

## Absorptive and Postabsorptive States in a Nutshell

### Absorptive State

As stated in class, following a meal carbohydrates are broken down to simple sugars by various hydrolases in the brush border of the intestine and are imported into intestinal enterocytes using a sodium symport (**step "1" in Figure 1**). Proteins are broken down to amino acids (AAs), which are imported into intestinal enterocytes also using a sodium symport. AAs and glucose then enter the bloodstream and are delivered to the liver via the hepatic portal vein (**"2" in Figure 1**). Lipids take a different route as most are packaged into chylomicrons (**"3" in Figure 1**), which enter lacteals and eventually enter the blood stream through the thoracic duct.

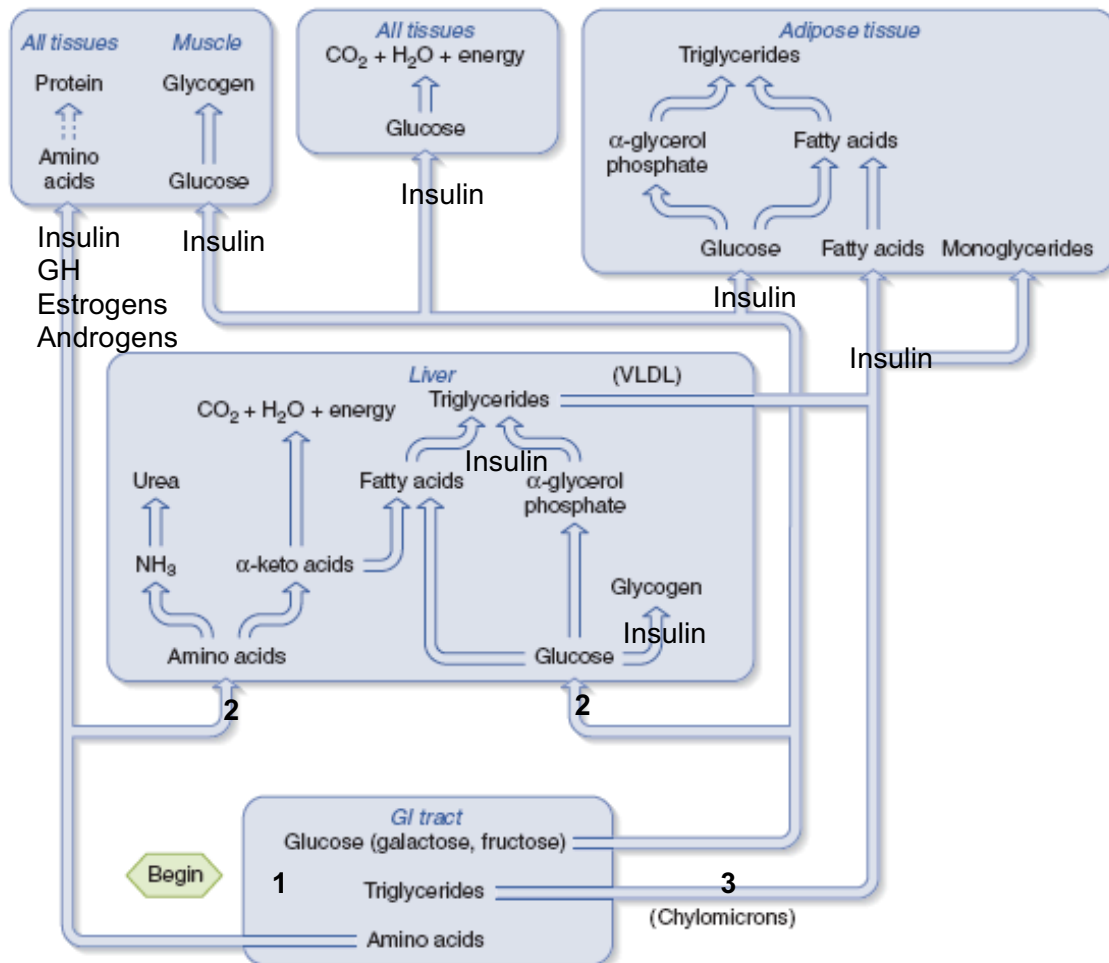


Figure 1. Overview of the absorptive state (after Vander's Human Physiology, McGraw Hill)

