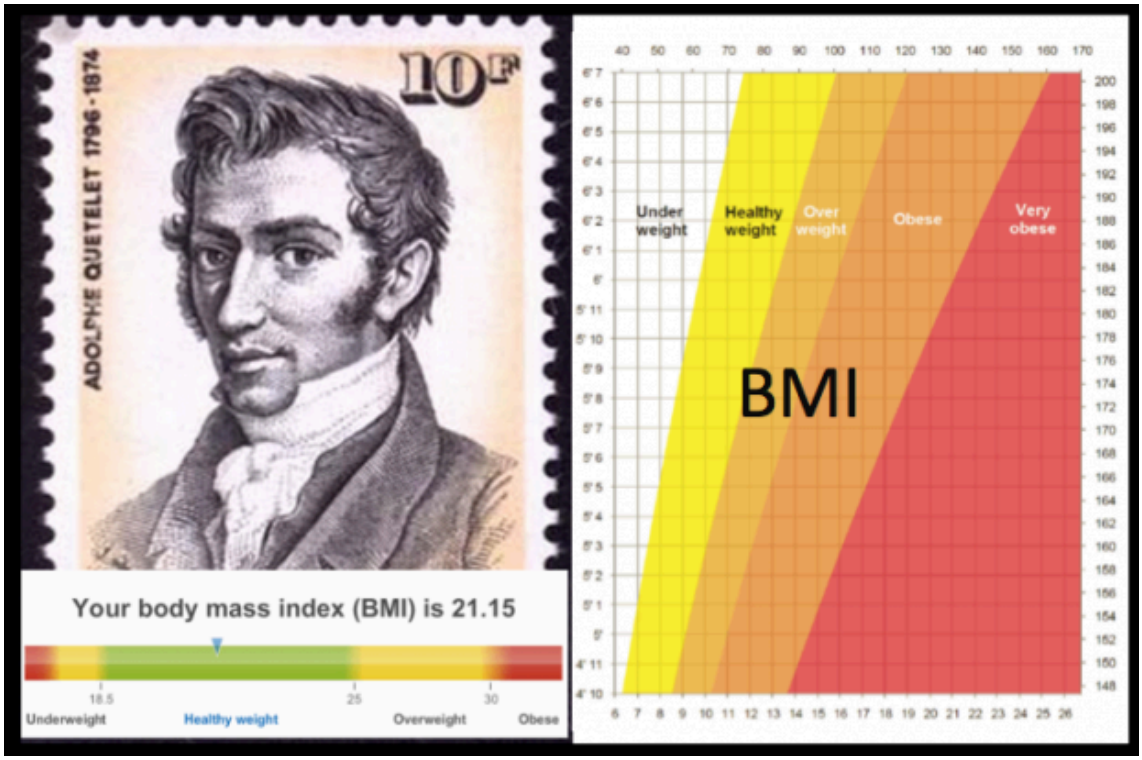
Body Mass Index (BMI)



A Spire Maths Activity

https://spiremaths.co.uk/

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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

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)

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

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.

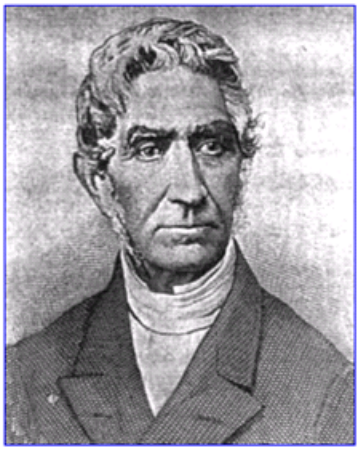
At http://schools-wikipedia.org/wp/b/Body_mass_index.htm the Schools Wikipedia Selection for BMI gives the date of invention between 1830 and 1850 by Quetelet, comments on its initial popularity in the early 1950s and 60s (when obesity first started to be an issue) and continues with a brief commentary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

