

Why are people so excited about Wolfram|Alpha?

Because it lets you go beyond what you've gotten used to asking a computer.

Wolfram|Alpha is not a search engine. Search engines work very well when you need to look something up: if it exists, they will find it for you.

The “if it exists” part is the catch, because the most interesting questions are often those that have not been asked before, or whose answers have never been written down. And if it's not written down on someone's web page, a search engine is not going to find it.

Search engines are a bit like a parent who refuses to do your homework for you, and instead tells you where you can look up the facts you need, then expects you to put them together to work out the answer yourself. It's a fine teaching technique, but can get pretty annoying if you really just want the answer.

Say you're writing an article about Japan's economy and you want to compare it to the EU. If Japan were an EU country, what percentage of this hypothetical expanded EU's GDP would it represent? You could use a search engine to look up Japan's GDP and then look up the EU's GDP, but no search engine is going to tell you the GDP of a hypothetical combined EU + Japan—that's math you'd have to do yourself (and don't forget currency conversion problems).

If you ask Wolfram|Alpha the same question, it tells you straight out that Japan's GDP would be 23% of that of the hypothetical combined entity.



The screenshot shows the Wolfram|Alpha interface. At the top is the logo with a red starburst and the text "WolframAlpha™ computational... knowledge engine". Below the logo is a search bar containing the query "gdp of Japan / (gdp of Japan + EU)". The search bar has a blue equals sign icon on the right. Below the search bar is a section for "Input interpretation:" with the text "Mathematica form" on the right. The input is shown as a fraction:
$$\frac{\text{Japan GDP}}{\text{Japan GDP} + \text{European Union GDP}}$$
 Below the input section is a "Result:" section with the text "Show details" on the right. The result is "0.207 (2007 estimate)". At the bottom of the interface, there are three links: "Computed by: Wolfram Mathematica", "Source information »", and "Download as: PDF | Live Mathematica".

Wolfram|Alpha did the math, and it automatically factored in today's currency conversion rates (which you would have had to look up separately if you were using a search engine). Think about it: Wolfram|Alpha just answered a question that had not been asked before, and gave an answer that could not be not found by any search engine.

Would Japan be the biggest country in the EU + Japan? Let's ask which country has the biggest GDP in the EU.



biggest gdp in EU =


Input Interpretation:

biggest country	
by	GDP
in	European Union

Result by GDP:

1	Germany	\$3.317 trillion per year (US dollars per year)
2	United Kingdom	\$2.768 trillion per year (US dollars per year)
3	France	\$2.546 trillion per year (US dollars per year)

It's Germany, so how does Germany's GDP compare to that of Japan?



gdp Japan vs. Germany

Input interpretation: Mathematica form

Japan	GDP
Germany	

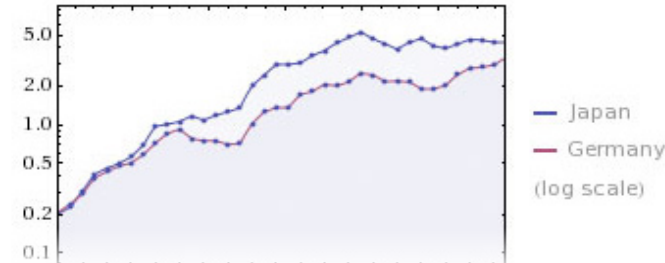
Result:

Japan	\$4.38 trillion per year (US dollars per year)
Germany	\$3.317 trillion per year (US dollars per year)

Relative values: Reverse

	visual	ratios		comparisons
Japan		1.32	1	32.02% larger
Germany		1	0.757	24.25% smaller