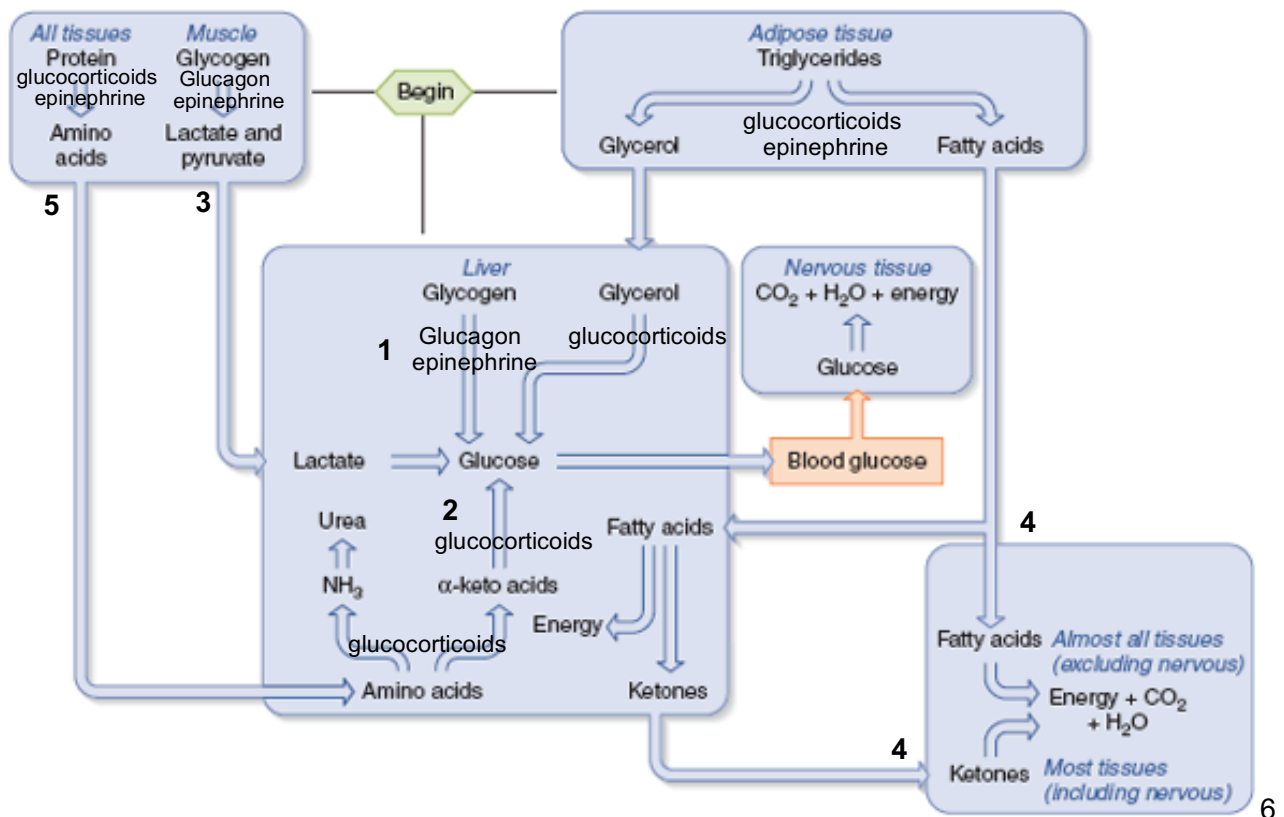
As blood glucose and amino acid concentrations rise following the meal, insulin is released from beta cells of the pancreatic islets. Insulin is the major hormone, directing organs, tissues and cells in terms of what to do with the absorbed nutrients during the absorptive state. All tissues increase their uptake and utilization of AAs and glucose, glucose for energy in part to fuel protein synthesis of the imported AAs under the control of growth hormone (GH) and androgens/estrogens.

**The liver** regulates the levels of glucose and amino acids in the blood arriving at the hepatic portal vein before the blood reaches the inferior vena cava, stabilizing glucose levels at or below 150 mg/dl following a meal. Hepatocytes convert the glucose to glycogen (**glycogenesis**) until liver stores are met (about 5% by weight) and also use the glucose for its energetic needs (**glycolysis**). If excess glucose remains in the blood, hepatocytes will convert it to triglycerides and export them in VLDLs, to be taken up by adipose tissues. The liver also regulates plasma amino acid levels (between 35 and 65 mg/dl), but not as precisely as it does glucose levels. Hepatocytes use the amino acids for protein synthesis or they may convert abundant ones to less abundant ones and export them for circulation to other tissues to be used for protein synthesis.

In **adipose tissue**, insulin directs adipocytes to take up fatty acids and glycerol for triglyceride synthesis (**lipogenesis**). Glucose is taken up to fuel their synthesis and amino acids are imported as needed for protein synthesis.

## Postabsorptive State

As the absorptive state comes to an end, enterocytes stop providing glucose to the hepatic portal circulation. Peripheral tissues continue to take up glucose at first until plasma glucose levels dip below about 80 mg/dl at which point hepatocytes begin to catabolize their glycogen stores (**glycogenolysis**) into glucose in response to the rising levels of glucagon (released by alpha cells of the pancreatic islets) and epinephrine, thus beginning the post-absorptive state (**step "1" in Figure 2**). After about four hours of liver *glycogenolysis*, liver stores start to become depleted and blood glucose levels begin to fall (to about 70 mg/dl). At this point the liver stabilizes glucose levels by undergoing **gluconeogenesis** (**"2" in Figure 2**) under the direction of glucocorticoids that have been released from the adrenal cortex. To make glucose, the liver takes up glycerol, lactate, and amino acids from the blood as well as fatty acids to power gluconeogenesis. The circulating fatty acids, and the glycerol used for gluconeogenesis, have been mobilized from adipose tissue under the direction of the increased circulating levels of glucocorticoids and epinephrine. As the duration of the post-absorptive state lengthens, the liver becomes more and more active in the import of amino acids for gluconeogenesis (from glucogenic AAs) and the synthesis of ketones (**ketogenesis**) (from ketogenic AAs).



In regard to **peripheral tissues** during the post-absorptive state, as circulating levels of lipids and ketones rise, peripheral tissues decrease their reliance on circulating glucose and increase their reliance on these compounds. **Neural tissues** continue to rely on glucose, that is until glucose levels are insufficient to meet their energetic demands, at which point they have no choice but to rely on circulating ketones (**"6" in Figure 2**).