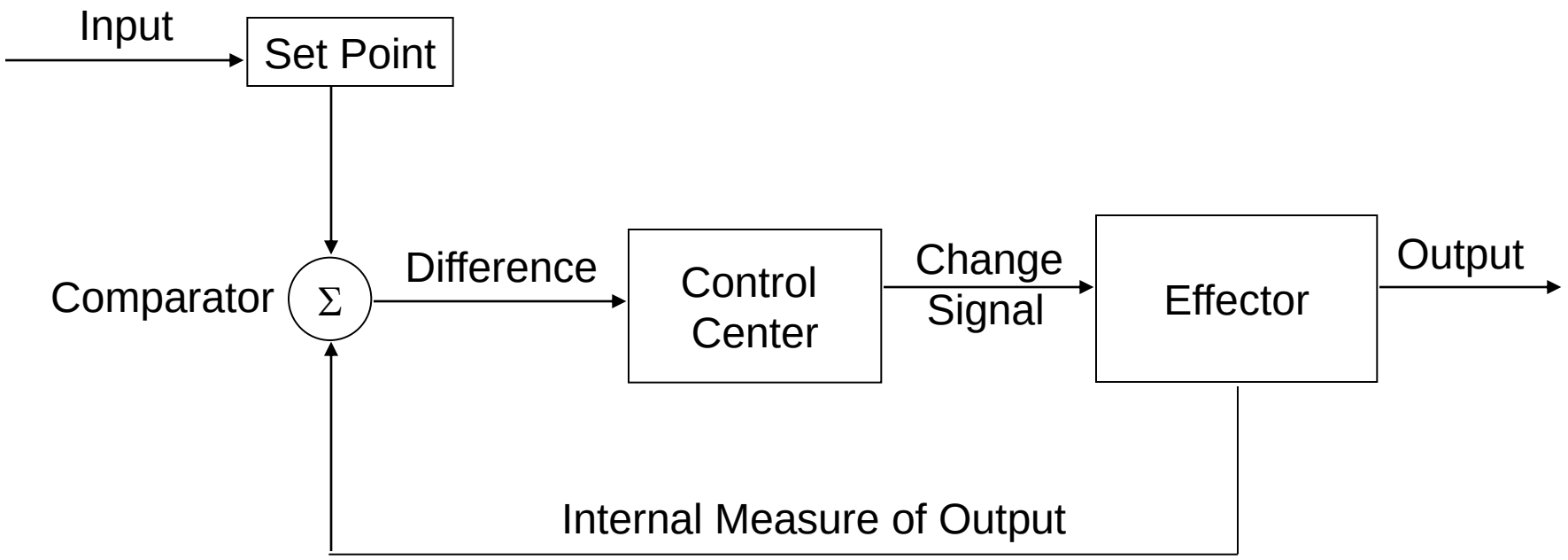
Homeostasis

Draw a Block Diagram of a Homeostatic System.

Homeostasis



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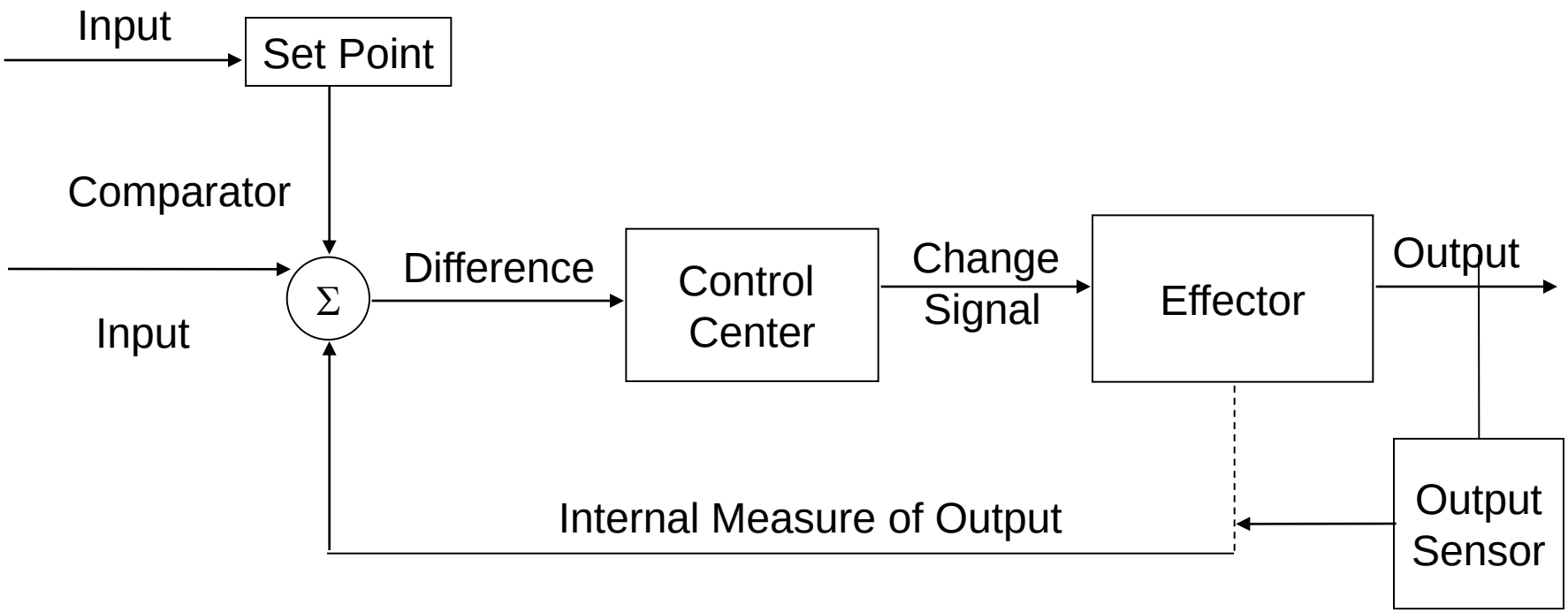

