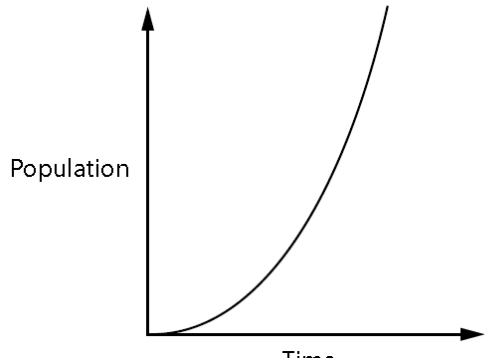
Is change inevitable?
Who wins and who loses in the changes?
Who/what is responsible for change?

Humans can only manage change, they cannot control it…

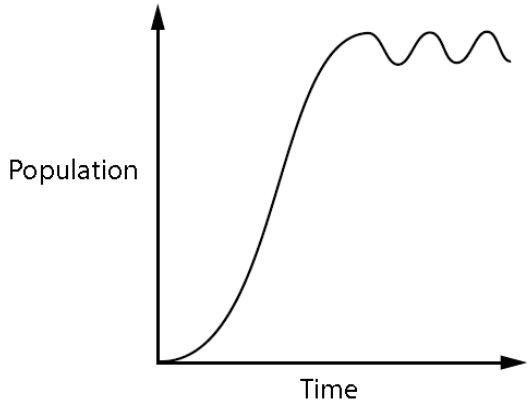
2.6 Changes in Ecosystems

2.6.1	Explain the concepts of limiting factors and carrying capacity in the context of population growth.	3	
2.6.2	Describe and explain S and J population curves.	3	Explain changes in both numbers and rates of growth in standard S and J population growth curves. Population curves should be sketched, described, interpreted and constructed from given data.

J curve



S curve



2.6.3	Describe the role of density-dependent and density-independent factors, and internal and external factors, in the regulation of populations.	2	According to theory, density-dependent factors operate as negative feedback mechanisms leading to stability or regulation of the population. Both types of factors may operate on a population. Many species, particularly *r*-strategists, are probably regulated by density-independent factors, of which weather is the most important. Internal factors might include density-dependent fertility or size of breeding territory, and external factors might include predation or disease.
2.6.4	Describe the principles associated with survivorship curves including, *K*- and *r*-strategists.	2	*K*- and *r*-strategists represent idealized categories and many organisms occupy a place on the continuum. Students should be familiar with interpreting features of survivorship curves including logarithmic scales.

Glossary

Carrying capacity	The maximum number of a species or "load" that can be sustainably supported by a given environment.
***K*-strategist**	Species that usually concentrate their reproductive investment in a small number of offspring, thus increasing their survival rate and adapting them for living in long-term climax communities.
***r*-strategist**	Species that tend to spread their reproductive investment among a large number of offspring so that they are well adapted to colonize new habitats rapidly and make opportunistic use of short-lived resources.

Key words

Carrying capacity (K)

'J' curve - Exponential/Geometric growth

'S' curve – (sigmoid) Arithmetic growth

Limiting factors (density dependant & independent)

Survivorship curves

r-species

K-species

2.6.2 Describe and explain S and J population curves.

Population Growth

- All populations (plants, people, bacteria...) have the ability to reproduce offspring

- So, as a global community, what are *common* traits we all share regarding reproduction?

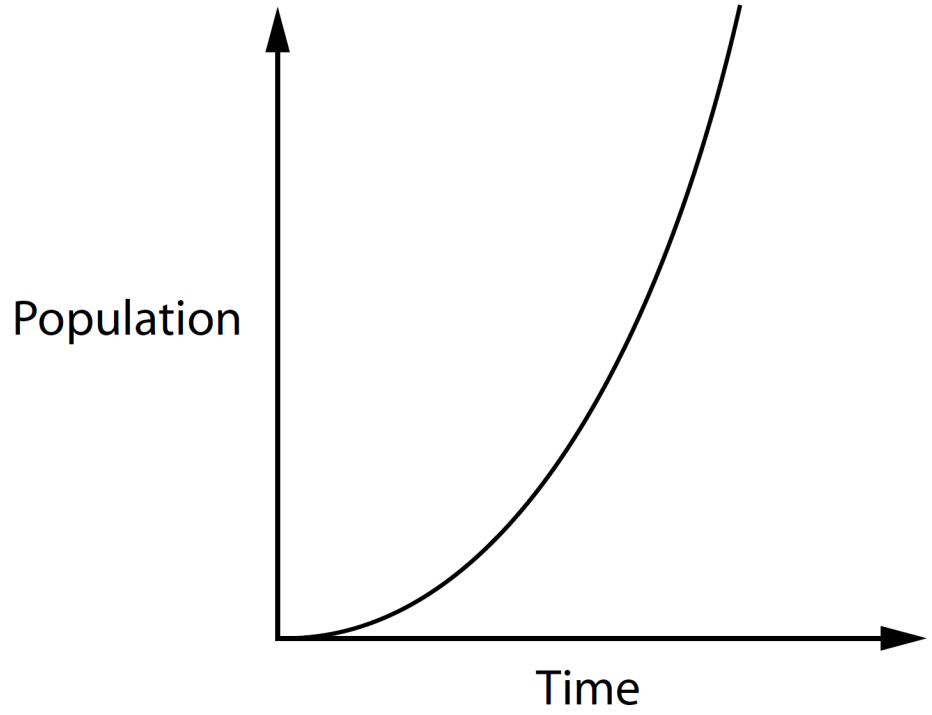
- Each population of species reproduces more offspring than is needed to replace mating partners when they die.

