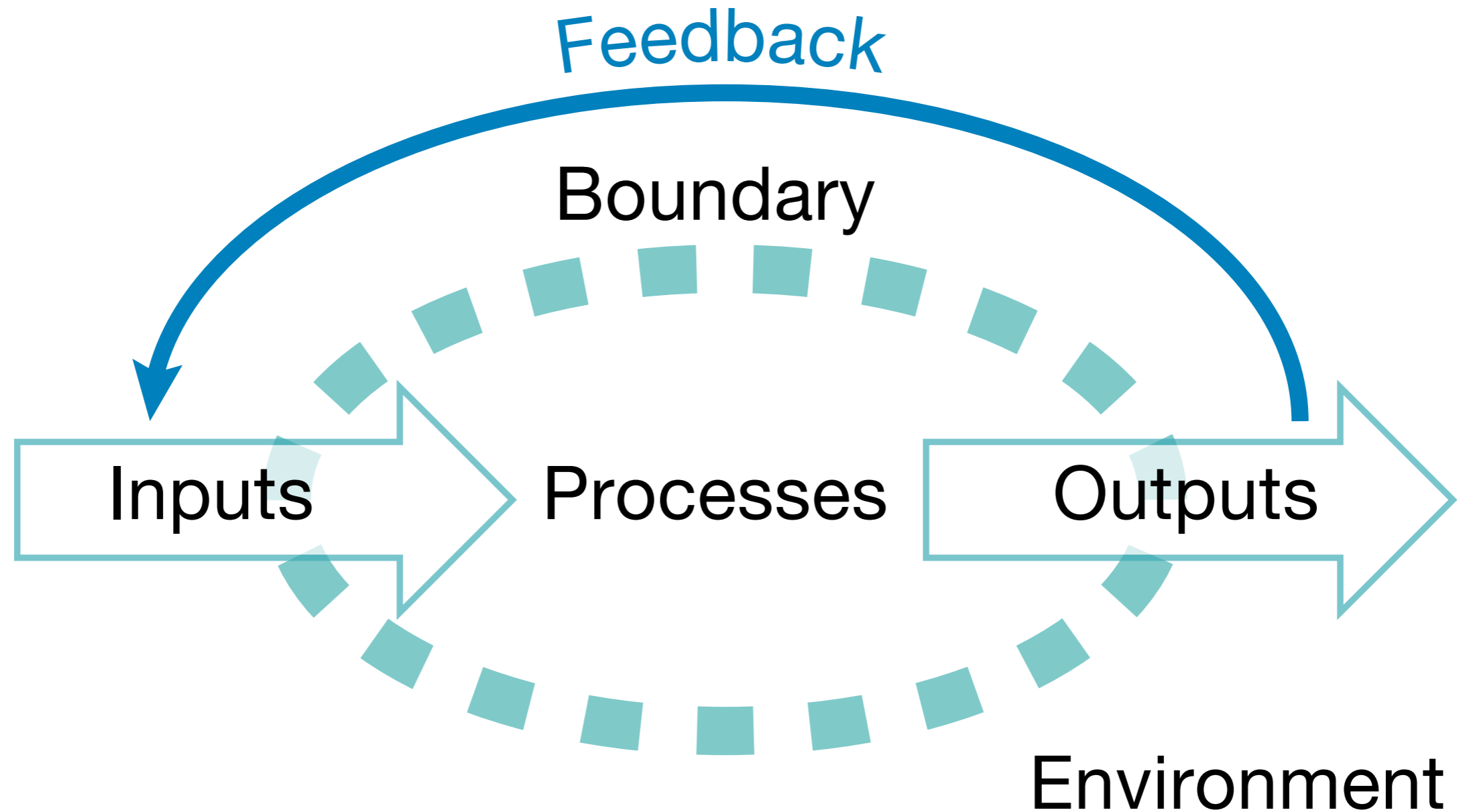


Topic 1

Systems in physical geography

Resources and answer guidance

Basic elements of an open system

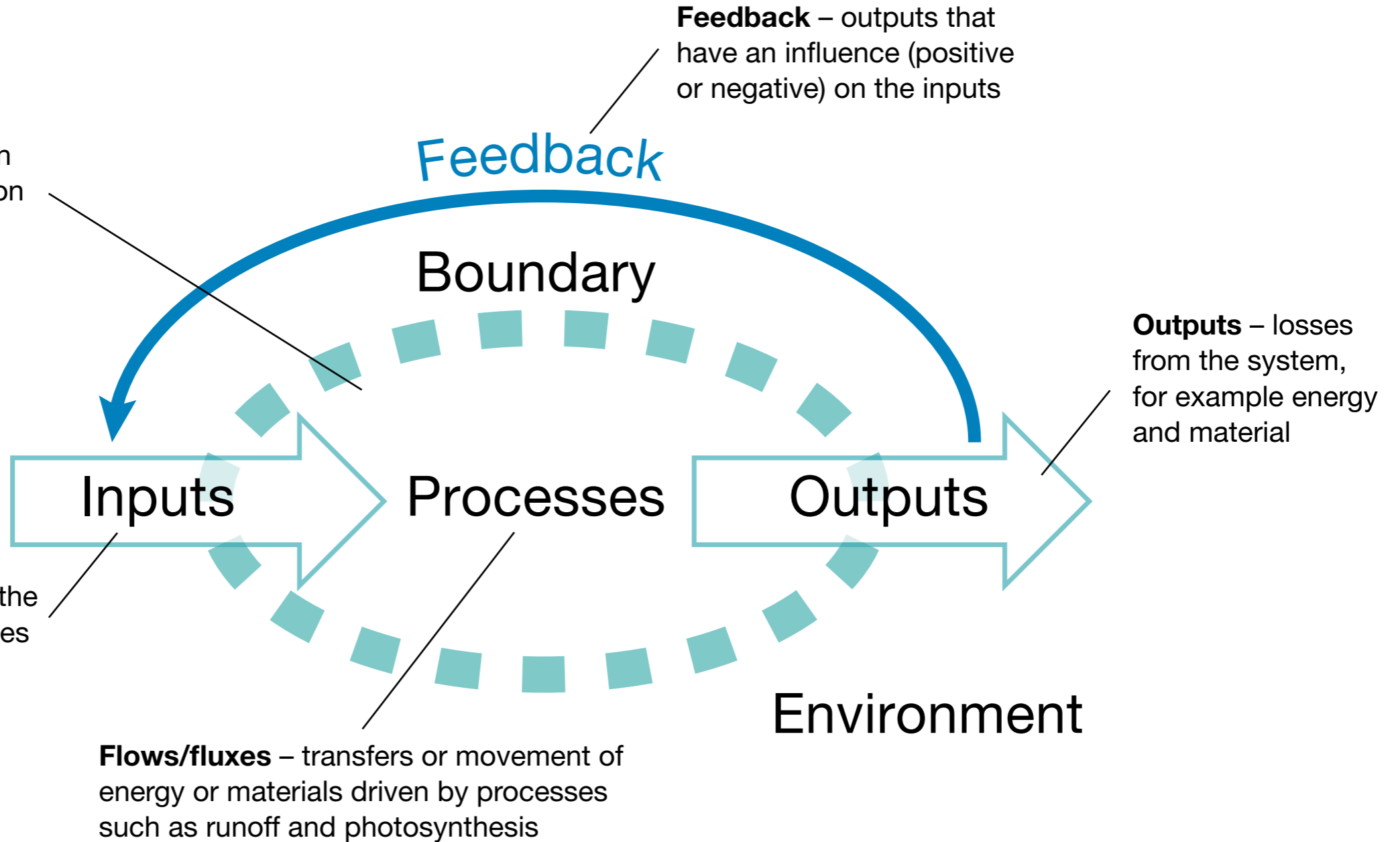


Q1 The systems approach

ANSWER

Stores – energy or materials stored within the system, e.g. carbon or water

Feedback – outputs that have an influence (positive or negative) on the inputs



Inputs – additions to the system or driving forces such as radiation

Flows/fluxes – transfers or movement of energy or materials driven by processes such as runoff and photosynthesis