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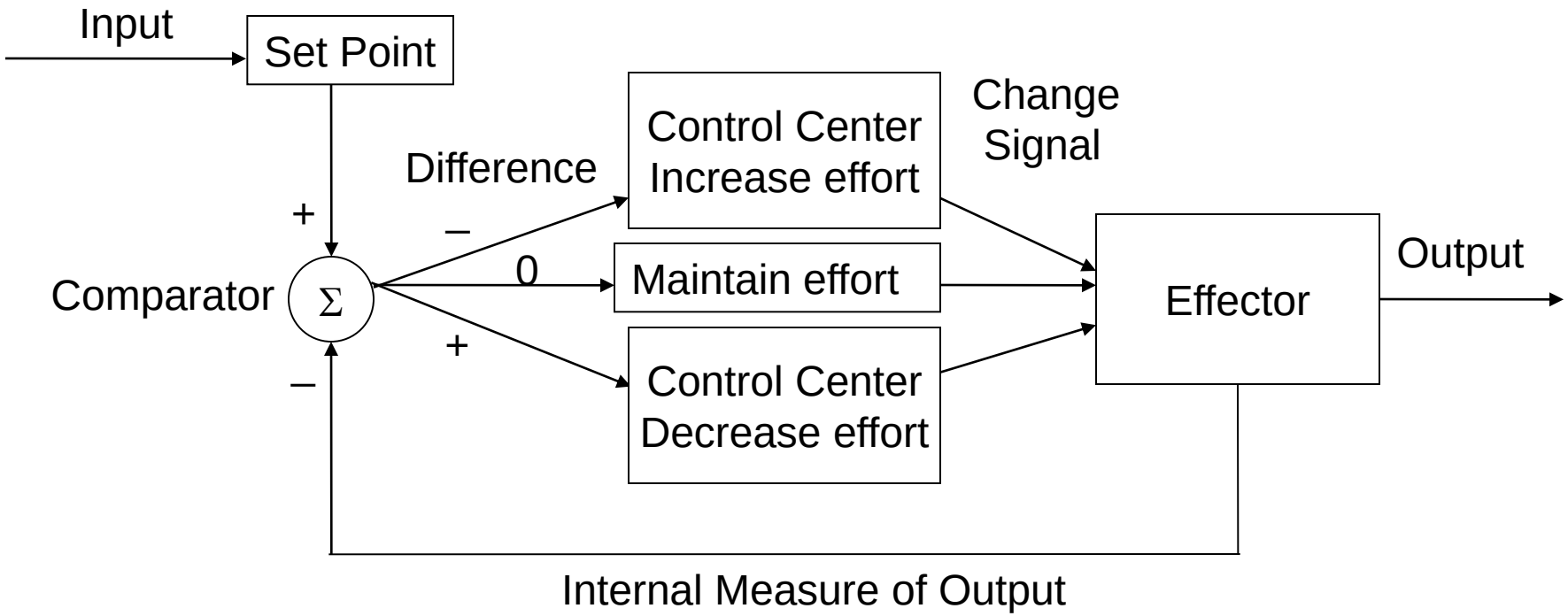

