

Exercise walk-through

5.13

Methods to Reduce Urban Runoff

AP Environmental Science

Urbanization and sustainability

Urbanization adds
impervious surfaces :

- more runoff, less recharge;
heat island; sprawl
- fix with permeable pavement,
green roofs

An ecological footprint above
biocapacity cannot last.



Sprawl: impervious surfaces and heat islands

What a city does to the land it covers

impervious surfaces

roads and buildings replace soil, so rain **runs off** instead of soaking in – more flooding, less recharge

urban heat islands

dark surfaces and waste heat leave a city several degrees warmer than the land around it

urban sprawl

low-density spread consumes farmland and locks in car dependence

synthetic fertilizers

from the surrounding farms, carried into the city's rivers by that same runoff

Runoff is the link: pave the ground and you change the flood risk, the groundwater, and what reaches the river, all at once.

Exam tips

- Explain the **tragedy of the commons** – shared, unowned resources get overused – and how rules/ownership prevent it.
- Weigh the trade-offs of the green revolution, irrigation (salinisation, aquifer depletion), and mining/urbanisation.
- Compute an **ecological footprint** in “number of Earths” (footprint $\div$ biocapacity per person); it is measured **per person**.
- List the harms of **deforestation** (erosion, flooding, lost habitat, more CO₂).
- Define **sustainability** (meeting needs without harming future generations) and give sustainable methods (IPM, crop rotation, quotas).

Exercises 2.1-2.3

2.1 How does permeable pavement reduce runoff?

[1]

2.2 What is a rain garden?

[1]

2.3 State one benefit of a green roof.

[1]

Exercises 2.1-2.3

2.1 How does permeable pavement reduce runoff? [1]

2.1

- It lets water pass through into the ground instead of running off
-

2.2 What is a rain garden? [1]

2.2

- A planted depression that collects and absorbs runoff
-

2.3 State one benefit of a green roof. [1]

2.3

- Any one: absorbs rain (less runoff), cools the building, reduces heat island

Exercise 3.1

3.1 Permeable pavement reduces flooding by allowing water to

[1]

☐

A run off faster

B soak into the ground

C evaporate instantly

D freeze

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3.1 B

- soak into the ground

Exercise 3.2 (a)

3.2 A city installs rain gardens and permeable pavement.

(a) Explain how these reduce runoff and pollution.

[3]

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(a)

- They increase infiltration so less water runs off (less flooding), and soil/plants filter pollutants before the water reaches rivers

Exercise 3.2 (b)

3.2 A city installs rain gardens and permeable pavement.

(b) State the underlying problem they address.

[1]

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[1]

(b)

- Impervious surfaces causing runoff

Exercise 3.3

3.3 Explain how green roofs reduce both runoff and the urban heat island effect. [2]

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3.3

- The vegetation absorbs rainwater (reducing runoff) and cools the air through shade and transpiration, lowering the urban heat island effect