Outputs – losses from the system, for example energy and material

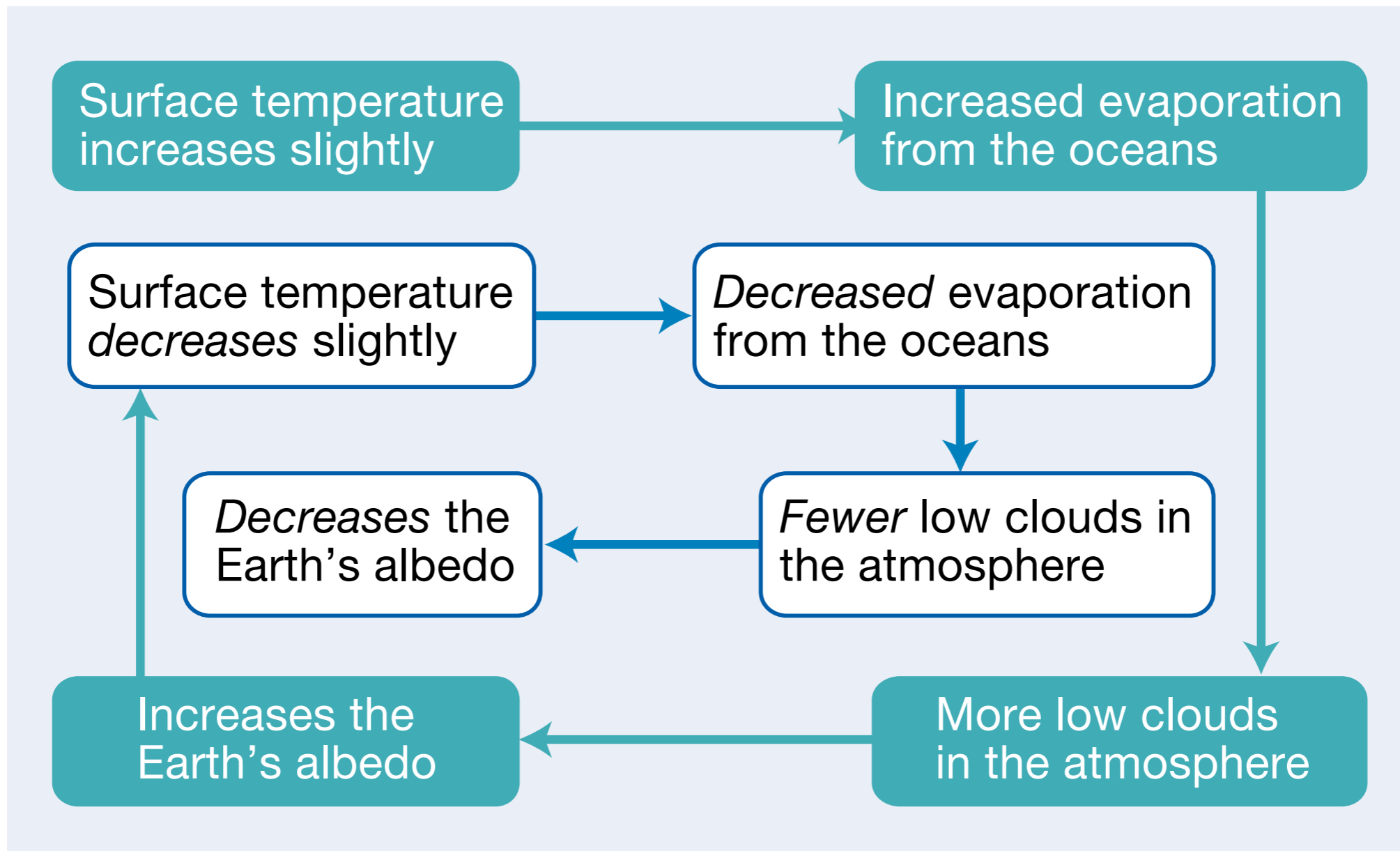
Q2

ANSWER

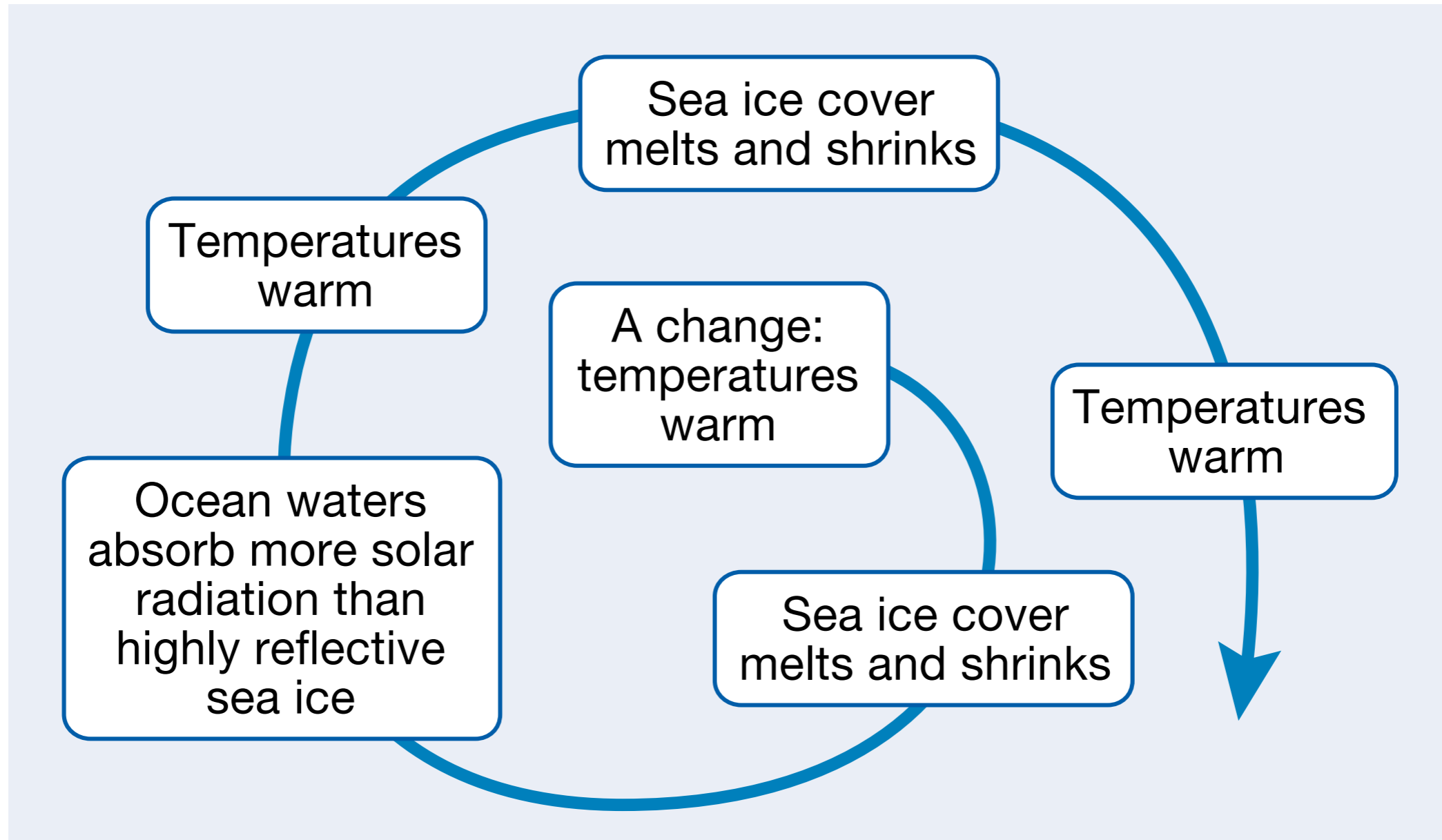
The systems approach

- The water balance provides an overview of water inputs, outputs, stores and flows within a drainage basin.
- A systems approach enables managers to gauge sustainable water use by understanding the links and interrelationships within the system – where water comes from, where it goes, how it is used, etc.
- A systems approach provides a holistic approach to management and enables quantification of stores and transfers.

A negative feedback cycle



A positive feedback cycle in the Arctic



Q3

ANSWER

Equilibrium and feedback

- A negative feedback lessens the effect of the original change.
- It encourages a return to stability, balance and a state of dynamic equilibrium.
- Negative feedbacks are commonplace in natural systems, such as the interaction between beach profiles and waves (steep profiles lead to destructive waves, which in turn reduce the beach profile).