- Every generation of offspring also has this same ability to reproduce

Exponential Growth

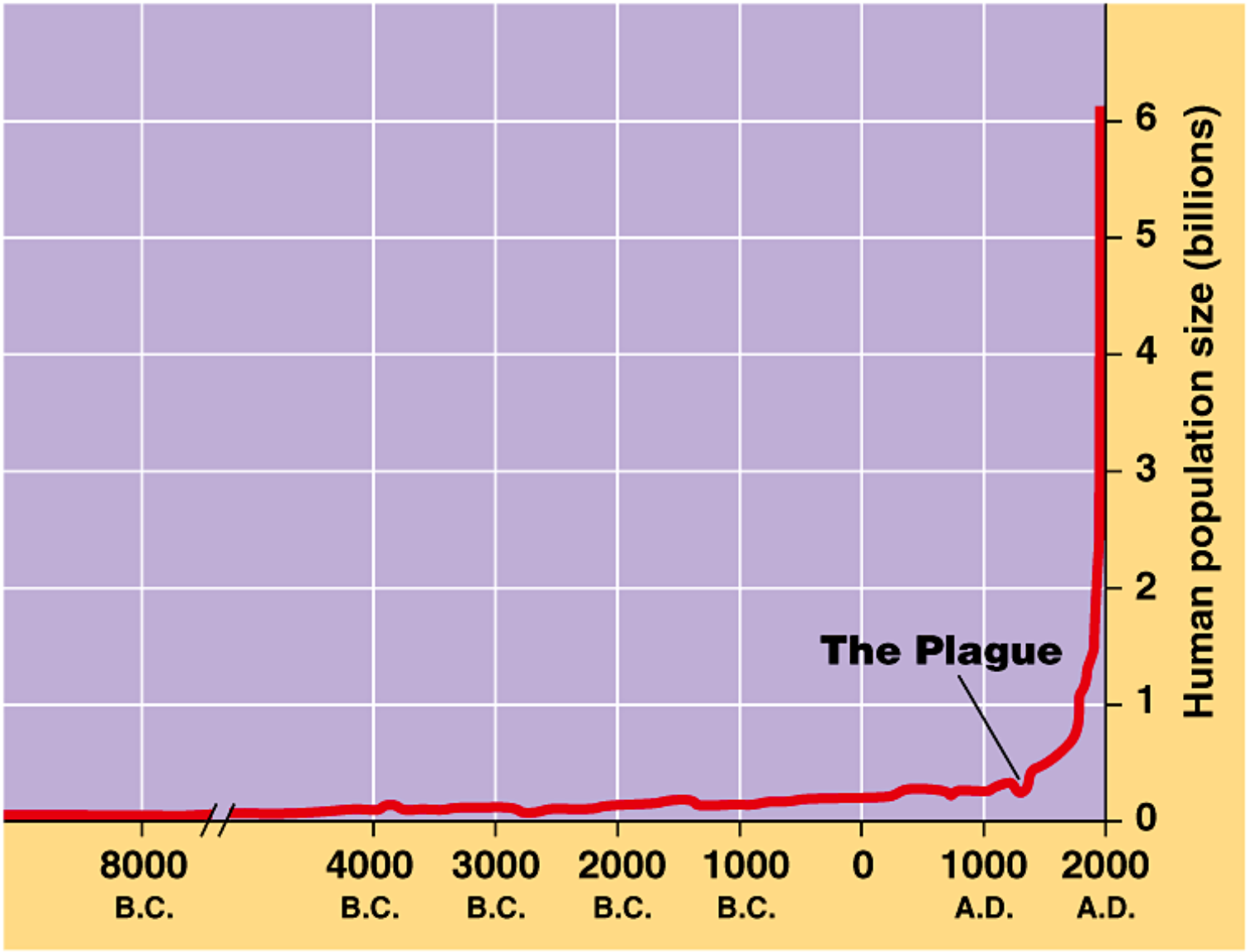
- *Thus over time, there are more and more individuals that will be reproducing - positive feedback*
- So, population growth is, ***exponential (geometric)*** at least initially: 2, 4, 8, 16…

Population Growth: 'J' Curves
(sketch it!)

