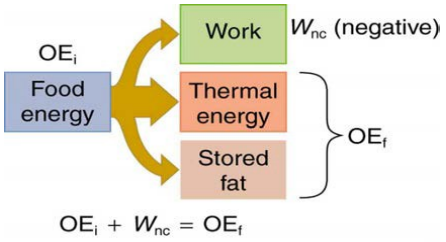
Physics 06-06 Energy in Humans and the World — *Name:* _____

Energy in Humans



Human bodies (all living bodies) convert _____

Rate of _____ use is _____ rate

- Basal _____ rate (BMR)
- Total energy _____ at rest
- Highest: _____ and _____

Table 7.4 Basal Metabolic Rates (BMR)

Organ	Power consumed at rest (W)	Oxygen consumption (mL/min)	Percent of BMR
Liver & spleen	23	67	27
Brain	16	47	19
Skeletal muscle	15	45	18
Kidney	9	26	10
Heart	6	17	7
Other	16	48	19
Totals	85 W	250 mL/min	100%

Table 7.5 Energy and Oxygen Consumption Rates[4] (Power)

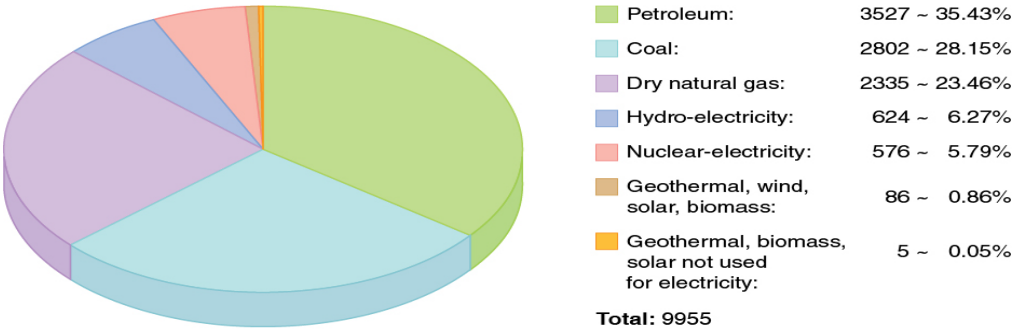
Activity	Energy consumption in watts	Oxygen consumption in liters O_2/min
Sleeping	83	0.24
Sitting at rest	120	0.34
Standing relaxed	125	0.36
Sitting in class	210	0.60
Walking (5 km/h)	280	0.80
Cycling (13–18 km/h)	400	1.14
Shivering	425	1.21
Playing tennis	440	1.26
Swimming breaststroke	475	1.36
Ice skating (14.5 km/h)	545	1.56
Climbing stairs (116/min)	685	1.96
Cycling (21 km/h)	700	2.00
Running cross-country	740	2.12
Playing basketball	800	2.28
Cycling, professional racer	1855	5.30
Sprinting	2415	6.90

World Energy Use

Energy is required to do _____

World wide, the most common source of energy is _____

USA has _____of world population, but uses _____of world's oil



World energy consumption continues to _____ quickly

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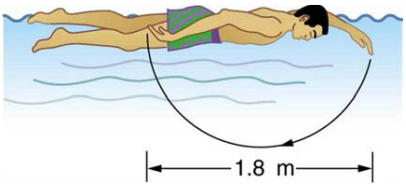
- Growing economies in _____ and _____
- _____ are very polluting
- Many countries trying to develop _____ energy like _____ and _____
- Generally, _____ energy use per capita = better _____ of living

Practice Work

1. Explain why it is easier to climb a mountain on a zigzag path rather than one straight up the side. Is your increase in gravitational potential energy the same in both cases? Is your energy consumption the same in both?
2. Discuss the relative effectiveness of dieting and exercise in losing weight, noting that most athletic activities consume food energy at a rate of 400 to 500 W, while a single cup of yogurt can contain 1360 kJ (325 kcal). Specifically, is it likely that exercise alone will be sufficient to lose weight? You may wish to consider that regular exercise may increase the metabolic rate, whereas protracted dieting may reduce it.
3. What is the difference between energy conservation and the law of conservation of energy? Give some examples of each.
4. (a) What is the power output in watts and horsepower of a 70.0-kg sprinter who accelerates from rest to 10.0 m/s in 3.00 s? (b) Considering the amount of power generated, do you think a well-trained athlete could do this repetitively for long periods of time? (OpenStax 7.45) **1.17×10^3 W, 1.56 hp, Very high power**
5. Calculate the power output in watts and horsepower of a shot-putter who takes 1.20 s to accelerate the 7.27-kg shot from rest to 14.0 m/s, while raising it 0.800 m. (Do not include the power produced to accelerate his body.) (OpenStax 7.46) **641 W, 0.860 hp**
6. (a) What is the efficiency of an out-of-condition professor who does 2.10×10^5 J of useful work while metabolizing 500 kcal of food energy? (b) How many food calories would a well-conditioned athlete metabolize in doing the same work with an efficiency of 20%? (OpenStax 7.47) **10.0%, 251 kcal**
7. Energy that is not utilized for work or heat transfer is converted to the chemical energy of body fat containing about 39 kJ/g. How many grams of fat will you gain if you eat 10,000 kJ (about 2500 kcal) one day and do nothing but sit relaxed for 16.0 h and sleep for the other 8.00 h? Use data from Table 7.5 for the energy consumption rates of these activities. (OpenStax 7.48) **10.5 g**
8. Using data from Table 7.5, calculate the daily energy needs of a person who sleeps for 7.00 h, walks for 2.00 h, attends classes for 4.00 h, cycles for 2.00 h, sits relaxed for 3.00 h, and studies for 6.00 h. (Studying consumes energy at the same rate as sitting in class.) (OpenStax 7.49) **3800 kcal**
9. The swimmer shown in Figure 7.44 exerts an average horizontal backward force of 80.0 N with his arm during each 1.80 m long stroke. (a) What is his work output in each stroke? (b) Calculate the power output of his arms if he does 120 strokes per minute. (OpenStax 7.56) **144 J, 288 W**



10. Review: A toy gun uses a spring with a force constant of 300 N/m to propel a 10.0-g steel ball. If the spring is compressed 7.00 cm and friction is negligible: (a) How much force is needed to compress the spring? (b) To what maximum height can the ball be shot? (c) At what angles above the horizontal may a child aim to hit a target 3.00 m away at the same height as the gun? (d) What is the gun's maximum range on level ground? (OpenStax 7.63) **−21.0 N, 7.50 m, 5.77°, 84.23°, 15.0 m**
11. Review: (a) What force must be supplied by an elevator cable to produce an acceleration of 0.800 m/s^2 against a 200-N frictional force, if the mass of the loaded elevator is 1500 kg? (b) How much work is done by the cable in lifting the elevator 20.0 m? (c) What is the final speed of the elevator if it starts from rest? (d) How much work went into thermal energy? (OpenStax 7.64) **1.61×10^4 N, 3.22×10^5 J, 5.66 m/s,4.00 kJ**