GDP history: Linear scale

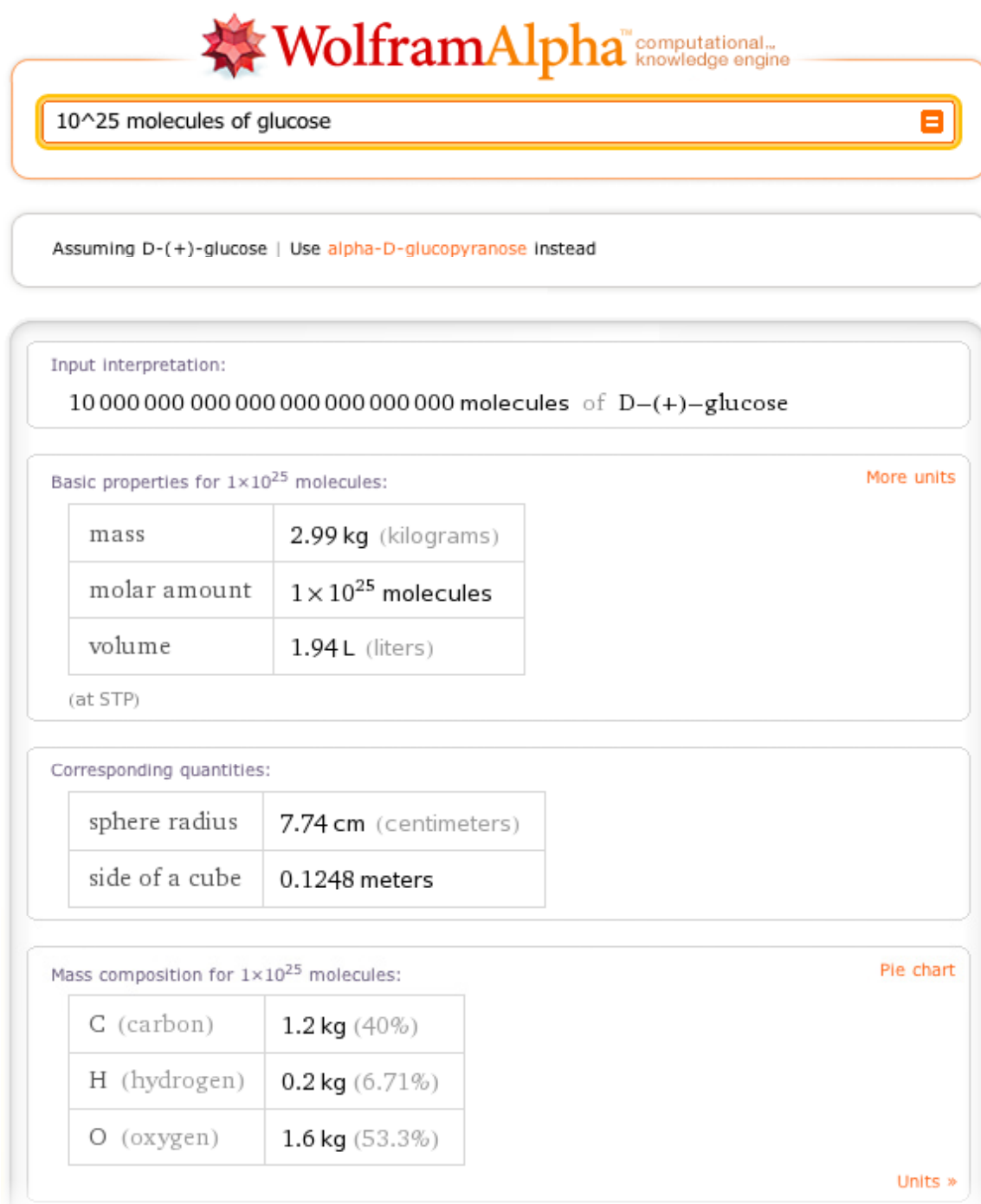


— Japan
— Germany
(log scale)

Well, it looks like in the 1970's they were about the same, but now Japan is over 50% bigger. You can finish your article now: if Japan were to join the EU, it would be the biggest member, one and a half times as large as Germany, and would represent over 23% of the EU's total GDP.

Notice that we didn't ask Wolfram|Alpha a big wordy question like "What percentage of GDP would Japan be in a hypothetical combined EU and Japan?" That doesn't work any better in Wolfram|Alpha than it does in a search engine. Instead, just as you learn to use a search engine effectively by putting in the right combination of keywords, you learn to use Wolfram|Alpha by distilling your question into one or more facts and relationships between them.