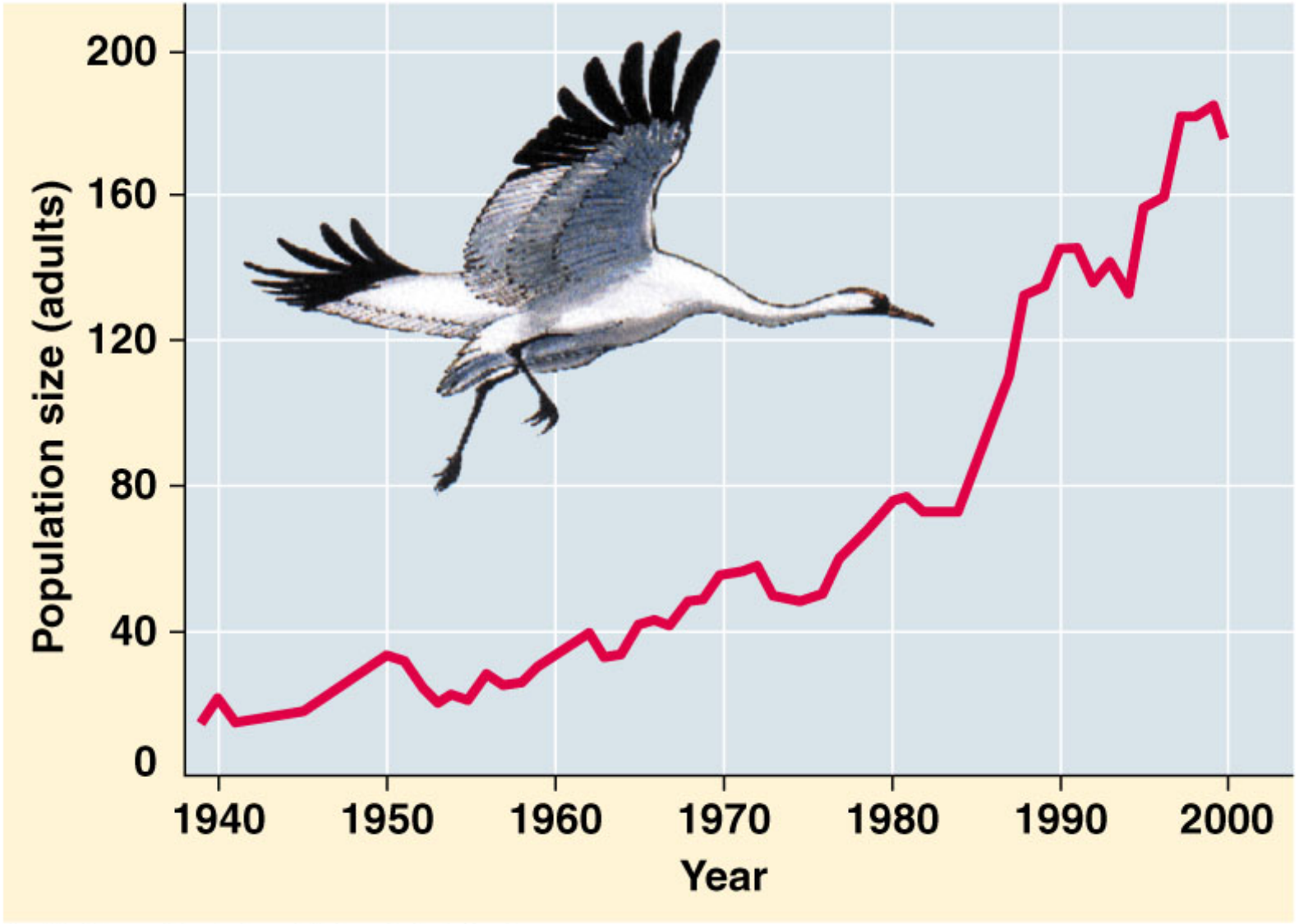


The population is growing exponentially – it is increasing at an accelerating rate

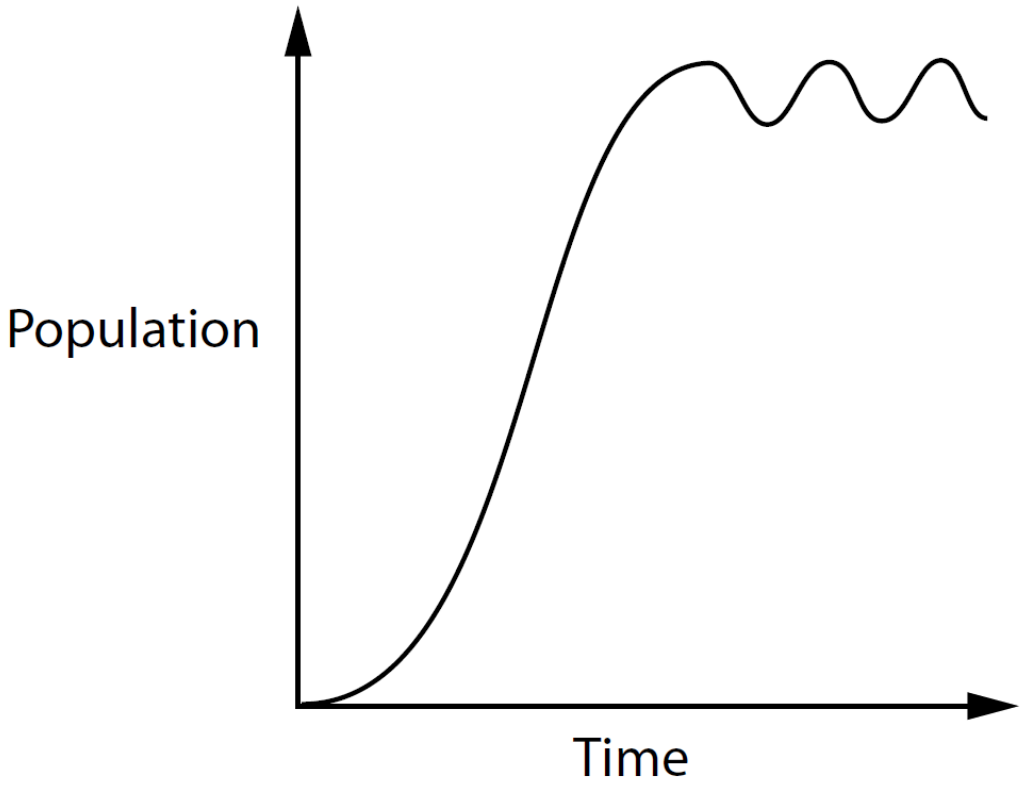
Human population growth curve



Ex: Egret population growth curve



Population Growth: Sigmoid 'S' Curves (sketch it!)