Weight: ☐ lbs **Height:** ☐ feet ☐ inches Calculate

Weight: ☐ stones ☐ lbs **Height:** ☐ feet ☐ inches Calculate

Weight: ☐ kilograms **Height:** ☐ centimetres Calculate

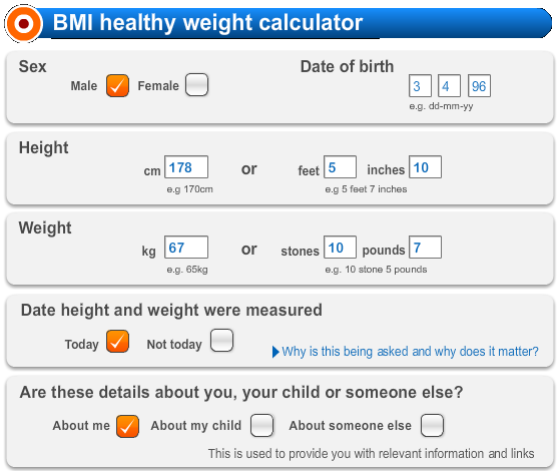
Body Mass or *Quetelet* Index: ☐

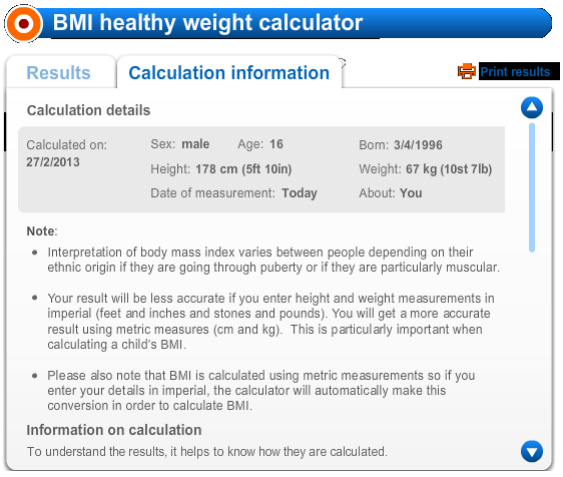


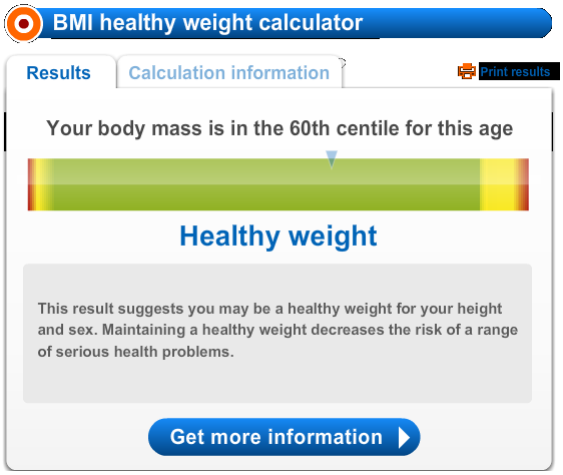
BMI healthy weight calculator (NHS version)

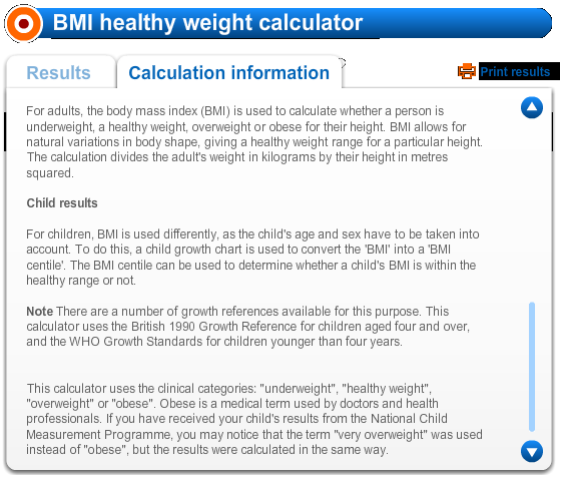
http://www.nhs.uk/Tools/Pages/Healthyweightcalculator.aspx

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)



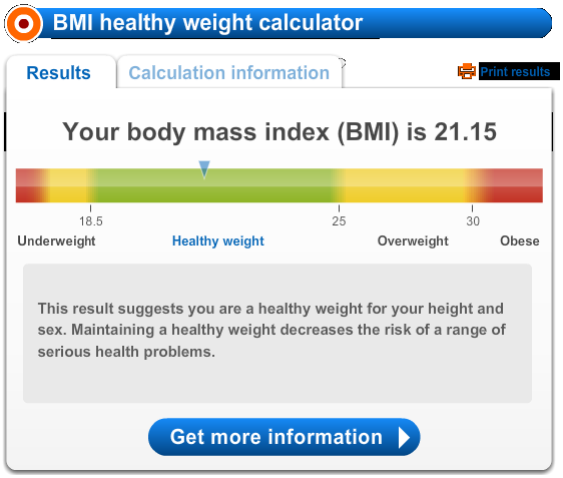






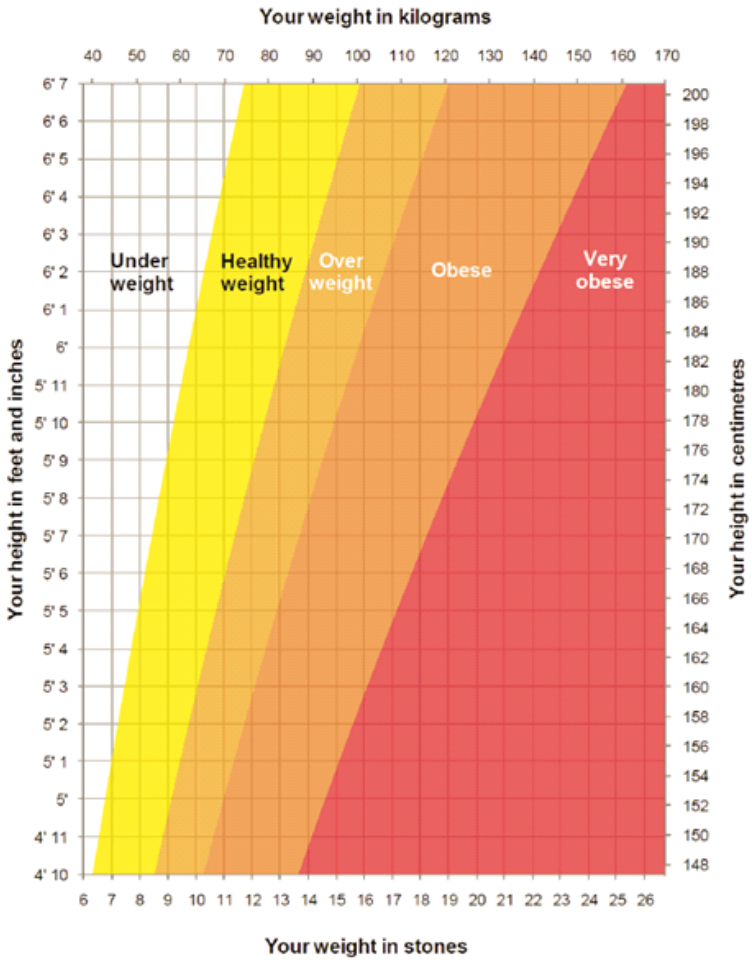
BODY MASS INDEX (BMI)