In many subject areas Wolfram|Alpha can take a question almost exactly as you would naturally encounter it. Let's try a more technical example. A typical chemistry homework assignment might ask for the weight of 10^{25} molecules of glucose. That's something you can enter verbatim, and read the answer right off the results page, along with a dozen other interesting things, not about glucose in general, but about that specific quantity of glucose.



WolframAlpha™ computational... knowledge engine

Assuming D-(+)-glucose | Use [alpha-D-glucopyranose](#) instead

Input interpretation:
10 000 000 000 000 000 000 000 000 000 molecules of D-(+)-glucose

Basic properties for 1×10^{25} molecules: [More units](#)

mass	2.99 kg (kilograms)
molar amount	1×10^{25} molecules
volume	1.94 L (liters)

(at STP)

Corresponding quantities:

sphere radius	7.74 cm (centimeters)
side of a cube	0.1248 meters

Mass composition for 1×10^{25} molecules: [Pie chart](#)


C (carbon)	1.2 kg (40%)
H (hydrogen)	0.2 kg (6.71%)
O (oxygen)	1.6 kg (53.3%)

[Units »](#)

To get this answer, Wolfram|Alpha had to combine its knowledge of Avogadro's number with the molecular weight of glucose, and also know which formula to use to combine those facts to give the final answer. A search engine would have forced you to figure out all those things yourself, and would have given you information only about glucose in general, not about the specific amount you asked about.

Of course Wolfram|Alpha is far more than a tool for doing chemistry homework. Because it knows facts and relationships in so many areas of human knowledge, Wolfram|Alpha can make these sorts of inferences, and generate real answers, using data as diverse as the temperature in Madrid (right now, in real time) how old Barack Obama was in 1975 —both questions you can ask Wolfram|Alpha directly.

Wolfram|Alpha knows geography. Give it three cities and it will compare and contrast them for you.


computational...
knowledge engine

London Chicago Quito⊞


Assuming London (United Kingdom) | Use London (Canada) or more instead

Input interpretation: Mathematica form
London, United Kingdom | Chicago, Illinois | Quito, Pichincha, Ecuador

Populations:

	city population	metro area population
London	7.421 million people	12.58 million people
Chicago, Illinois	2.843 million people	9.278 million people
Quito, Pichincha	1.4 million people	1.595 million people

Path: Show shortest path



Distance: Show metric units | Show all distances

	distance	flight time
--	----------	-------------

Wolfram|Alpha knows space. Type in “moon” and it will tell you the distance from the Earth to the Moon. But it’s not just the average distance you would find with a search engine, it’s the actual distance right now, which varies from hour to hour.



moon



Assuming "moon" is an astronomical object | Use as a general topic or a word instead

Input interpretation:

[Mathematica form](#)

Moon

Orbital properties:

[Show metric units](#) | [More](#)

current distance from Earth	251 163 miles \approx 1.348 light seconds
average distance from Earth	239 200 miles \approx 1.284 light seconds
orbital period	27.303 days
mass	7.3459×10^{22} kg (kilograms) \approx 0.012296 M_{\oplus} (Earth masses)
radius	1079.6 miles \approx 0.27241 R_{\oplus} (equatorial radii of Earth)
rotation period	27.322 days

Current phase of the Moon:

[Show unoriented](#)



waning gibbous moon
59.80% illuminated

If you ask about the International Space Station, Wolfram|Alpha tells you what direction in the sky to look for it from where you are currently located.



ISS



Assuming "ISS" is a spacecraft | Use as [an airport](#) instead

Input interpretation:

International Space Station (spacecraft)

Current position:

[Show DMS](#) | [Show 3D](#) | [Orthographic projection](#)



51.43° North 76.79° West (Canada)

Current orbital information:

[Show metric units](#) | [More](#)

altitude	228.8 miles
instantaneous velocity	17 202 mph
average velocity	17 214 mph (miles per hour)
average altitude	225.8 miles
orbital period	91.59 minutes
inclination	51.64°
orbit type	LEO (low Earth orbit)

[Units >](#)

Wolfram|Alpha knows weather, both yours and everyone else's. If you ask what the air temperature is, it tells you your air temperature, using the nearest available weather reporting station, and up to date to within a few minutes.