- **This population has reached a – steady state equilibrium,... WHY?**

organism	Average number of fertilised eggs produced by a female in her lifetime		organism	Average number of fertilised eggs produced by a female in her lifetime
oyster	100×10^6		mouse	50
codfish	9×10^6		dogfish	20
Plaice (fish)	35×10^4		penguin	8
salmon	10×10^4		elephant	5
stickleback	500		Victorian Englishwoman	10
Winter moth	200			

- **Which organism's population will grow the fastest? Explain.**

- the oyster has a high reproduction rate (or a tremendous ability to produce a large number of offspring), yet the oceans are not full of oysters.

Why not?

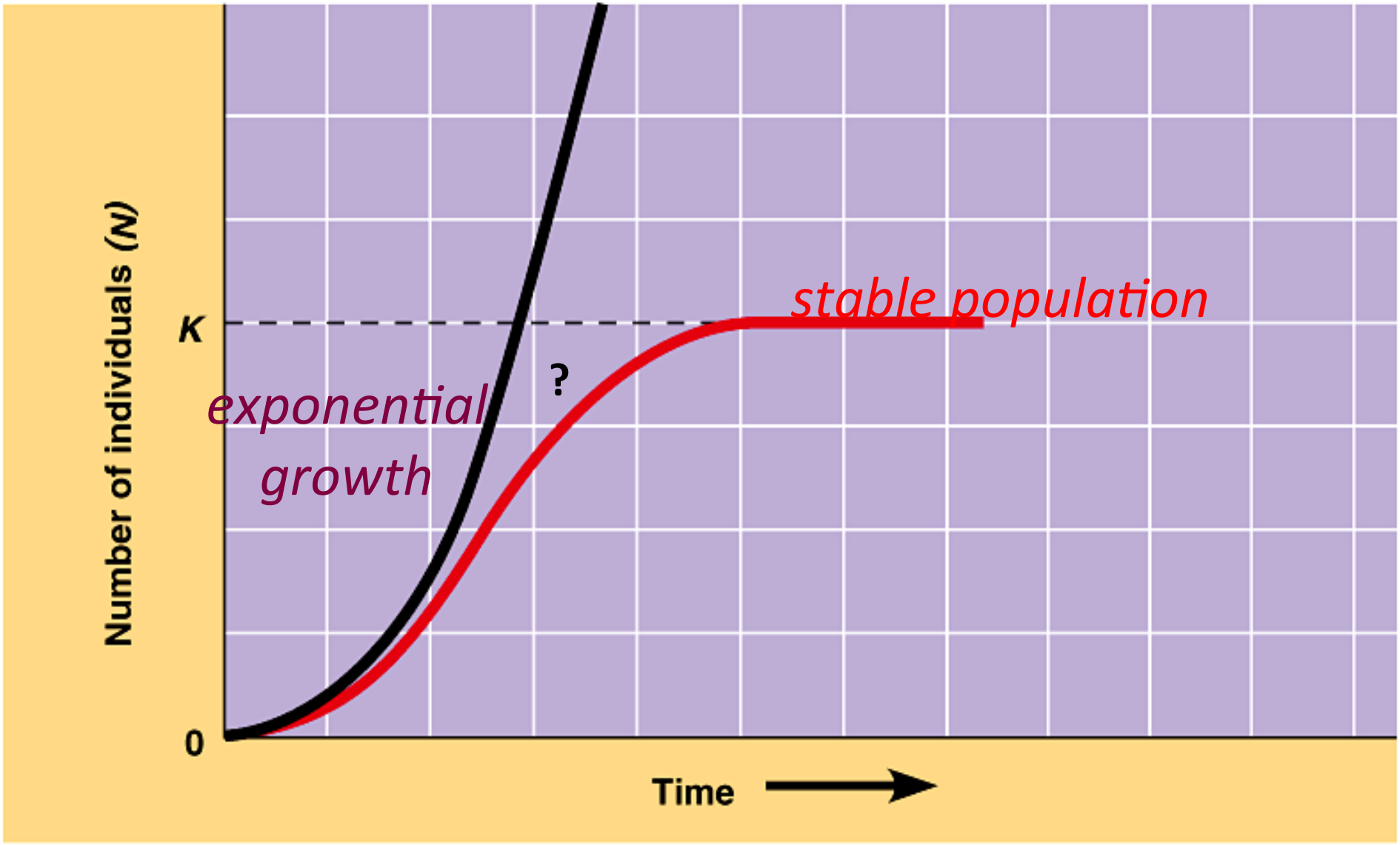
- there are factors which prevent an indefinite 'J' curve increase in population size

- ***environmental resistance*** or ***limiting factors***. (factors which limit the distribution or population size of an organism in an area)

- These are negative feedback mechanisms that help to regulate population size

2.6.1 Explain the concepts of limiting factors and carrying capacity in the context of population growth.

Population growth curves



Carrying Capacity (K)

- The maximum number of a species or “load” that can be ***sustainably*** supported by a given environment.