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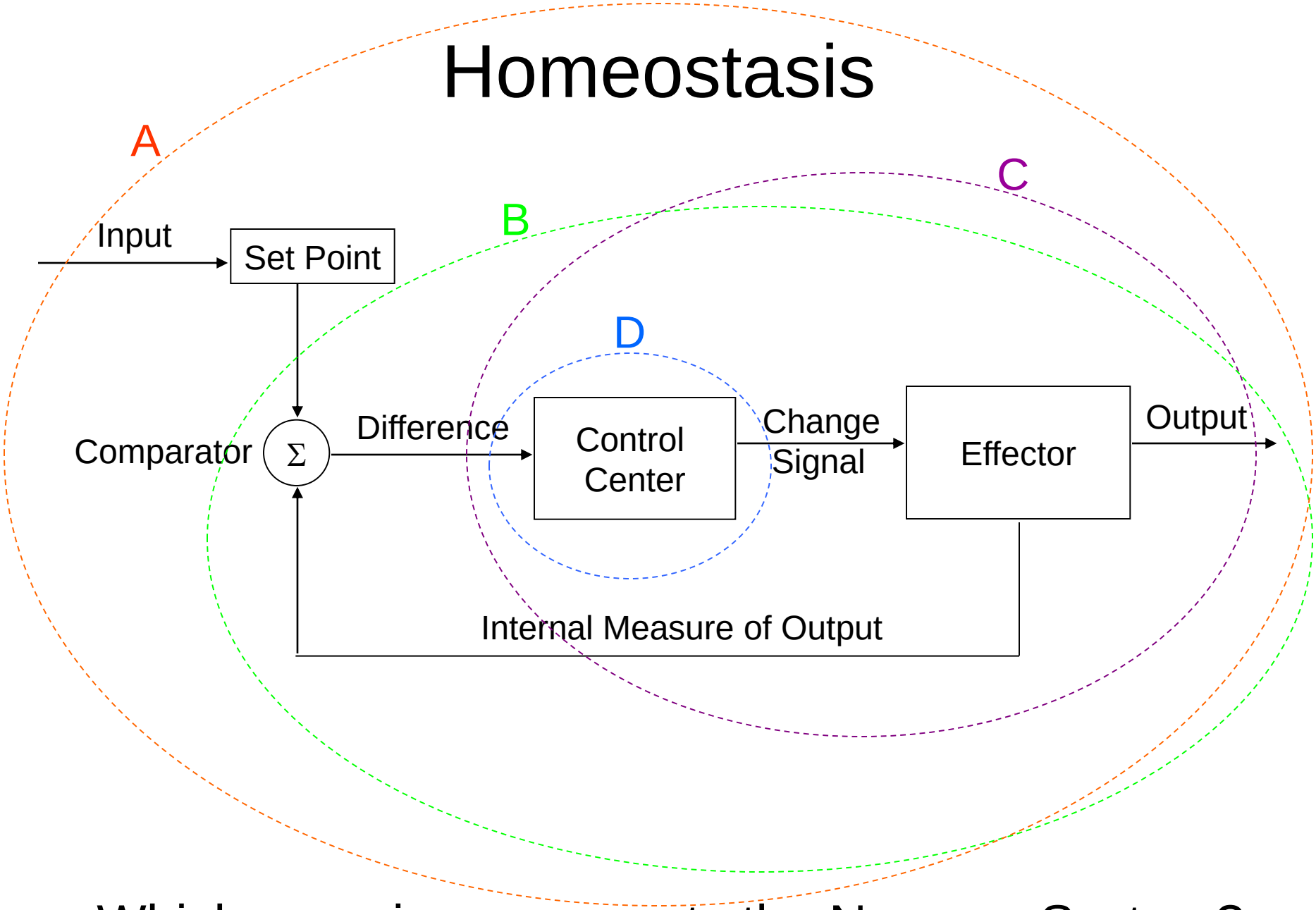
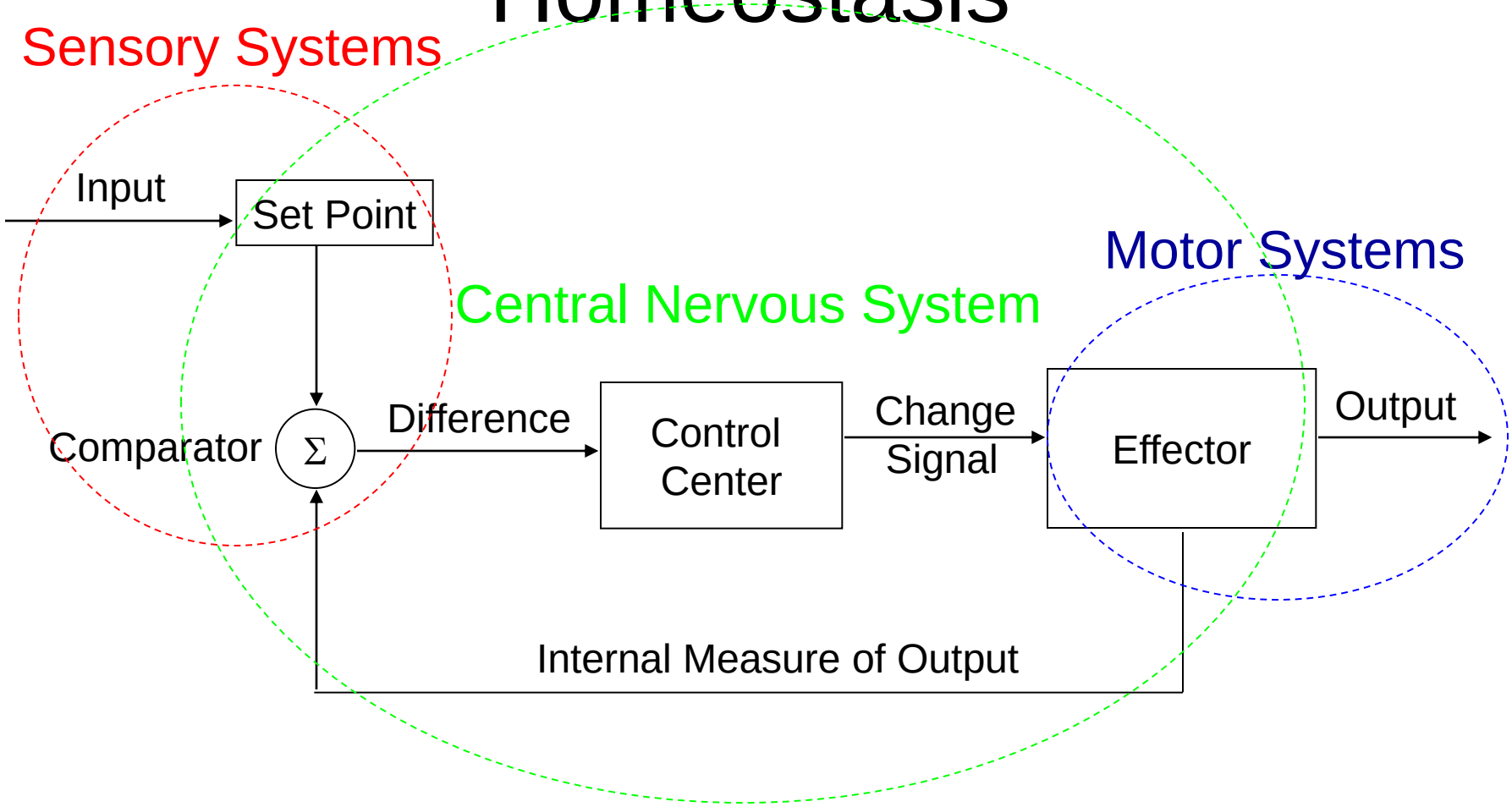


Which grouping represents the Nervous System?

Homeostasis



Homeostasis of thermoregulation

Goals:

- To keep internal conditions constant
- Prevent the body from harmful effects of overheating or hypothermia
- Fever is part of the innate, non-specific immune response, that helps to create a hostile enviroment for microbial pathogens

