Your Brain Runs on Glucose

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Symptoms of Mental Tiredenss

From the survey:

- Sleepy
- Difficult to concentrate
- Easy to forget things
- Having trouble to function properly
- Low productivity
- Low creativity
- Easy to make mistakes
- Feeling stressed

How to Combat Mental Tiredness?

From the survey:

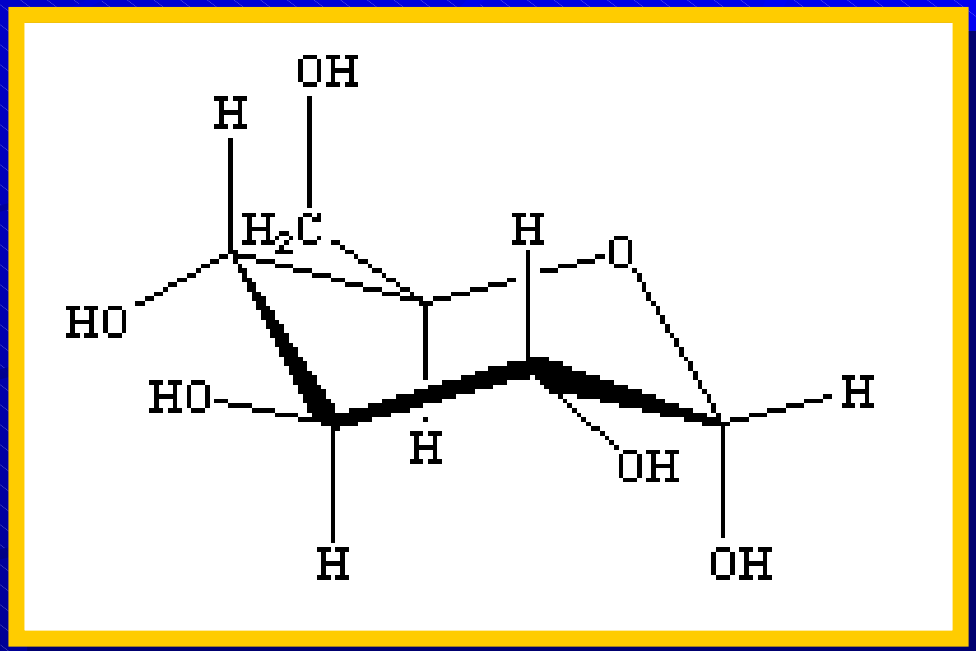
- Have a drink
- Take a walk outside the office
- Wash the face
- Take a nap
- Have some snacks
- Do some exercises
- Others

What is Glucose?

A sugar in our blood and a source of energy for our bodies.

(Center for Disease Control and Prevention, USA)

What is Glucose?



Chemical structure of glucose

- A form of carbohydrate
- Monosaccharide – a single molecule sugar
- 3.4 kcal / gram

Sources of Glucose in Foods

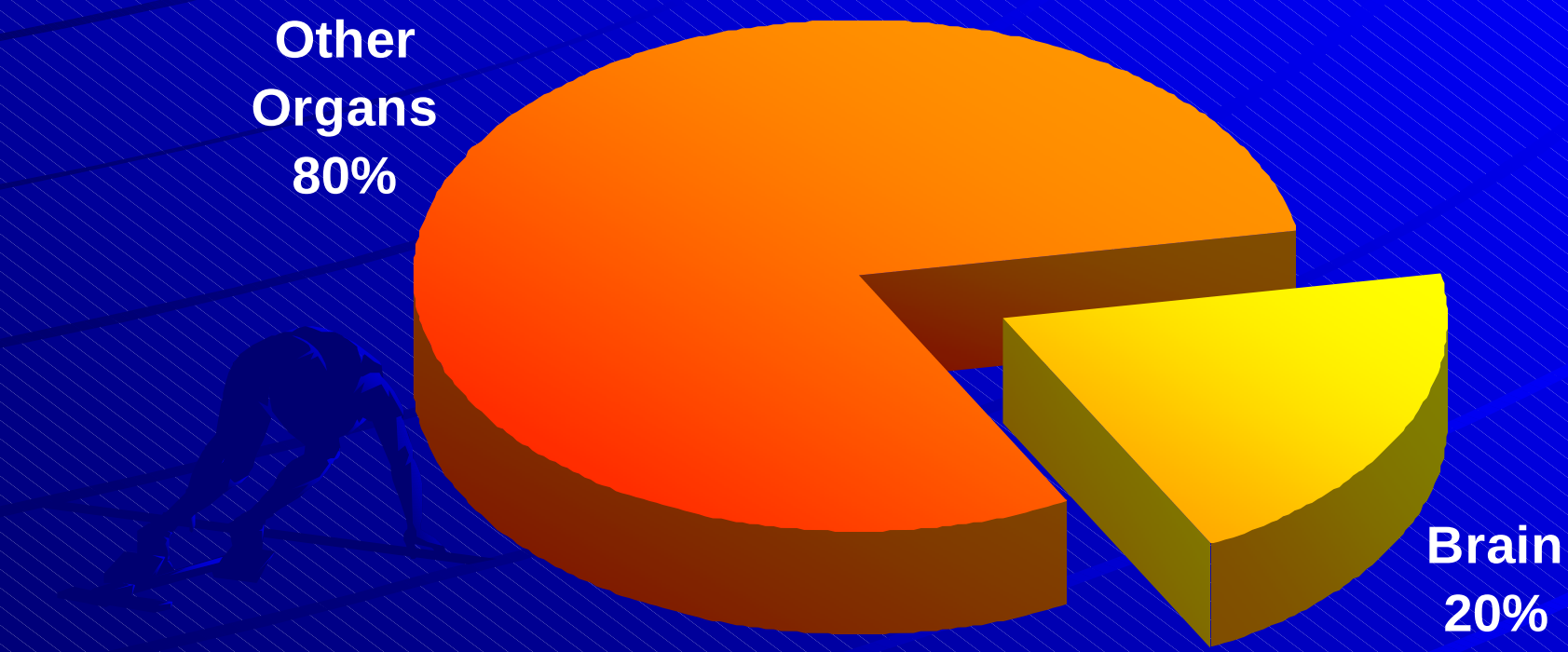
- Grains
- Fruits
- Vegetables
- Sweet Corn
- Honey
- Corn Syrup
- Glucose Syrup
- Glucose Drinks
- Glucose Powder
- Glucose Candies

Carbohydrates will be broken down and converted to glucose for energy.