air temperature



Input interpretation:

weather

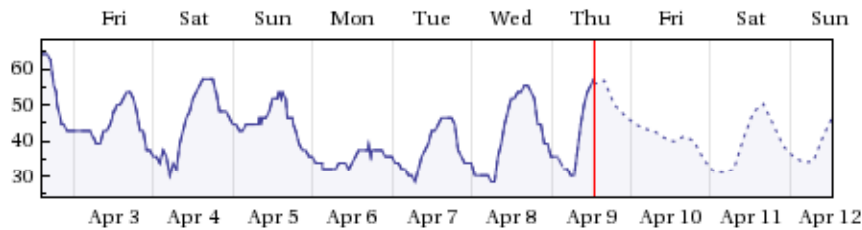
temperature

Result:

57 °F

History and forecast:

[24 hrs](#) | [Month](#) | [Year](#) | [5](#) | [10](#) | [All](#) | [Show metric](#)



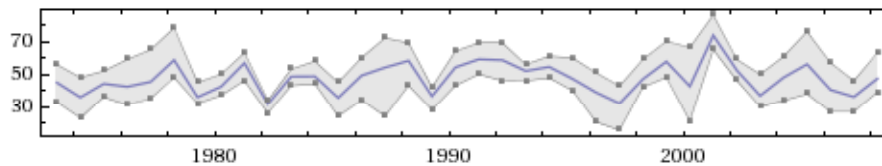
minimum: 28 °F
Wed, Apr 8, 7:00 am, ...

average: 43 °F

maximum: 64 °F
Thu, Apr 2, 1:00 pm, ...

Historical temperatures for April 9:

[Show table](#) | [Show metric](#)



minimum: 16 °F
Apr 1997

average: 47 °F

maximum: 86 °F
Apr 2001

(not corrected for changes in local weather station environment)

Weather station information:

[Show metric units](#) | [More](#)

name	KCMI (Willard)
relative position	5 mi S (from center of Champaign)
relative elevation	16 feet (above center of Champaign)
local time	2:50:08 pm EDT Thursday, April 9, 2009

If you want to know the weather at some other time or place, just ask.



weather Jan 20th, 2009, noon, Washington, DC



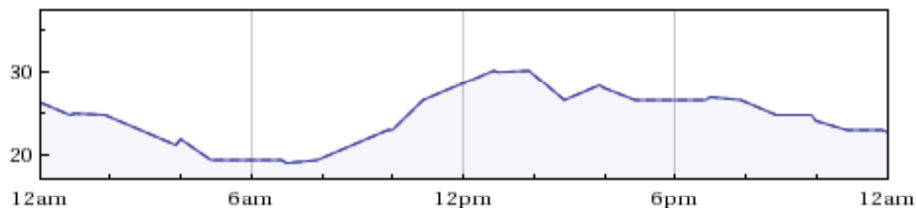
Input interpretation:

weather	Washington, District Of Columbia
	12:00:00 pm CST Tuesday, January 20, 2009

Weather history:

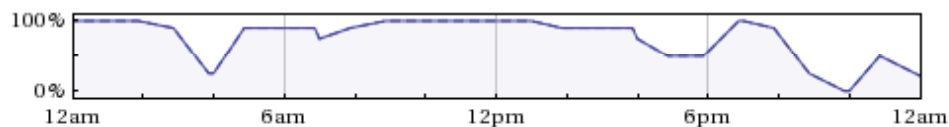
[Week](#) | [Show metric](#) | [More](#)

Temperature:



minimum: 19 °F Wed, Jan 21, 7:00 am, ... average: 27 °F maximum: 36 °F Mon, Jan 19, 12:45 pm, ...

Cloud cover:



overcast: 33.2% (7.6 hours) | clear: 4.6% (1.1 hours)

Conditions:

(no precipitation or fog)

Weather station information:

[Show metric units](#) | [More](#)

name	KDCA (National)
relative position	4 mi S (from center of Washington)
relative elevation	43 feet (above center of Washington)
local time	4:55:23 pm EDT Friday, April 10, 2009
local sunlight	sun is above the horizon azimuth: 254° (WSW) altitude: 31°

[Satellite image](#) » | [Units](#) »

How do hurricanes Katrina and Andrew compare? Any time you give Wolfram|Alpha two concepts, it tries to compare and contrast them for you, using facts, figures, or maps.