Homeostasis of thermoregulation

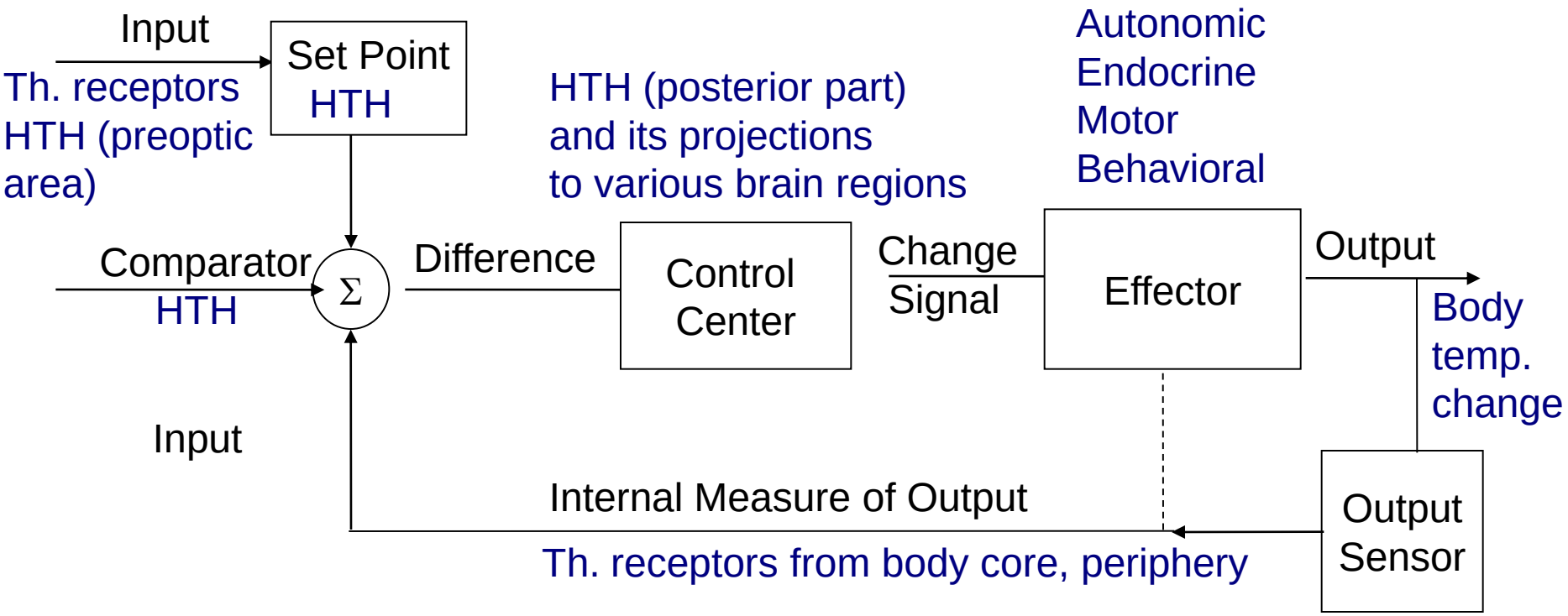
Heat transfer from body

Radiation – emission of the electromagnetic waves, all matter possesses that have temperature above absolute zero
Convection – energy transfer between objects that are in physical contact (a body and a chair)
Conduction – energy transfer between body and its enviroment, due to fluid motion
Evaporation – most effective. In hot weather (x humidity of the enviroment)

Heat production

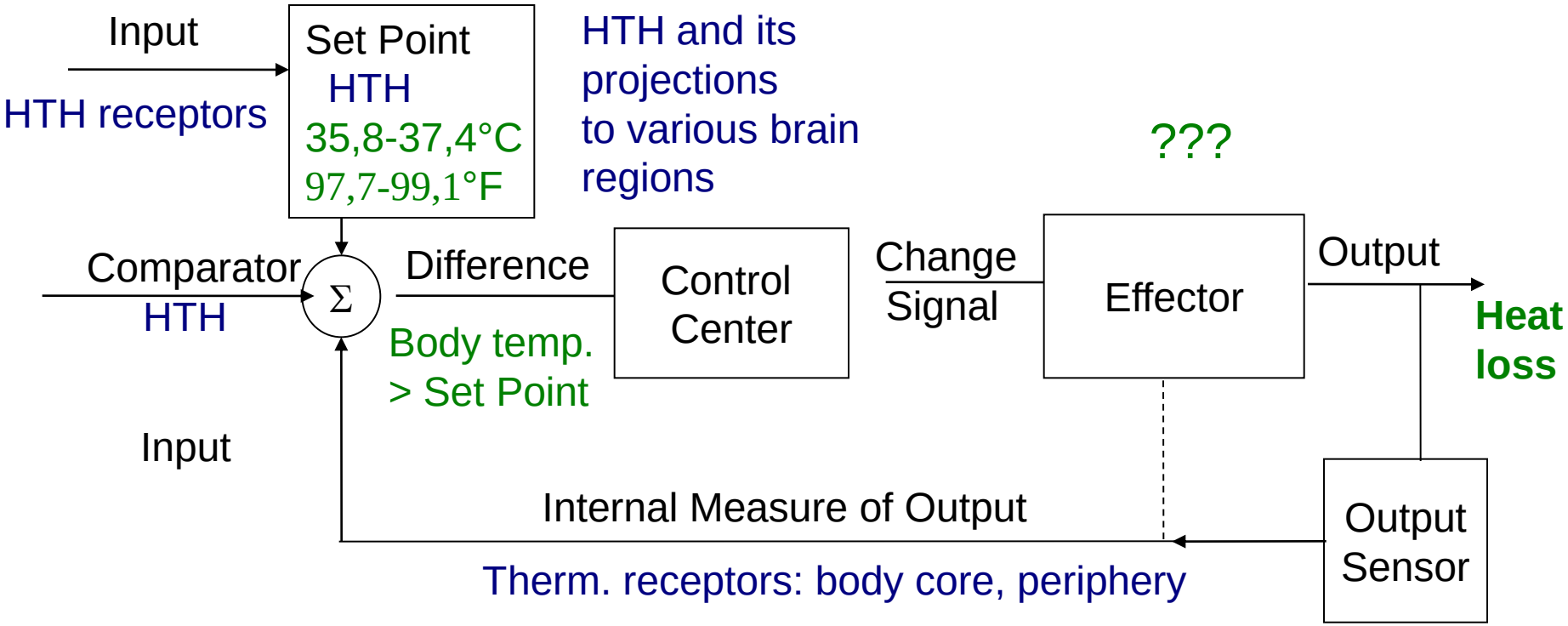
Most produced in deep organs: liver, brain, heart (heat is the byproduct of metabolic reactions) and in contraction of muscles