Version for adults



NHS BMI healthy chart for adults and BMI values

http://bit.ly/bminhsadultchart



BODY MASS INDEX (BMI)

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

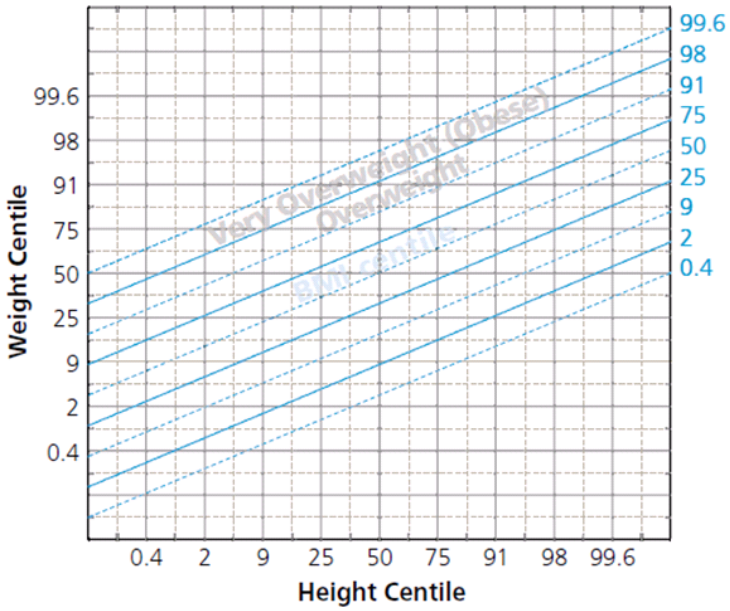
http://bit.ly/2-18boys
http://bit.ly/2-18girls

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 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.



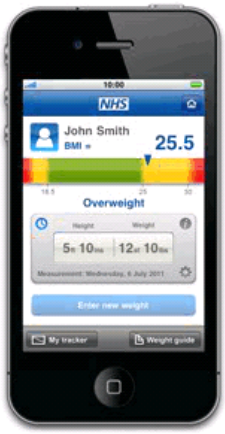
What does a high or low BMI mean?

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.

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

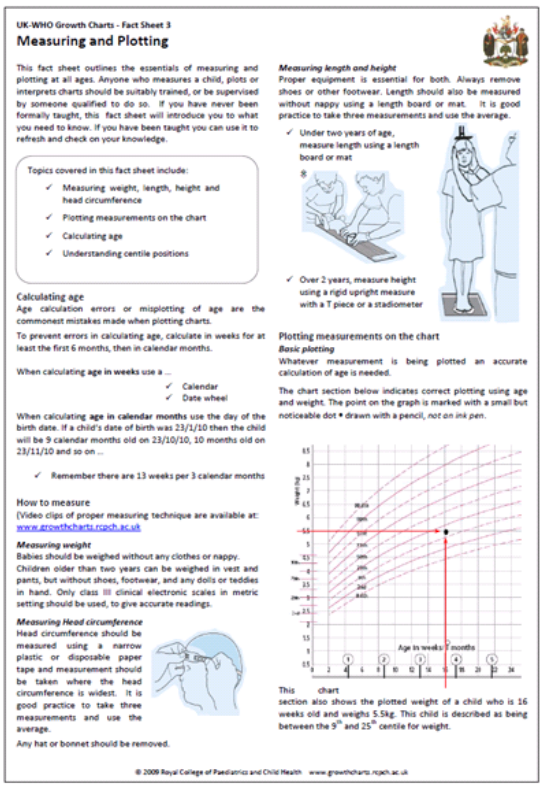
Download it now!