- Populations in the wild do not remain constant in size but fluctuate about the carrying capacity

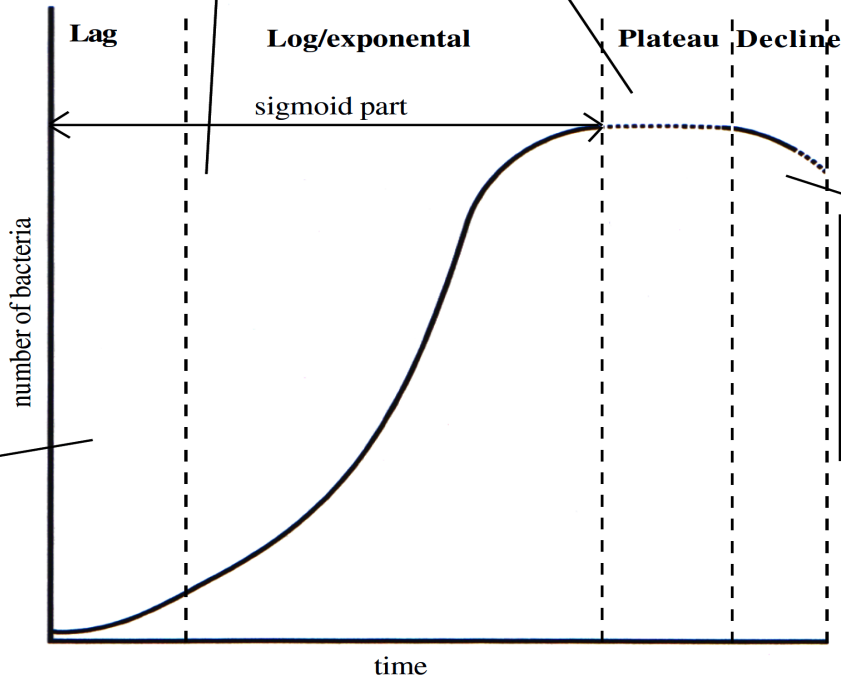
Fig 1. Growth rate curve

Log/exponential phase
Maximum growth rate.
Growth is exponential ie numbers double in constant time periods/every generation.
There are no limiting factors (eg there is plenty of oxygen/ nutrients and waste products aren't poisoning them yet).

Plateau/stationary phase
Growth rate/production of new cells is slow.
Limiting factors are in operation (nutrients/oxygen low or competition for them is very high/waste products of metabolism/toxins/extreme pH killing some cells).
Number of new cells = number dying.

Lag phase
Small number reproducing because time needed to:
- Activate genes.
- Synthesise enzymes for medium they are in.
- Remember that, if the organisms are in an unfamiliar/unusual/ complex growth medium eg xylose or sucrose rather than, say, glucose, the lag phase may take longer than otherwise.

Cells are growing in size before reproducing.