Homeostasis of thermoregulation



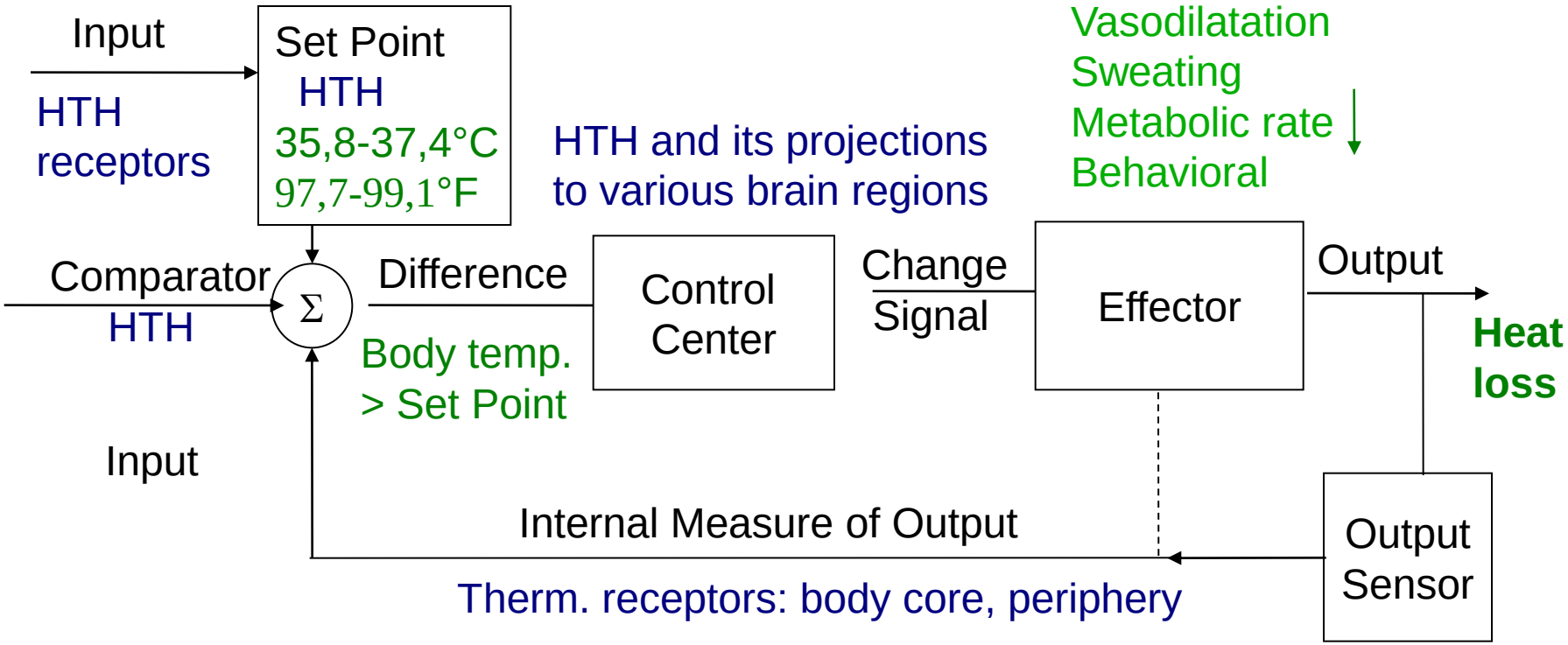
Th. in the periphery are different from the homeostatic thermoreceptors in the hypothalamus, that provide feedback to body temp. Homeostatic temp.center in HTH is separated from the temperature sensation – we can feel the temp. of the perifery (receptors in the skin), not from the body core or from the brain. TH = thalamus, HTH = hypothalamus.

Homeostasis of thermoregulation



Hot weather
Intensive physical activity

Homeostasis of thermoregulation



Hot weather
Intensive physical activity

Homeostasis of thermoregulation

Heat loss mechanisms in humans:

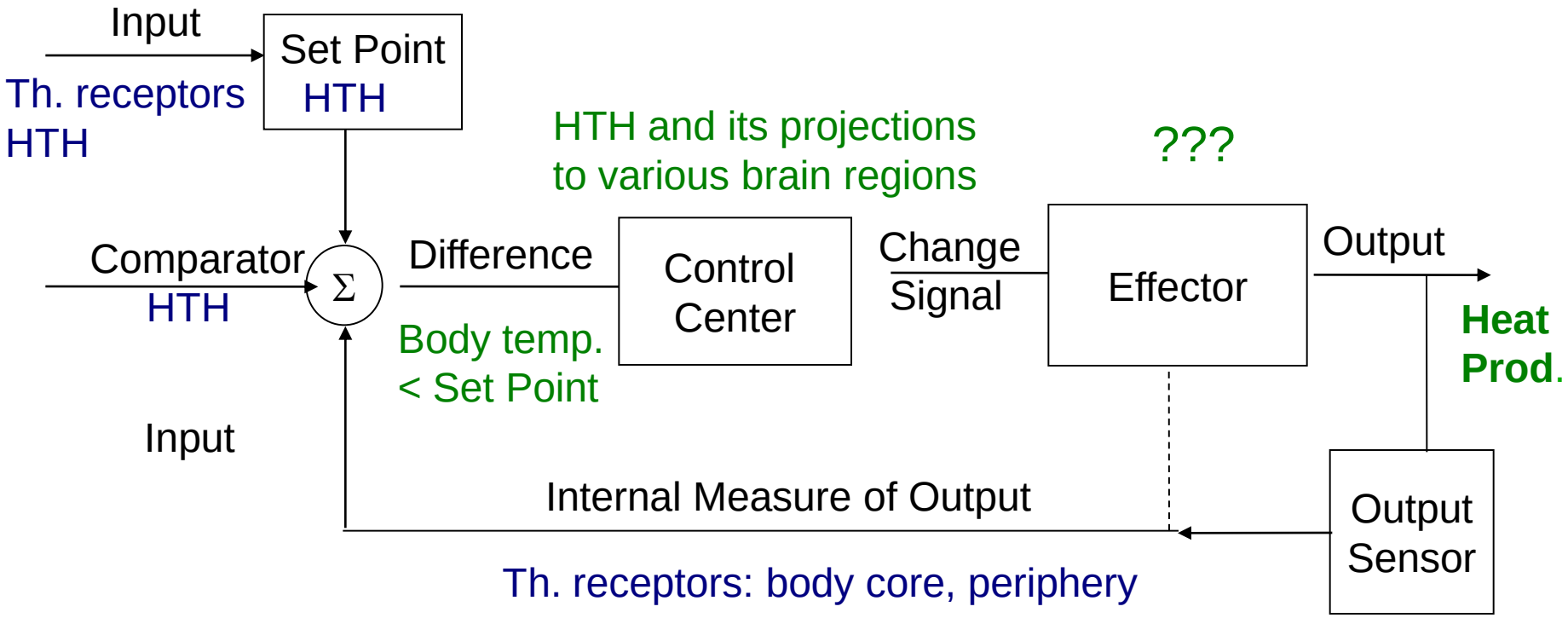
Vasodilatation – incr. blood flow to skin capillaries. Heat loss due to incr. convection, conduction