hurricane Katrina, hurricane Andrew



Assuming Katrina (2005) | Use [Katrina \(1981\)](#) or [more](#) Instead

Input Interpretation:

Katrina (hurricane)Comment | Andrew (hurricane)Comment

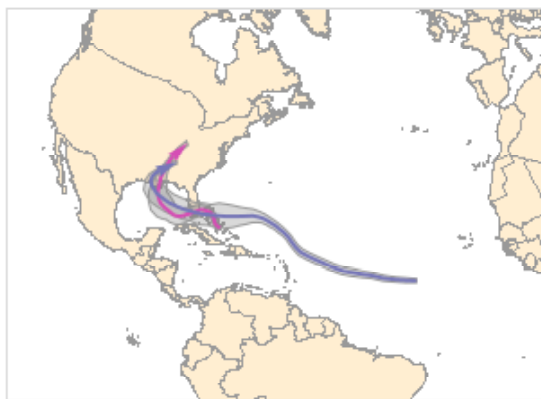
Properties:

[Show metric units](#) | [More](#)

	Katrina (hurricane)	Andrew (hurricane)
start date	Tuesday August 23, 2005 <small>(3.6 years ago)</small>	Sunday August 16, 1992 <small>(16.7 years ago)</small>
end date	Wednesday August 31, 2005	Friday August 28, 1992
duration	7 days	11 days
maximum wind speed	150 mph <small>(August 28, 2005)</small>	150 mph <small>(August 23, 1992)</small>
storm type	hurricane <small>(category 5)</small>	hurricane <small>(category 5)</small>

[Units »](#)

Storm path:



— Katrina 2005

— Andrew 1992

(track width indicates wind speed of storm)

Wolfram|Alpha knows math. Put in a function and you get a nice show and tell about it.



$x^3 \sin(4x)$



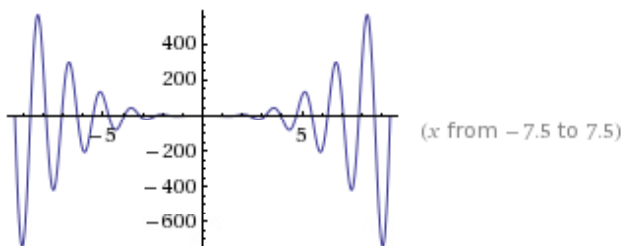
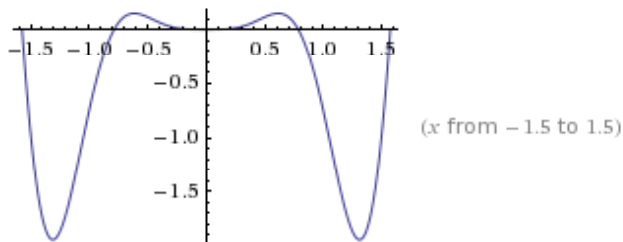
Assuming multiplication | Use a list instead

Input:

$x^3 \sin(4x)$

Mathematica form

Plots:



Alternate forms:

$$4x^3 \sin(x) \cos^3(x) - 4x^3 \sin^3(x) \cos(x)$$

$$8x^3 \sin\left(\frac{\pi}{4} - x\right) \sin(x) \sin\left(x + \frac{\pi}{4}\right) \cos(x)$$

$$\frac{1}{2} i e^{-4ix} x^3 - \frac{1}{2} i e^{4ix} x^3$$

Roots:

$$x = 0$$

$$x = \frac{\pi n}{4}, \quad n \in \mathbf{Z}$$

\mathbf{Z} is the set of integers »

If you want something more specific, tell Wolfram|Alpha what you'd like to do with the formula, say, for example, integrate it.