Functions of Glucose

- The major form of energy being delivered to cells
- Maintain the functional integrity of our nerve tissues
- Main source of energy for the brain

Glucose and Your Brain



- the brain uses approximately 20% of the energy intake

Glucose and Your Brain

- The sole source of energy for the brain and central nervous system under normal condition
- The brain does not have a good glucose storage
- The brain relies on a continuous supply of glucose from the blood
- An average brain needs about 120 g of glucose daily

Your Brain without Glucose

- (Transient) Impairment of brain function results during hypoglycemia
- Normal fasting blood glucose level: 3.9 – 6.4 mmol/L

Blood Glucose (mmol/L)	*Impairment of brain function*
< 3.0	Decreased choice reaction time
< 2.5	Short-term memory deterioration
< 2.3	Slowing of finger tapping and simple motor tasks

Your Brain without Glucose

- After a few days of fasting or without glucose supply, your brain will use other sources of energy.
- The body will generate “ketone bodies” from fatty acid breakdown, an energy source for some of the brain cells.
- However, increased blood level of “ketone bodies” :
  - Can affect your overall blood pH levels
  - Can result in serious side effects

Glucose and Cognitive Performance

- Cognitive performance includes perceiving, thinking, recognizing and remembering.
- Usual Study Design:
  - Overnight or 2 hr. fast
  - (with or without meal)

Administration of (25 - 50 g) a glucose drink or placebo

  - Cognitive performance test
  - Blood glucose being monitored
  - All healthy subjects

Glucose and Cognitive Performance – What they found?

- Significant higher blood glucose level with consumption of glucose drink compared to placebo.
- Correlation found with blood glucose level or the raise of blood glucose level and cognitive performance.
- Administration of glucose can enhance aspects of cognitive performance (concentration, memory & reaction), particularly when tasks are difficult or mentally demanding.

Caloric Concern

- Your body needs glucose for normal body function
- It should be included in your diet in forms of carbohydrate, while maintaining overall caloric balance
- Consult your physician and dietitian if you:
  - Are watching your weight, or
  - Have diabetes / impaired glucose tolerance, or
  - Have any other chronic disease

A Light Note about Caffeine

- Water soluble, very absorbable, detected in tissues after 30-45 minutes, peaked at 2 hours
- Does not increase blood glucose level
- Stimulate the central nervous system
- Shows some positive effect on cognitive performance in sleep-deprived individuals

Nutritional Tips for Brain

- A balanced diet rather than focusing on one nutrient
- Regular meal pattern
- Drink plenty of fluids
- Adequate carbohydrate intake through out the day

- As...

Your Brain Runs on Glucose!

Thank you.

References

1. The Society for Neuroscience. J Carey [Ed.] Brain facts: A primer on the brain and nervous system. 4th Edition. www.w3.sfn.org/baw/pdf/brainfacts.pdf Accessed: 30th July 2003
2. Brody T. *Nuritional Biochemistry 1994*
3. Benton D, Sargent J. Breakfast, blood glucose and memory. Biol Psychol 1992;33:207-10.
4. Benton D, Owens DS. Blood glucose and human memory. Psychopharmacology 1993;113:83-8.
5. Harland, B.F. Caffeine and Nutrition. *Nutrition;* 2000; 16 (7/8): p. 522-526
6. Kaplan RJ, Greenwood CE, Winocur G, Wolever TMS. Cognitive performance is associated with glucose regulation in healthy elderly persons and can be enhanced with glucose and dietary carbohydrate. Am J Clin Nutr 2000;72:825-36
7. Kaplan RJ, Greenwood CE, Winocur G, Wolever TMS. Dietary protein, carbohydrate and fat enhance memory performance in the healthy elderly. Am J Clin Nurr 2001; 74:687-93
8. Kennedy DO, Scholey AB. Glucose administration, heart rate and cognitive performance: effects of increasing mental effort. Psychopharmacology 2000;149:63-71.
9. Rosenthal JM, Amiel Stephanie, Yaguez L, Bullmore E, Hopkins D, Evans M, Pernet A, Reid H, Giampietro V, Andrew CM, Suckling J, Simmons A, Williams SCR. The Effect of Acute Hypoglycemia on Brain Function and Activation. A functional Magnetic Resonance Imaging Study. Diabetes 2001; 50: 1618-1626
10. Sauders. Miller-Keane Encyclopaedia & Dictionary of Medicine, Nursing, Allied Health. 6th Edition. 1997.
11. Sunram-Lea SI, Foster JK, Durlach P, Perez C. Glucose facilitation of cognitive performance in healthy young adults: examination of the influence of fast-duration, time of day and pre-consumption plasma glucose levels. Psychopharmacology 2001; 157:46-54
12. Sunram-Lea S.I et al. Investigation into the significance of task difficulty and divided allocation of resourses on the glucose memory facilitation effect. Psychopharmacology 2002; 160: 387-397.