Q4

ANSWER

Equilibrium and feedback

- A positive feedback encourages and accentuates change.
- Slide 6 shows how warm temperatures cause ice to melt. This exposes a greater surface area of water. Water absorbs heat, whereas ice reflects it back into space. This further increases temperature, leading to yet more melting and greater exposure of sea.
- The melting of Arctic sea ice could have profound impacts on climate, oceans and natural marine ecosystems (e.g. the well-documented plight of the polar bear).

Characteristics of the atmosphere

Component	Characteristics
Atmosphere	<ul style="list-style-type: none"> ■ A mixture of transparent gases held to the Earth by gravitational force. It mainly consists of nitrogen (78.09%) and oxygen (20.95%) by volume. Other gases include argon, carbon dioxide and traces of hydrogen, neon, helium, krypton, xenon, ozone, methane and radon. ■ The upper limit is assumed to be 1000 km, but, due to gravity and compression, most of the atmosphere is concentrated near to the Earth's surface. ■ About 50% of the atmosphere's mass lies within 5.6 km of the surface and 99% within 40 km. ■ Most of our climate and weather processes operate within 16–17 km of the surface in the zone of the lower atmosphere known as the troposphere. ■ Carbon dioxide absorbs long-wave radiation from the Earth (the greenhouse effect) and is important in plant photosynthesis.

Characteristics of the biosphere

Component	Characteristics
Biosphere	<ul style="list-style-type: none">■ Comprises those parts of the Earth's surface and atmosphere where living organisms exist. It is the worldwide sum of all ecosystems.■ The biosphere extends from root systems of trees, to the dark environment of ocean trenches, to dense rain forests and relatively barren high mountain summits. It extends to heights of up to ten kilometres above sea level, used by some birds in flight.■ The vast majority of species of animals, fungi, parasitic plants and many bacteria depend directly or indirectly on photosynthesis.

Characteristics of the hydrosphere

Component	Characteristics
Hydrosphere	<ul style="list-style-type: none">■ This is the total amount of water on the planet.■ The hydrosphere includes water that is on the surface, underground and in the air. It can be in the form of liquid, vapour or ice.■ Liquid water exists on the surface in the form of oceans, lakes and rivers. It also exists below ground – as groundwater, in wells and aquifers.■ Water vapour is most visible as clouds and fog.■ The frozen part of the Earth's hydrosphere (cryosphere) is made of ice: glaciers, ice caps and icebergs.

Characteristics of the lithosphere

Component	Characteristics
Lithosphere	<ul style="list-style-type: none">■ The lithosphere includes the crust and the upper mantle – the outermost ‘layer’ of the Earth’s structure.■ Tectonic processes such as earthquakes and volcanic eruptions are active within this subsystem.

Q5

ANSWER

Global physical systems

Component	Connections to...
Atmosphere	<p>Biosphere: insolation to stimulate growth, precipitation, wind</p> <p>Hydrosphere: precipitation, heat for evaporation, oceanic carbon sinks</p> <p>Lithosphere: precipitation, heat for weathering</p>
Biosphere	<p>Atmosphere: photosynthesis, evapotranspiration, respiration, natural fires</p> <p>Hydrosphere: aids soil water movement, evapotranspiration</p> <p>Lithosphere: compressed organic material, leaf litter decay, mechanical weathering</p>
Hydrosphere	<p>Atmosphere: evaporation, sublimation</p> <p>Biosphere: uptake of minerals and nutrients</p> <p>Lithosphere: groundwater stores (aquifers) and flows</p>
Lithosphere	<p>Atmosphere: emissions (steam, carbon, gases) from volcanoes</p> <p>Biosphere: minerals and nutrients following weathering</p> <p>Hydrosphere: deep-seated sources of groundwater, springs</p>

Sea ice near Kulusuk, Greenland



Q6

Sea ice near Kulusuk, Greenland

ANSWER

Inputs – include precipitation and radiation (heat) from the sun

Stores – water stored in the form of liquid water, snow and ice



Flows – water transferred between the hydrosphere and atmosphere by processes such as evaporation and sublimation

Positive feedback – warmer temperatures cause ice melt, which increases exposure of dark surfaces (rock, water), which further increases temperature and so on

Outputs – includes water and dissolved carbon