integrate $x^3 \sin(4x)$



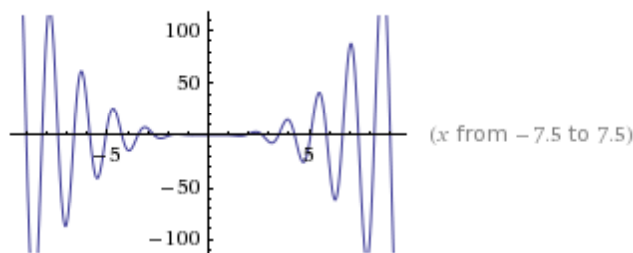
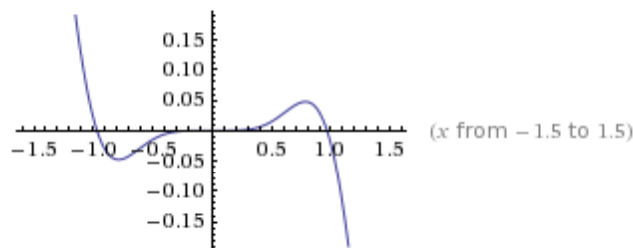
Indefinite Integral:

[Show steps](#)

$$\int x^3 \sin(4x) dx =$$

$$\frac{3}{128} (8x^2 - 1) \sin(4x) - \frac{1}{32} x (8x^2 - 3) \cos(4x) + \text{constant}$$

Plots of the Integral:



Alternate forms of the integral:

$$\frac{1}{128} (-32x^3 \cos(4x) + 24x^2 \sin(4x) - 3 \sin(4x) + 12x \cos(4x)) + \text{constant}$$

$$\frac{3}{256} i (e^{-4ix} - e^{4ix}) (8x^2 - 1) - \frac{1}{64} (e^{-4ix} + e^{4ix}) x (8x^2 - 3) + \text{constant}$$

$$-\frac{1}{4} x^3 \sin^4(x) - \frac{1}{4} x^3 \cos^4(x) + \frac{3}{2} x^3 \sin^2(x) \cos^2(x) + \frac{3}{4} x^2 \sin(x) \cos^3(x) -$$

$$\frac{3}{4} x^2 \sin^3(x) \cos(x) + \frac{3}{32} x \sin^4(x) + \frac{3}{32} x \cos^4(x) -$$

$$\frac{3}{32} \sin(x) \cos^3(x) - \frac{9}{16} x \sin^2(x) \cos^2(x) + \frac{3}{32} \sin^3(x) \cos(x) + \text{constant}$$

Not sure how that integral was done? Use the Show Steps button to find out.



integrate $x^3 \sin(4x)$



Indefinite integral:

[Hide steps](#)

$$\int x^3 \sin(4x) dx =$$

$$\frac{3}{128} (8x^2 - 1) \sin(4x) - \frac{1}{32} x (8x^2 - 3) \cos(4x) + \text{constant}$$

Possible intermediate steps:

$$\int x^3 \sin(4x) dx$$

For the integrand $x^3 \sin(4x)$, integrate by parts, $\int f dg = fg - \int g df$, where

$$f = x^3, \quad dg = \sin(4x)dx,$$
$$df = 3x^2 dx, \quad g = -\frac{1}{4} \cos(4x):$$

$$= \frac{3}{4} \int x^2 \cos(4x) dx - \frac{1}{4} x^3 \cos(4x)$$

For the integrand $x^2 \cos(4x)$, integrate by parts, $\int f dg = fg - \int g df$, where

$$f = x^2, \quad dg = \cos(4x)dx,$$
$$df = 2x dx, \quad g = \frac{1}{4} \sin(4x):$$

$$= -\frac{1}{4} x^3 \cos(4x) + \frac{3}{16} x^2 \sin(4x) - \frac{3}{8} \int x \sin(4x) dx$$

For the integrand $x \sin(4x)$, integrate by parts, $\int f dg = fg - \int g df$, where

$$f = x, \quad dg = \sin(4x)dx,$$
$$df = dx, \quad g = -\frac{1}{4} \cos(4x):$$

$$= -\frac{1}{4} x^3 \cos(4x) + \frac{3}{16} x^2 \sin(4x) + \frac{3}{32} x \cos(4x) - \frac{3}{32} \int \cos(4x) dx$$

For the integrand $\cos(4x)$, substitute $u = 4x$ and $du = 4dx$:

$$= -\frac{3}{128} \int \cos(u) du - \frac{1}{4} x^3 \cos(4x) + \frac{3}{16} x^2 \sin(4x) + \frac{3}{32} x \cos(4x)$$