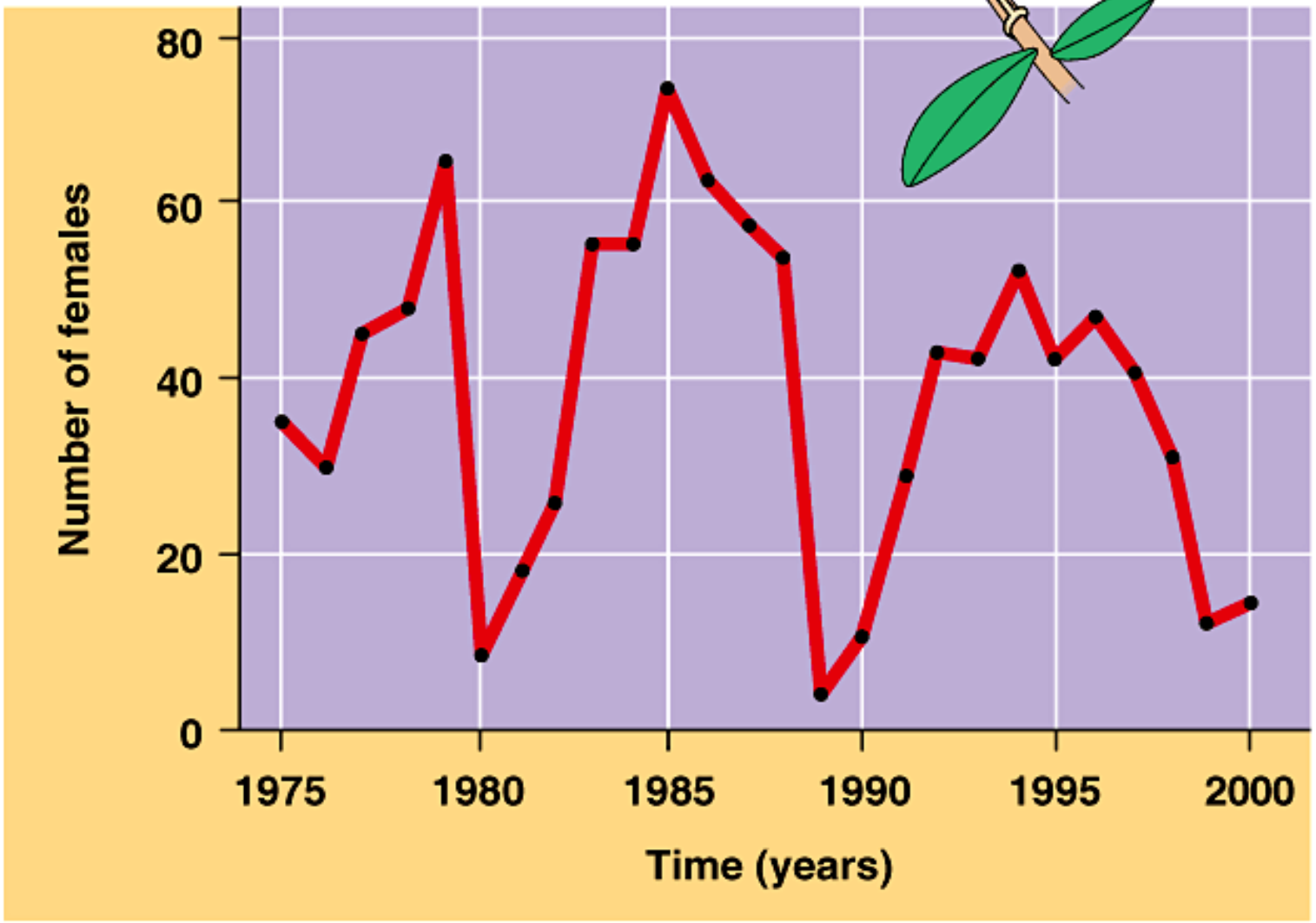


Decline phase
Death of cells exceeds production of new cells.
Waste products/toxins are rapidly killing cells.
Become overcrowded and starved of nutrients/oxygen.

Exam Hints

1. Do not go into the exam without knowing every bit of this graph off by heart!
2. Use the technical terms (sigmoid/exponential/limiting factors etc. They will be on the markscheme and it stops you waffling. Avoid writing things like " In the log phase numbers increase" "In the decline phase disease spreads rapidly and they run out of space." This is too vague. Make your points with the precision shown in the annotations in Fig 1.
3. Don't be put off if the y axis doesn't show numbers/population. There are other ways of measuring microorganisms e.g. chlorophyll concentration for algae, turbidity (cloudiness) for almost any microorganisms

Sparrow population growth curves - cycles



Biozone packet

Pop growth

Regulating pop

2.6.3 Describe the role of density-dependent and density-independent factors, and internal and external factors, in the regulation of populations.

