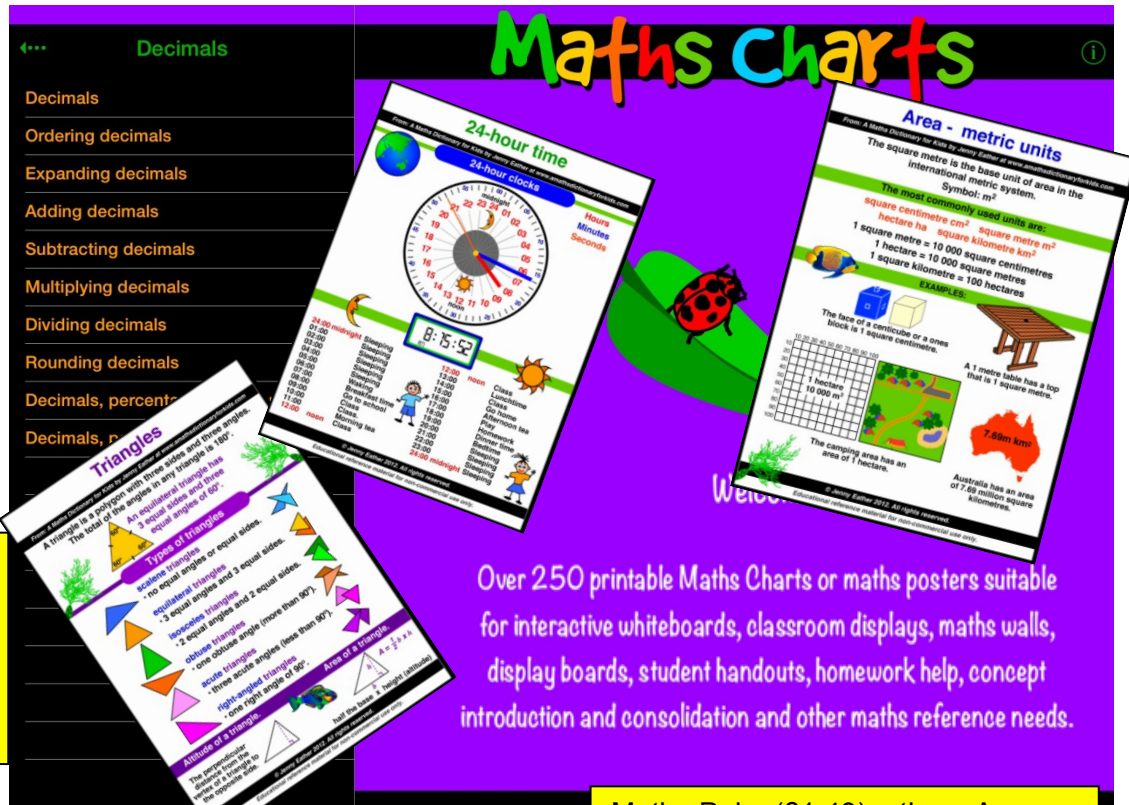


Randomised (79p): for probability lessons.
Age-ulator (free): for large number work and problem solving.
Grids4Maths (79p): much simpler version of GeoDraw for iPhones.



We've teamed up with Jenny Eather to bring her Maths Charts web resources to the iPad/iPhone. Try Maths Charts by Jenny Eather for free, then buy full Deluxe version for £3.99 (half this if you sign up for VPP with Apple and buy 20 or more copies).

Volume Purchase Programme (VPP) lets you buy Apple apps at discount rate of half price for 20 or more of the same app.



Over 250 printable Maths Charts or maths posters suitable for interactive whiteboards, classroom displays, maths walls, display boards, student handouts, homework help, concept introduction and consolidation and other maths reference needs.

$\frac{3}{8}$	$\frac{4}{5}$	$\frac{5}{8}$	$\frac{16}{36}$	$\frac{24}{30}$	$\frac{35}{63}$
$\frac{1}{9}$	$\frac{4}{9}$	$\frac{5}{9}$	$\frac{27}{36}$	$\frac{8}{72}$	$\frac{21}{56}$
$\frac{3}{5}$	$\frac{1}{7}$	$\frac{3}{4}$	$\frac{40}{64}$	$\frac{3}{21}$	$\frac{24}{40}$

Maths Pairs (£1.49) – three App bundle: eligible for VPP discount Directed Number, Equivalents and Multiplication Pairs (or 79p each).

7	x	1	=	Show
7	x	2	=	Show
7	x	3	=	Show
7	x	4	=	Show
7	x	5	=	Show
7	x	6	=	Show
7	x	7	=	Show
7	x	8	=	Show
7	x	9	=	Show
7	x	10	=	Show
7	x	11	=	Show
7	x	12	=	Show



Contact and further details:
In school training can be arranged to support implementation. www.jamtecstoke.co.uk
contact@jamtecstoke.co.uk

$64 \div 8$	$72 \div 12$	$48 \div 8$	9	6	5
$40 \div 8$	$70 \div 7$	$20 \div 4$	10	9	5
$72 \div 8$	$21 \div 3$	$81 \div 9$	8	6	7