The integral of $\cos(u)$ is $\sin(u)$:

$$= -\frac{3 \sin(u)}{128} - \frac{1}{4} x^3 \cos(4x) + \frac{3}{16} x^2 \sin(4x) + \frac{3}{32} x \cos(4x) + \text{constant}$$

Substitute back for $u = 4x$:

$$= \frac{1}{128} (3(8x^2 - 1) \sin(4x) - 4x(8x^2 - 3) \cos(4x)) + \text{constant}$$

Which is equal to:

$$= \frac{3}{128} (8x^2 - 1) \sin(4x) - \frac{1}{32} x (8x^2 - 3) \cos(4x) + \text{constant}$$

Wolfram|Alpha knows health and nutrition. If you're a 38-year-old male with a total cholesterol level of 200, how does that compare to the average?



male 38 cholesterol 200

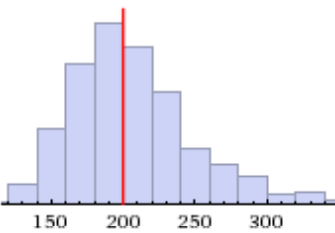


Input interpretation:

	200 mg/dL (milligrams per deciliter)
serum total cholesterol	male
	(33 to 43) years

Reference distribution:

[More](#)

95% reference range	(139 to 296) mg/dL
$\pm 1\sigma$ range	(163 to 244) mg/dL
distribution	
fraction below	51.6% of population
fraction above	48.4% of population
data sample size	419 people

(data from NHANES 2006 study, weighted for USA demographics)


[Units »](#)

Computed by: [Wolfram Mathematica](#)

[Source information »](#)

Download as: [PDF](#) | [Live Mathematica](#)

If you eat a Big Mac, how many more calories is that compared to a yogurt?



calories big mac / yogurt

Assuming any form of Breyers Strawberry Yogurt | Use a specific form [more](#) Instead
Assuming McDonald's Big Mac serving size of 1 Item (219 g) | Use [1 standard measure \(100 g\)](#) Instead
Assuming serving size of 1 standard measure (100 g)

Input Interpretation:

1	item	McDonald's Big Mac	total calories	/
1	standard measure	Breyers Strawberry Yogurt	total calories	

Result: **5.863** [Show details](#)

Computed by: [Wolfram Mathematica](#) [Source information »](#) Download as: [PDF](#) | [Live Mathematica](#)

Notice that for a relatively vague question, such as this one, Wolfram|Alpha made a number of automatic assumptions for you, such as what kind of yogurt and how much of it. The Assuming lines let you choose from different brands and serving sizes. (A Big Mac, on the other hand, is a standard object the world over, and requires no further clarification.)

Wolfram|Alpha can return results in many forms, not just tables and maps. If you want to know what it's like having 20/100 vision, Wolfram|Alpha will show you a picture.

The screenshot shows the Wolfram|Alpha interface with the search query "20/100 vision". The results are organized into several sections:

- Input Interpretation:** Shows the input "visual acuity 20/100".
- Approximate corrective prescription:** Displays "- 1.75 diopters (diverging lens)" and "(assuming spherical correction)". A "Show optical data" link is visible.
- Uncorrected appearance of Snellen chart:** Indicates "(legible to line 2)".

The Snellen chart is displayed with the following lines of letters and their corresponding visual acuity values:

E	20/200
F P	20/100
T O Z	20/70
L P E D	20/50
P R O P D	20/40
S P P O P	20/30
P E L O P D	20/25
S P P O P	20/20
S P P O P	20/15

At the bottom, it notes "Standard Snellen chart conditions at 20 feet".

We hope that these examples have given you a flavor of what Wolfram|Alpha can do. It's important to realize that while Wolfram|Alpha doesn't know everything about everything, it is not a bag of tricks. Wolfram|Alpha's knowledge is deep and broad in the areas it covers, and growing every day. The underlying technology and algorithms are applicable to virtually any area of human endeavor.

The consistent theme is that Wolfram|Alpha tries to give you the answer, not references or hints about where you might find it. Try any of the examples above in your favorite search engine and see how well it does. Do you get the answer, or a nagging series of half answers? A search engine gives you information, but Wolfram|Alpha gives you the answer.