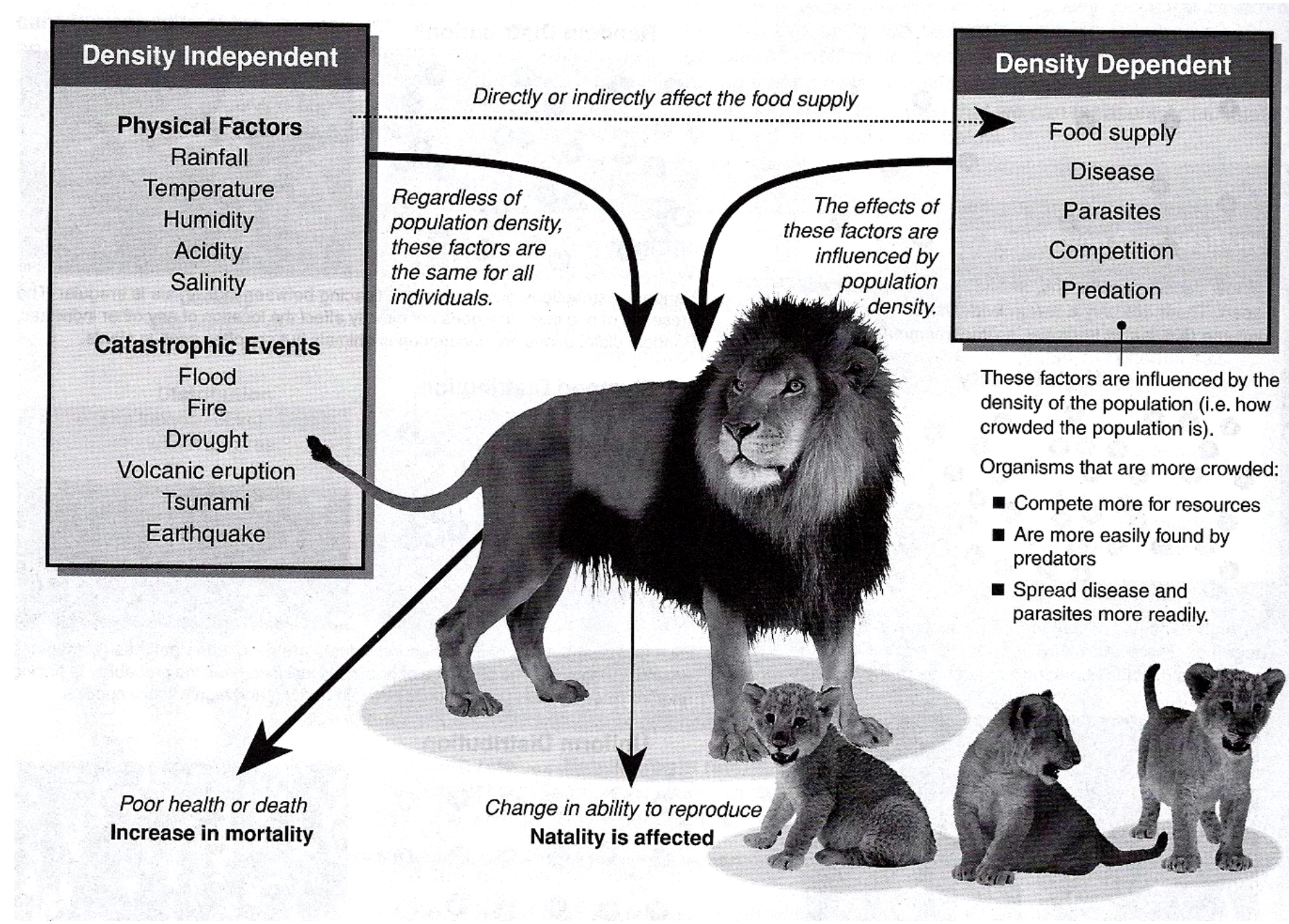
Limiting Factors

- an environmental factor that restricts and reduce population growth (resistance)
- The resource present in shortest supply is often limiting

Two types:

density *dependent*

density *independent*


Density Independent
Physical Factors
Rainfall
Temperature
Humidity
Acidity
Salinity
Catastrophic Events
Flood
Fire
Drought
Volcanic eruption
Tsunami
Earthquake
Directly or indirectly affect the food supply
Density Dependent
Food supply
Disease
Parasites
Competition
Predation
Regardless of population density, these factors are the same for all individuals.
The effects of these factors are influenced by population density.
These factors are influenced by the density of the population (i.e. how crowded the population is).
Organisms that are more crowded:
Compete more for resources
Are more easily found by predators
Spread disease and parasites more readily.
Poor health or death
Increase in mortality
Change in ability to reproduce
Natality is affected