› 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%2001092010/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

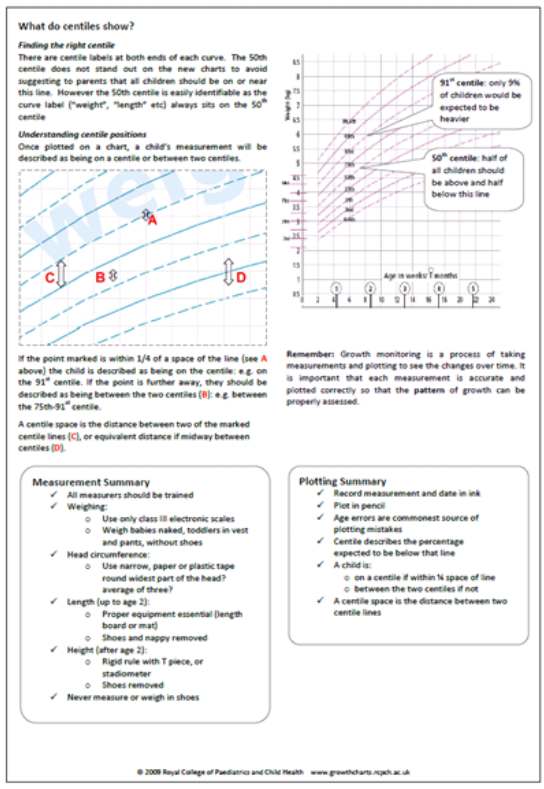
Basic plotting

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 5.5kg. 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.

If the point marked is within 1/4 of a space of the line (see A above) the child is described as being on the centile: e.g. on the 91st centile. If the point is further away, they should be described as being between the two centiles (B): e.g. between the 75th-91st centile.

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

91st centile: only 9% of children would be expected to be heavier

50th centile: half of all children should be above and half below this line

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.

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

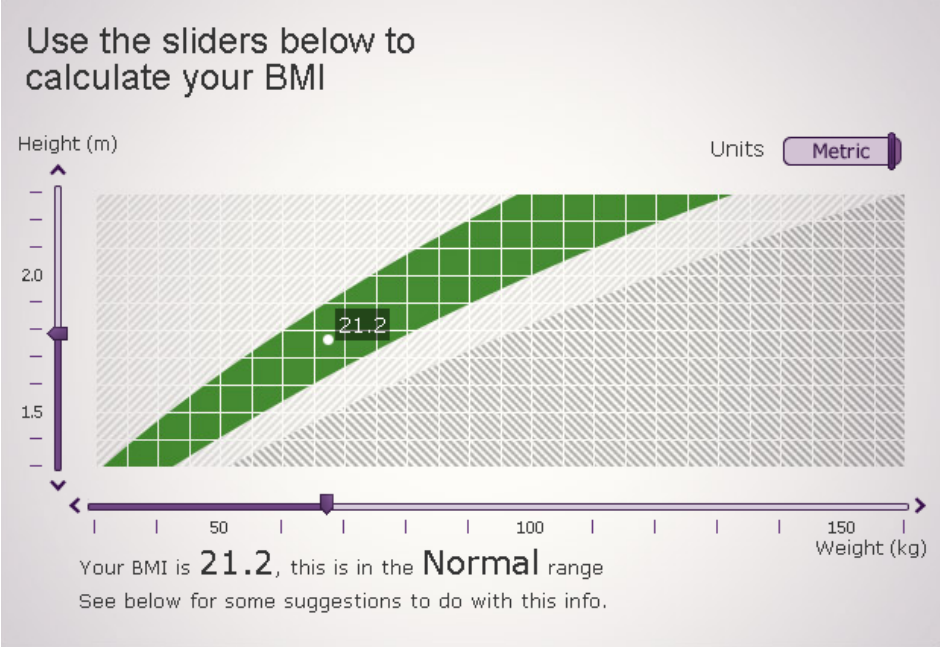
- ✓ Record measurement and date in ink
- ✓ Plot in pencil
- ✓ Age errors are commonest source of plotting mistakes
- ✓ Centile describes the percentage expected to be below that line
- ✓ A child is:
  - on a centile if within ¼ space of line
  - between the two centiles if not
- ✓ A centile space is the distance between two centile lines

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

BODY MASS INDEX (BMI)

BBC BMI Calculator

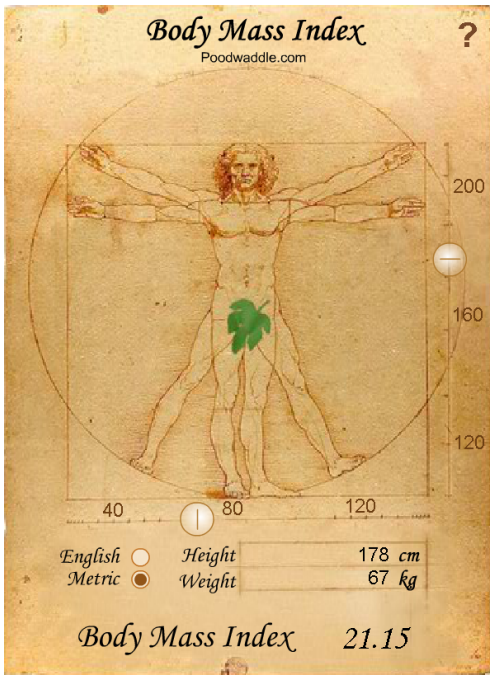
http://www.bbc.co.uk/health/tools/bmi_calculator/bmi.shtml



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.