Sweating – evaporative cooling

Behavioral – finding shade, weating light cotton clothes, pervious to sweat, impervious to sun heat radiation

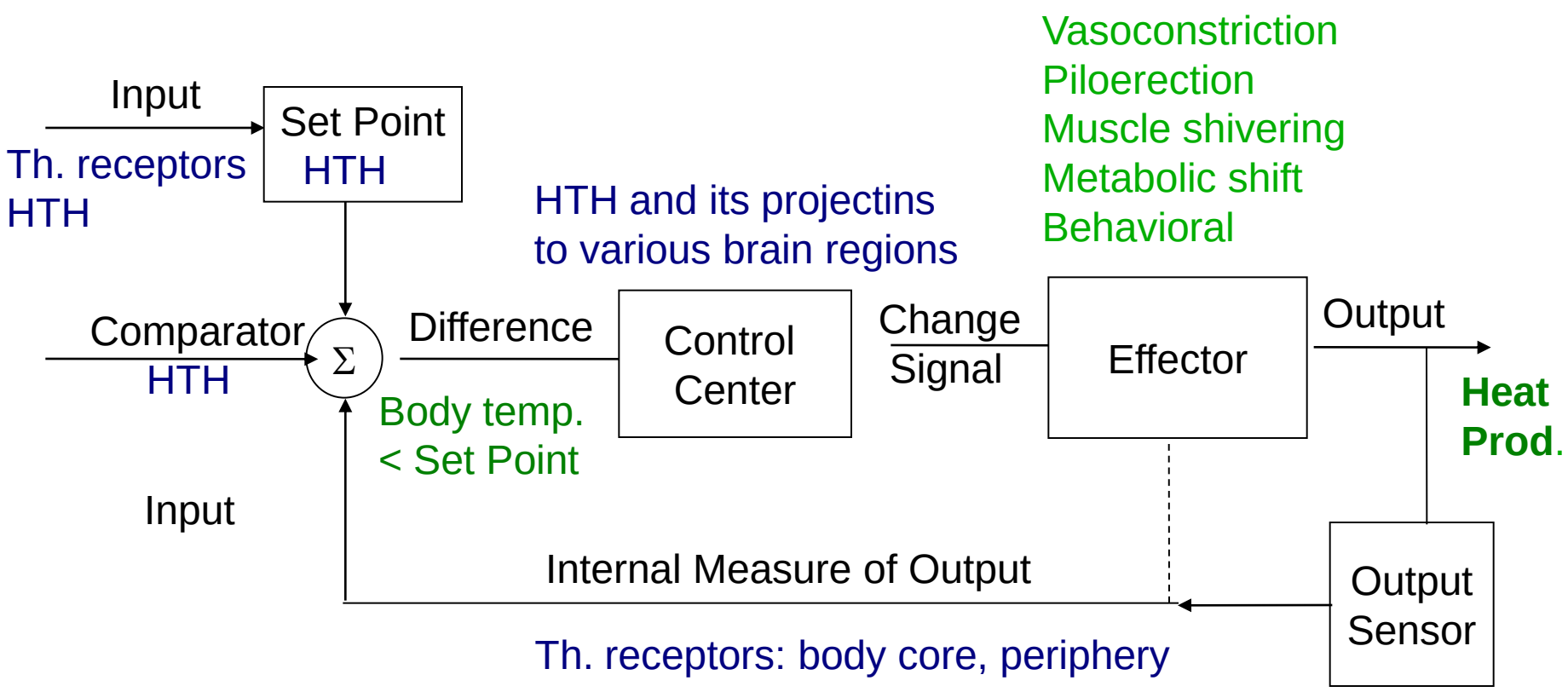
Metabolic - reactions decreased

Homeostasis of thermoregulation



Cold weather

Homeostasis of thermoregulation



Cold weather

Homeostasis of thermoregulation

Thermogenesis in humans

Piloerection (goose bumps) – insulating layer of staning hair, trapping heat

Vasoconstriction of superficial arterioles – blood rerouted to body core (numbness and pale skin)