BioZone

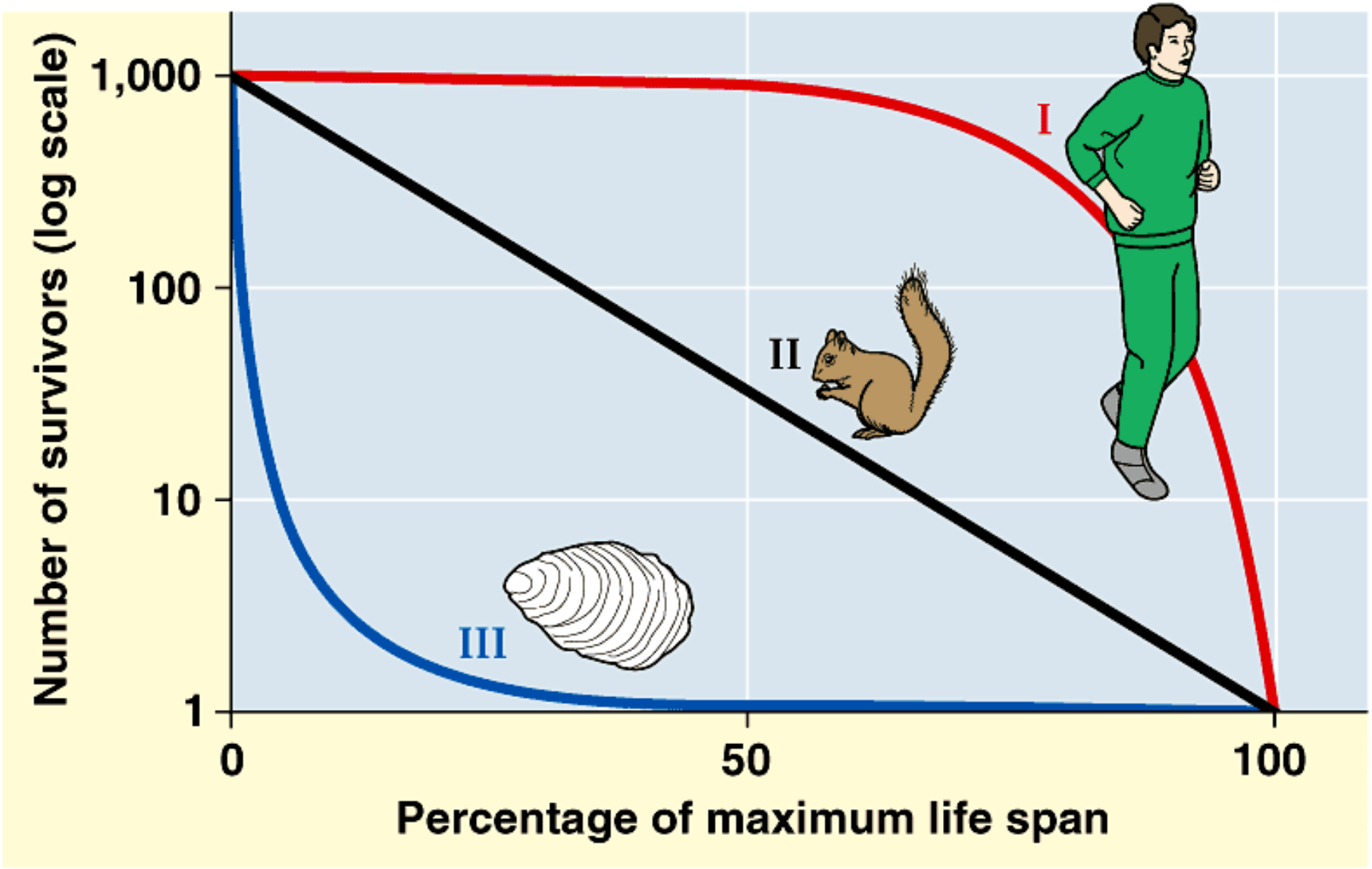
Regulating the population

2.6.4 Describe the principles associated with survivorship curves including, K- and r-strategists.

BioZone

r- and K- strategists

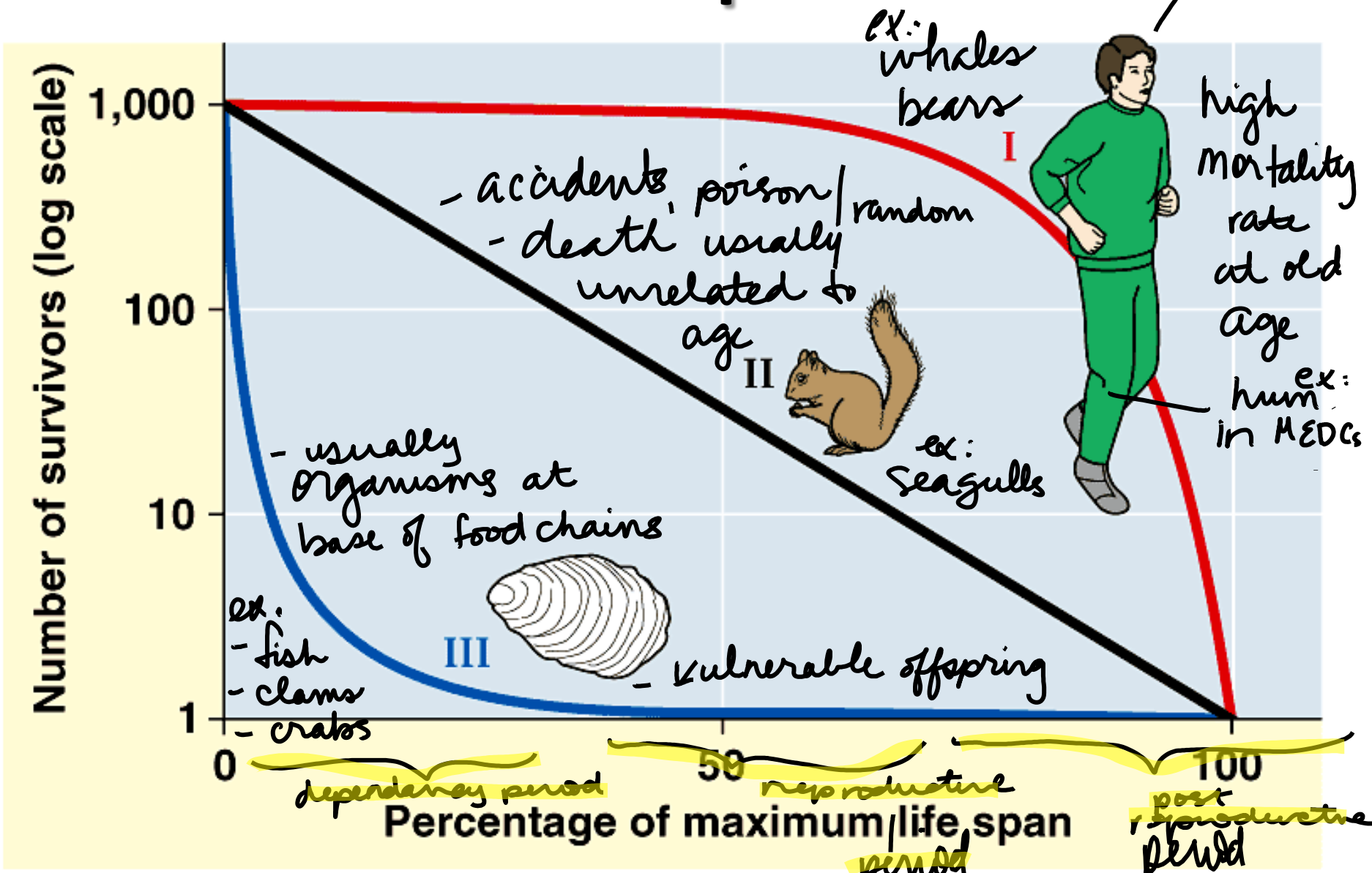
Survivorship Curves



Task:

- Qs on worksheets : population growth and survivorship curves

Survivorship Curves



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