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**
Height (inches)	**Body Weight (pounds)**																																			
58	91	96	100	105	110	115	119	124	129	134	138	143	148	153	158	162	167	172	177	181	186	191	196	201	205	210	215	220	224	229	234	239	244	248	253	258
59	94	99	104	109	114	119	124	128	133	138	143	148	153	158	163	168	173	178	183	188	193	198	203	208	212	217	222	227	232	237	242	247	252	257	262	267
60	97	102	107	112	118	123	128	133	138	143	148	153	158	163	168	174	179	184	189	194	199	204	209	215	220	225	230	235	240	245	250	255	261	266	271	276
61	100	106	111	116	122	127	132	137	143	148	153	158	164	169	174	180	185	190	195	201	206	211	217	222	227	232	238	243	248	254	259	264	269	275	280	285
62	104	109	115	120	126	131	136	142	147	153	158	164	169	175	180	186	191	196	202	207	213	218	224	229	235	240	246	251	256	262	267	273	278	284	289	295
63	107	113	118	124	130	135	141	146	152	158	163	169	175	180	186	191	197	203	208	214	220	225	231	237	242	248	254	259	265	270	278	282	287	293	299	304
64	110	116	122	128	134	140	145	151	157	163	169	174	180	186	192	197	204	209	215	221	227	232	238	244	250	256	262	267	273	279	285	291	296	302	308	314
65	114	120	126	132	138	144	150	156	162	168	174	180	186	192	198	204	210	216	222	228	234	240	246	252	258	264	270	276	282	288	294	300	306	312	318	324
66	118	124	130	136	142	148	155	161	167	173	179	186	192	198	204	210	216	223	229	235	241	247	253	260	266	272	278	284	291	297	303	309	315	322	328	334
67	121	127	134	140	146	153	159	166	172	178	185	191	198	204	211	217	223	230	236	242	249	255	261	268	274	280	287	293	299	306	312	319	325	331	338	344
68	125	131	138	144	151	158	164	171	177	184	190	197	203	210	216	223	230	236	243	249	256	262	269	276	282	289	295	302	308	315	322	328	335	341	348	354
69	128	135	142	149	155	162	169	176	182	189	196	203	209	216	223	230	236	243	250	257	263	270	277	284	291	297	304	311	318	324	331	338	345	351	358	365
70	132	139	146	153	160	167	174	181	188	195	202	209	216	222	229	236	243	250	257	264	271	278	285	292	299	306	313	320	327	334	341	348	355	362	369	376
71	136	143	150	157	165	172	179	186	193	200	208	215	222	229	236	243	250	257	265	272	279	286	293	301	308	315	322	329	338	343	351	358	365	372	379	386
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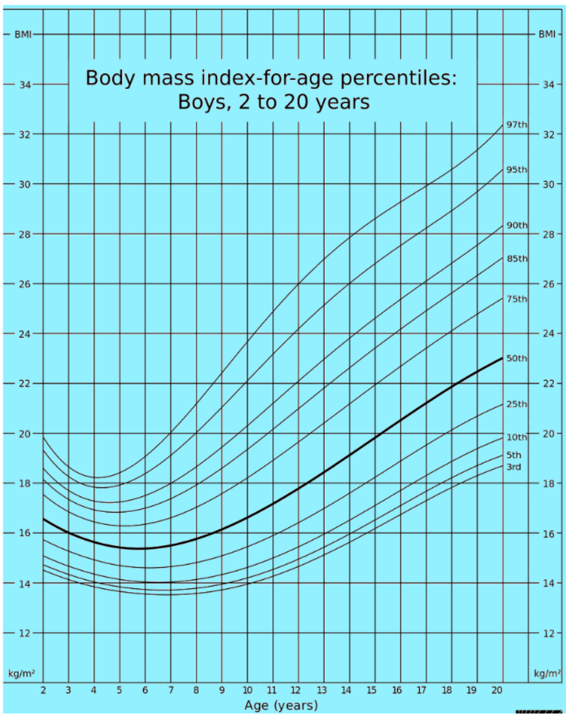
73	144	151	159	166	174	182	189	197	204	212	219	227	235	242	250	257	265	272	280	288	295	302	310	318	325	333	340	348	355	363	371	378	386	393	401	408
74	148	155	163	171	179	186	194	202	210	218	225	233	241	249	256	264	272	280	287	295	303	311	319	326	334	342	350	358	365	373	381	389	396	404	412	420
75	152	160	168	176	184	192	200	208	216	224	232	240	248	256	264	272	279	287	295	303	311	319	327	335	343	351	359	367	375	383	391	399	407	415	423	431
76	156	164	172	180	189	197	205	213	221	230	238	246	254	263	271	279	287	295	304	312	320	328	336	344	353	361	369	377	385	394	402	410	418	426	435	443

Source: Adapted from *Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults: The Evidence Report.*

CDC Growth Charts USA: Body mass index-for-age percentiles for boys, 2 to 20 years

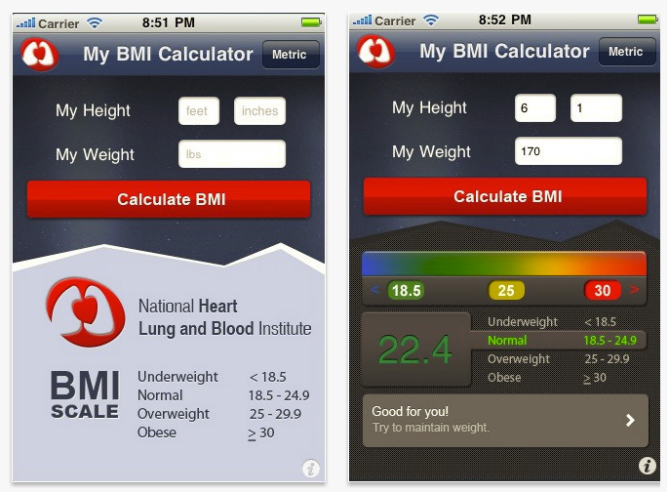
http://bit.ly/2-20chartboysusa http://bit.ly/2-20chartgirlsusa



