NEWSLETTER
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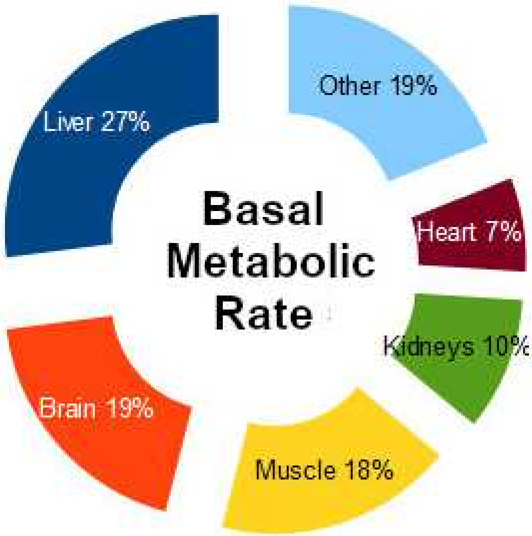
Measure metabolic rate and respiratory ratio

The human body and its organs needs energy for maintenance of homeostasis and to do mechanical work during physical activity. Except for heat that are needed to regulate body temperature, the common biochemical free energy currency to drive all other activity is ATP, a molecule that is used to store and drive other biochemical reactions.

The total and relative expenditure budget of BMR
It is custom to measure the human metabolic rate, in terms of the associated heat generation kcal/hour or Watt. Although it varies with for example body size, gender, age, stress, dysregulation of thyroid hormones. The total heat production of an adult human at rest is typically in the 40-100 Watt range.



During muscular excercise the metabolic rate can however increase an order of magnitude.

Metabolism of carbohydrates, fats and proteins
In short, the body breaks down food such as carbohydrates, fats and proteins into smaller units which then oxidates.

Carbohydrates processing during glycolysis ends with pyruvate, which can then take two pathways. Aerobic respiration converts pyruvate into Acetyl-CoA that enter krebs cycle, where the waste products are just carbon dioxide and water. This is the pathway that can be sustained in stationary states for longer periods of time.

The aerobic pathway however has a limited capacity, and when the demand for energy is higher than this can sustain, anaerobic fermentation of glycogen is needed as well. This however produces lactic acid as a byproduct, and the glycogen deposits in the body are also very limited, so this pathway is typically only for short period, during peak muscular efforts or during startup of an excercise session.

Fats and proteins can only be metabolised aerobically, and eventually all enter the krebs cycle after breakdown into smaller molecules.

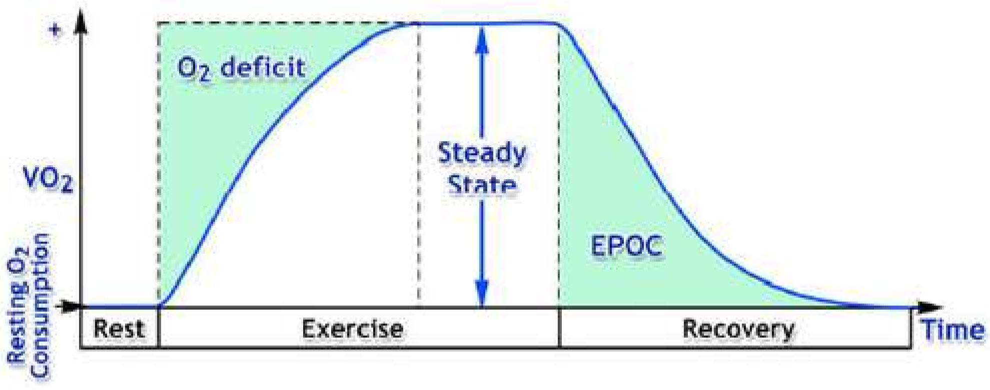
Overall we have this process

Carbohydrate/fats/proteins + oxygen -> carbondioxide + water + ATP + Heat

The exact overall stochiometry of the chemical reactions here is complex depend on the the relative amount of carbohydrates, fats and proteins used as energy source, as well as the relative proportions of aerobic vs fermentative pathways. For this reason, metabolic measurements from gas is being made during a stationary state where we can assume that all metabolism follow anaerobic pathways.

We can also measure CO2 production, get the RER, the ratio between produced CO2 and consumed O2. During steady state conditions, this also indicates in what proportions the body uses mainly carbohydrates vs fats as a source, as fat metabolism requires more oxygen per produced CO2 than carbohydrate sources.

How can we measure the metabolic rates and RER?
We can measure airflow and O2 concentration in expired air, and thus calculate the amount of oxygen used up by the body.



But in order to infer metabolic rates from measured oxygen consumption one needs to know that we are only having aerobic respiration. This is ensured by taking the dVO2/dt measurement from the steady state during excercise. Then from knowing for the average food sources of the human metabolism how much heat energy is released per consumed O2, we can calculate the metabolic rate from the dVO2/dt during steady state.

By also measuring produced CO2, we can during steady state conditions estimate if the body is burning fats or carbohydrates. The body usually increases its preference for carbohydrates over fat, as the intensity of excercise increases.

What equipment do you need?
A typical setup consists of a gas flow meter, that measures the inspired air, and a gas analyser that measures CO2 and O2 in the expired air. BIOPAC has two systems: both the research system

(MP160), and the Biopac Student Lab system.

For MP150/MP160 systems, see: **O2100C**, **CO2100C** and **TSD117A**
For the Biopac Student Lab system, see: **GASSYS-2** and **SS11LB**

For help on turnkey setups with tubings, mixing chambers, mouthpieces etc, don't hesitate to contact us and we will gladly help you!

Read more on our web »

För mer information, se:
H29 Basal Metabolic Rate »
H19 VO2 & RER »
Medium Flow Pneumotach Transducer Setup and Calibration »
Application Note 183 VO2: and RER Measurement »

Don't hesitate to contact us at **biopac@jor.se** with a short description of your situation and we are happy to give you tailored advice!

We also have research systems with more features.

BIOPAC Systems, Inc.

Skulle du föredra att få dessa nyhetsbrev på svenska i fortsättningen?
Skicka ett mejl till **biopac@jor.se** och meddela oss.

JoR AB Knivsta/Försäljning/Service: 018-34 28 20, **biopac@jor.se**

Välkommen in på vår hemsida: **http://www.jor.se/measurement**