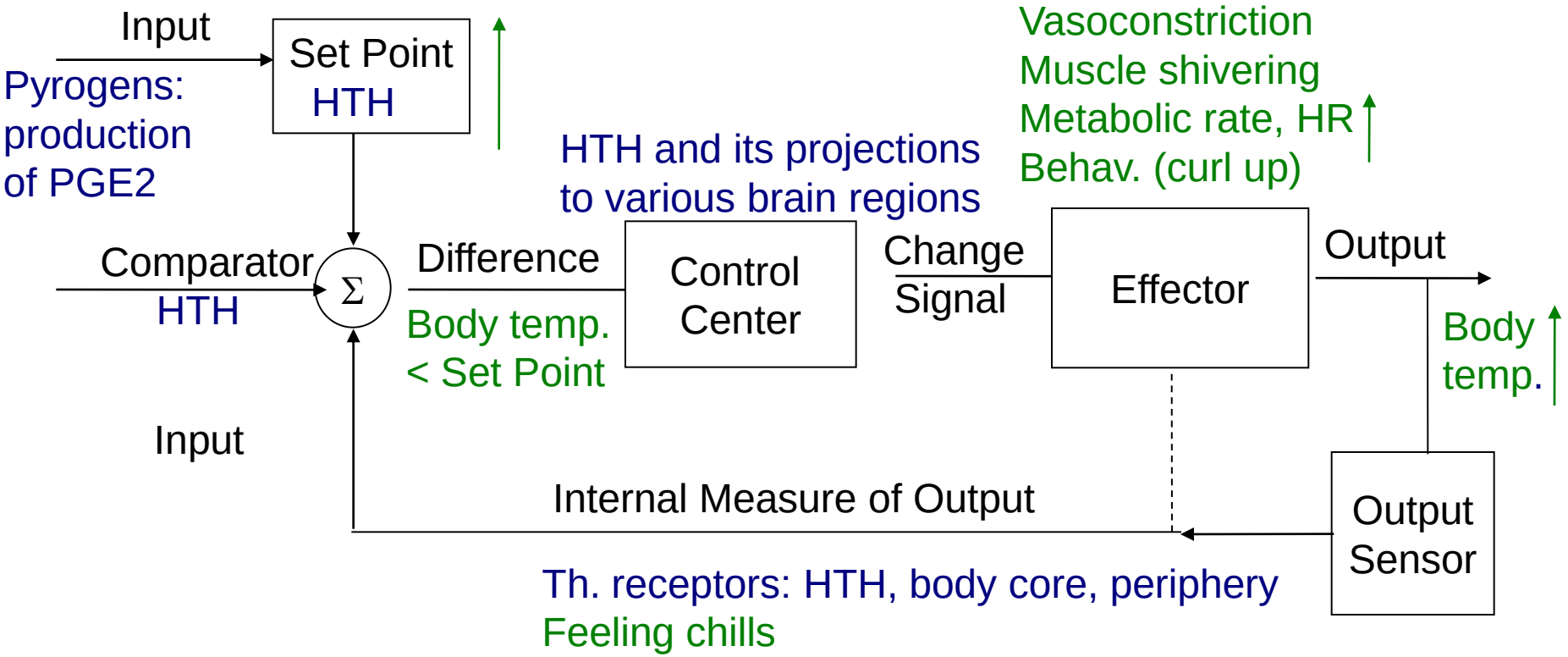
Muscle shivering – heat production

Mitochondria metabolism shift – transforming fat directly into energy (brown fat, norepinephrine induced)

Metabolic rate increase – epinephrine and thyroxine induced glycolysis (glucose – energy, heat as a byproduct)