BODY MASS INDEX (BMI)

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:

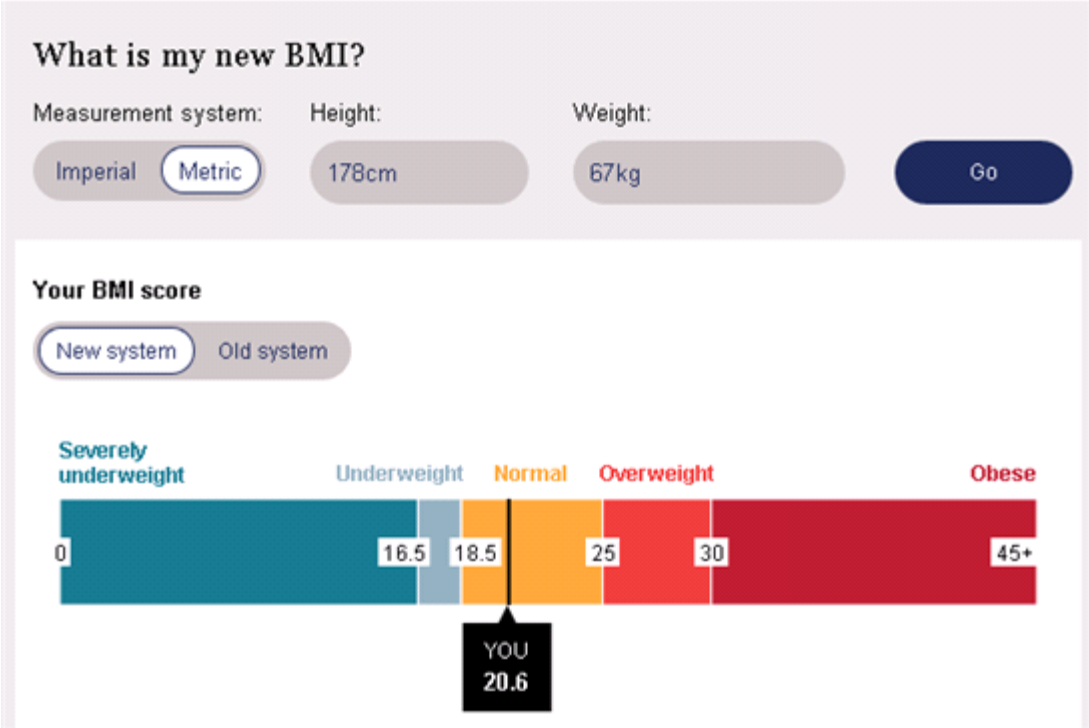
$$\frac{\text{weight}}{\text{height}^2}$$

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



The BMI debate

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

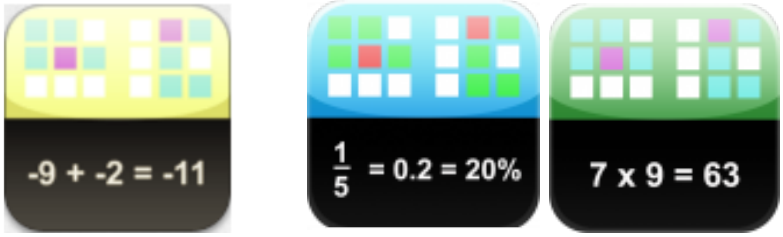
Both provided more comment on possible alternatives and problems with the original BMI. The former, which is more detailed and complicated, comments that Quetelet suggested using an exponent of between 2.3 and 2.7 rather than the 2 that was obviously used for simplicity.

Our Other Mathematics Resources

Lesson ideas and resources can be found at
www.spiremaths.co.uk

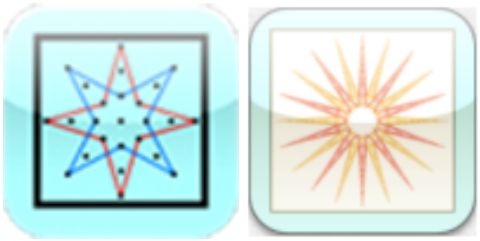
Our iPad and iPhone resources

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

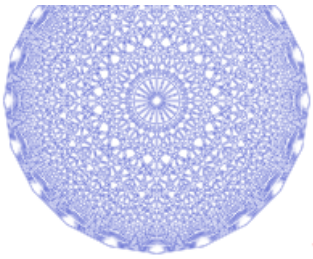
Half price for volume purchase of some Education APPs

Maths APPs for iPads and iPhones

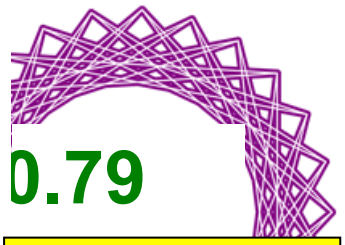
GeoDraw

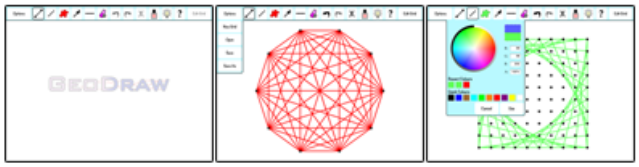
Available on iPad iOS 5.0 or later!

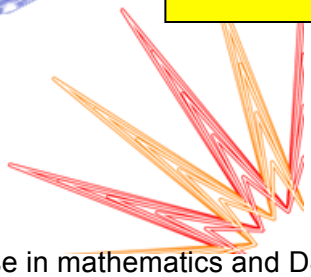
(iPad only)



Grids
Circular
Isometric: horizontal
Isometric: vertical
Polar
Square



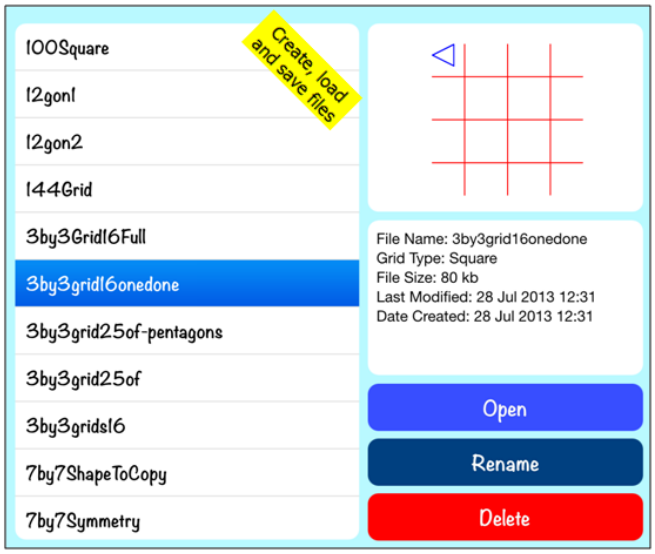


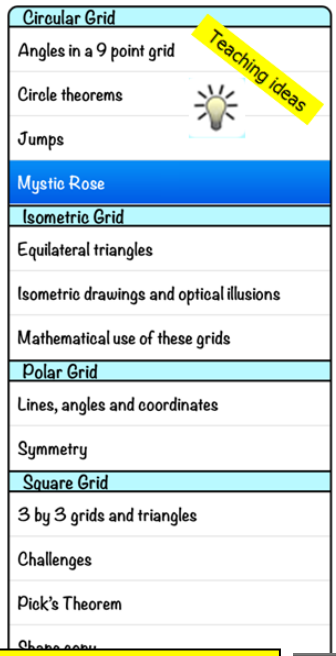


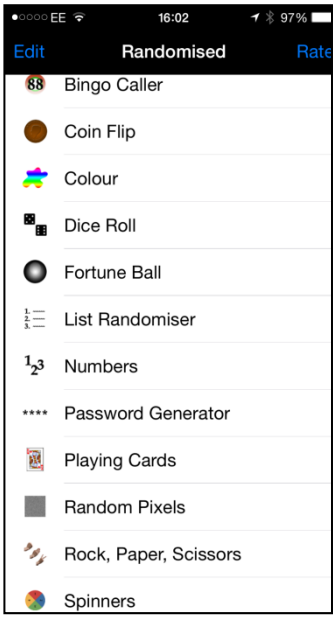
Change
Number of grid points
Grid point size
Line thickness
Line colour

- 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.

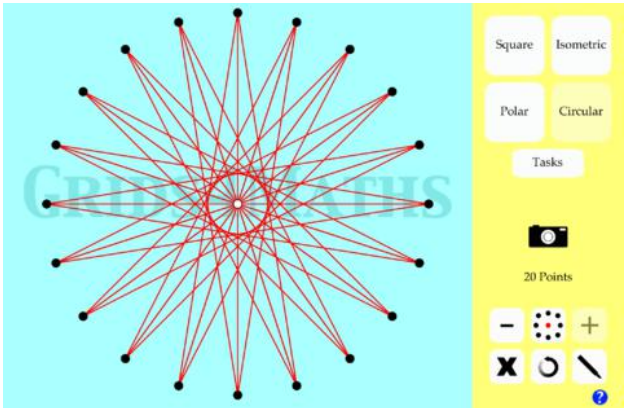
Eligible for VPP discount (see next page).