Behavioral – curl-up position (body surface), warm clothing, shelter

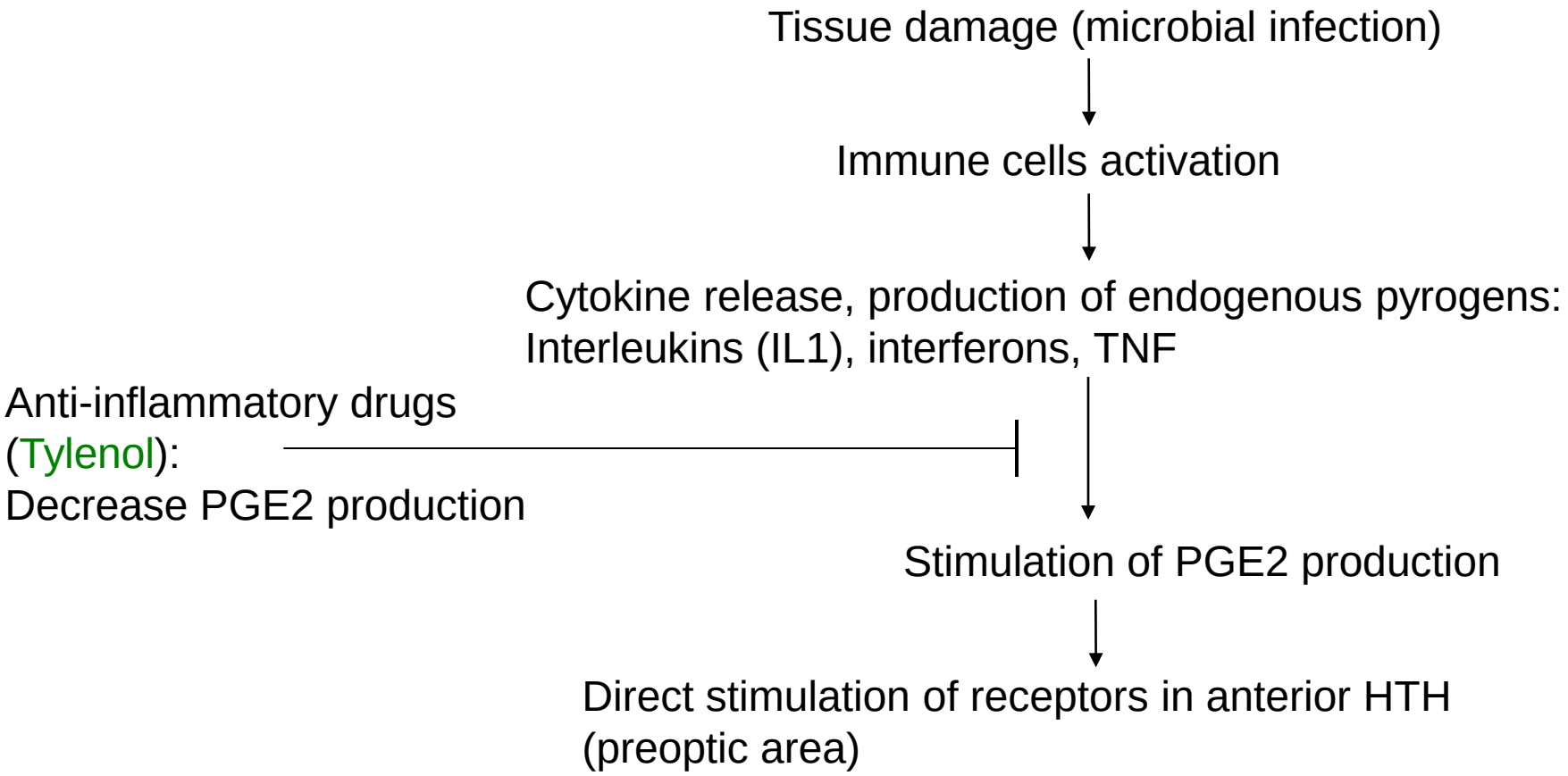
Homeostasis of thermoregulation



Fever = change of the Set Point

*Feeling chills and muscle shivering until the Body temp. = Set Point Temp.

Pyrogens = substances that induce fever
Exogenous: microbial particles, antigen-antibody-complexes
Produced internally: e.g. Interleukins, interferons



Homeostasis of thermoregulation

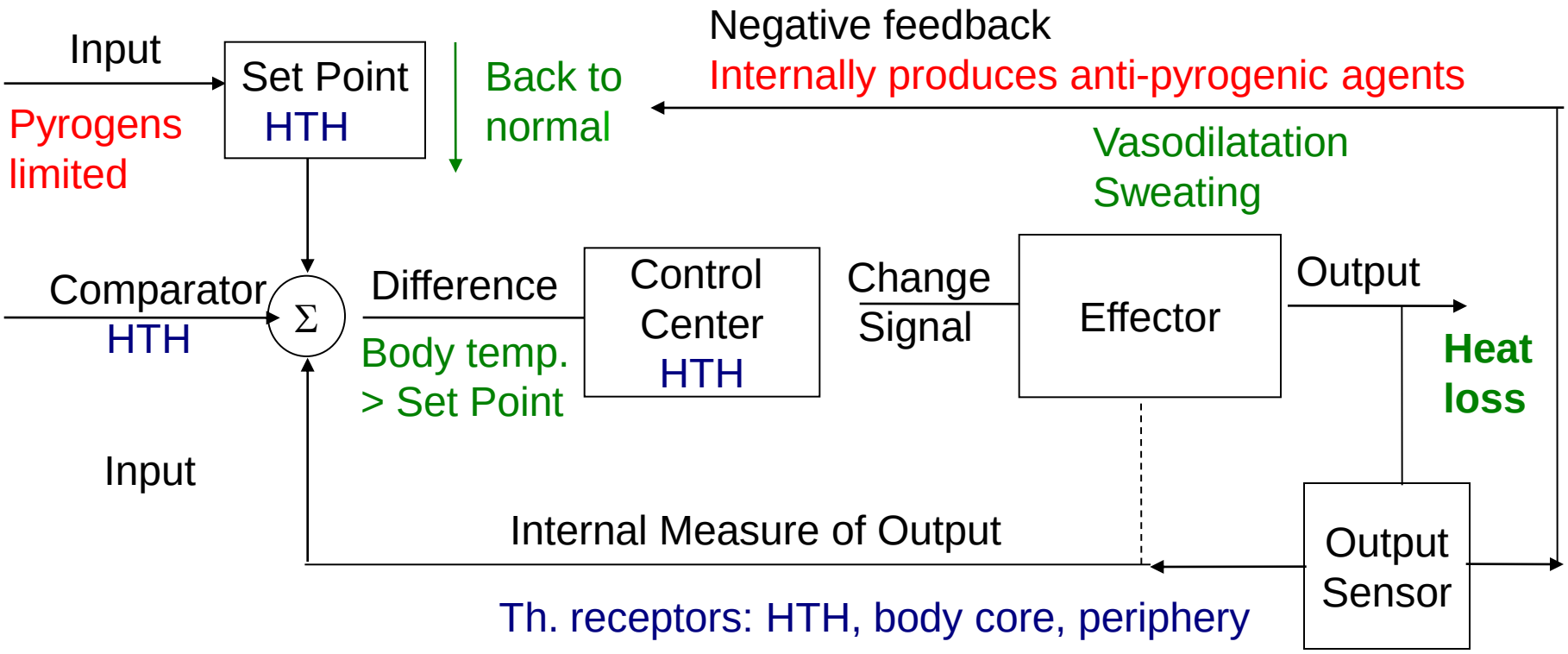
Other actions during fever

- Decrease in production of anti-diuretic hormone (pituitary) – increase fluid loss – decreased body fluid = less energy needed to maintain the body core temp.

- Behavioral – feeling cold (set point temp. > body temp.), wrap up warm, curl up.

Attempts to cool the periphery would result in an increase of the metabolic rate and effort to conserve the body temp. from the febrile body!

Homeostasis of thermoregulation



FEVER in most instances is self-limited reaction

Homeostasis of thermoregulation

Benefits of fever

- Increase in metabolic rate in body temp. 37,5-40°C allow more efficient immune response (quicker enzyme reactions rate, cellular immune system mobilization, accelerated tissue repair,...)
- Metabolism shift from glucose metab. to one based on lipolysis and proteolysis (redused free glucose available to invading pathogens, acute phase proteins produces in liver used for energy and tissue repair, binding minerals (Fe, Cu, Zn) needed for bacterial and viral replication.
- Most bacterias heat sensitive – with temp.elevated, their growth rate, mobility is decreased, cell walls become damaged. Viruses slow down their replication.

Harmful effects of fever

- Febrile convulsions (mainly in children) – linked with rapid T elevation or decreas, self-limiting
- Prolonged elevation over 40ºC – risk of cell damage
- Neuronal damage – T > 43ºC

Homeostasis of thermoregulation

Literature:

http://en.wikipedia.org/wiki/Heat_transfer

http://en.wikipedia.org/wiki/Thermoregulation

http://www.docstoc.com/docs/48160243/Physiology-of-fever