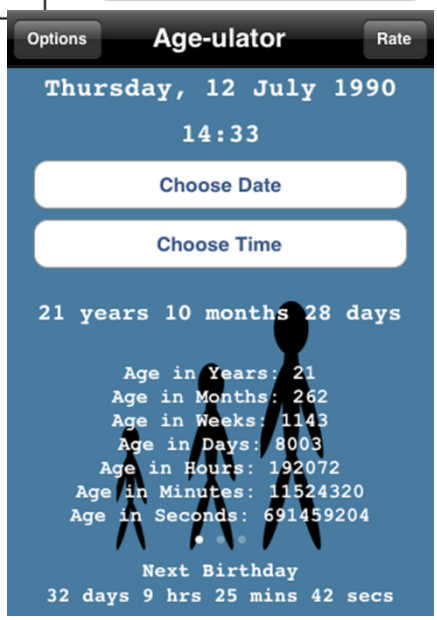






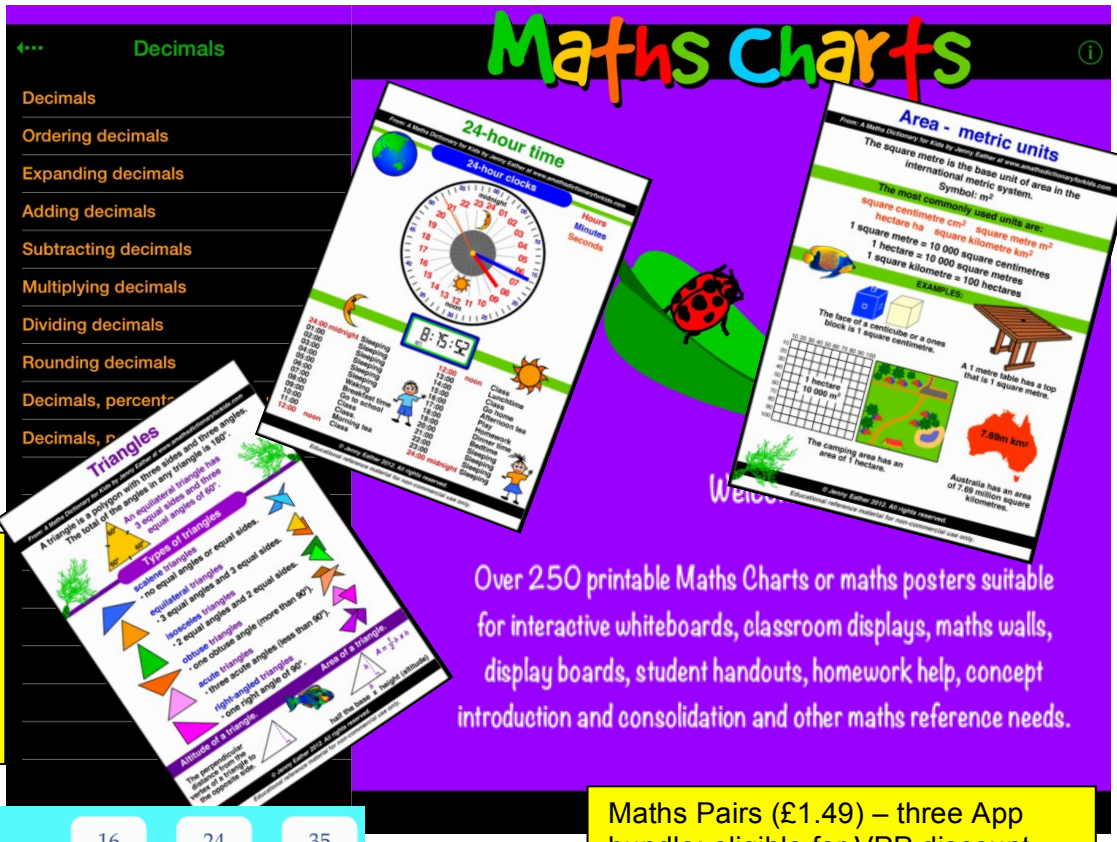
Randomised (79p): for probability lessons.
Age-ulator (free): for large number work and problem solving.
Grids4Maths (79p): much simpler version of GeoDraw for iPhones.



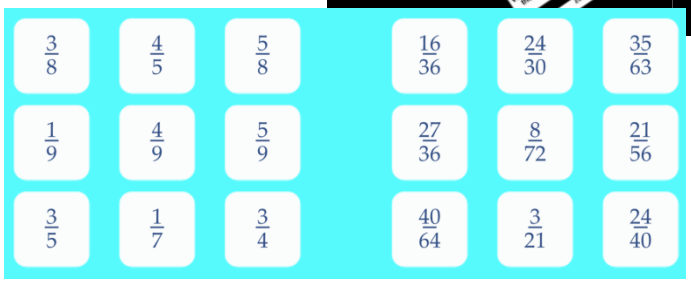


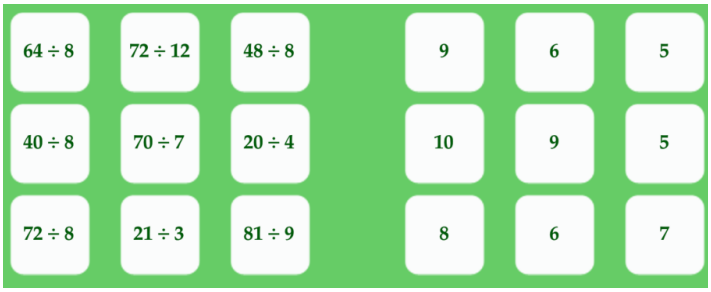
We've teamed up with Jenny Eather to bring her Maths Charts web resources to the iPad/iPhone.
Try Maths Charts by Jenny Eather for free, then buy full Deluxe version for £3.99 (half this if you sign up for VPP with Apple and buy 20 or more copies).

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



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





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