Gene 422/522

Design of breeding programs

University of New England, Armidale.

Animal Breeding ...

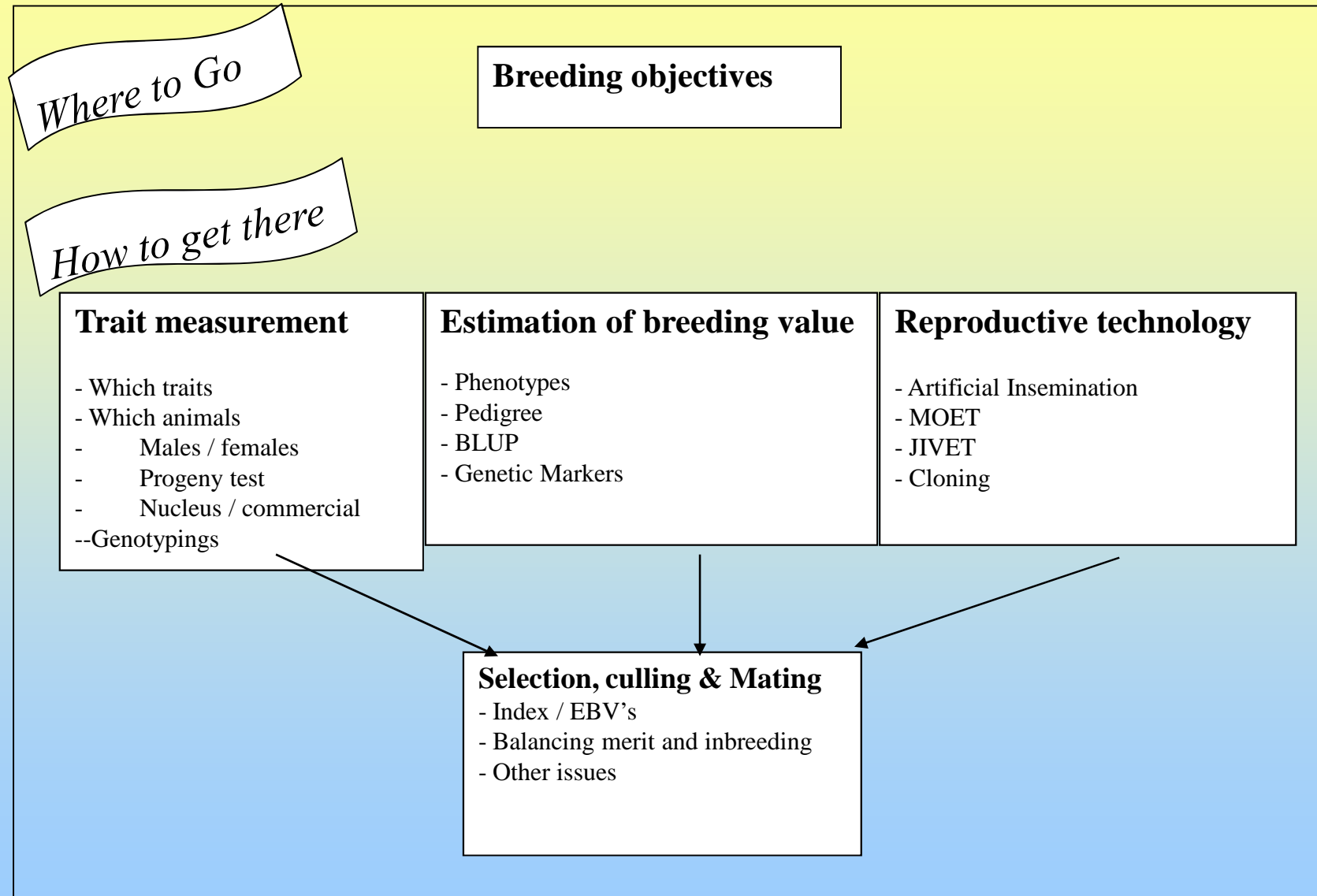**Objectives to target**   Where to go?

Tools to exploit

Strategies to adopt   How to get there?

Animal Breeding in a nutshell

Where to Go

How to get there

Breeding objectives

Trait measurement

- Which traits
- Which animals
-         Males / females
-         Progeny test
-         Nucleus / commercial
--Genotypings

Estimation of breeding value

- Phenotypes
- Pedigree
- BLUP
- Genetic Markers

Reproductive technology

- Artificial Insemination
- MOET
- JIVET
- Cloning

Selection, culling & Mating
- Index / EBV's
- Balancing merit and inbreeding
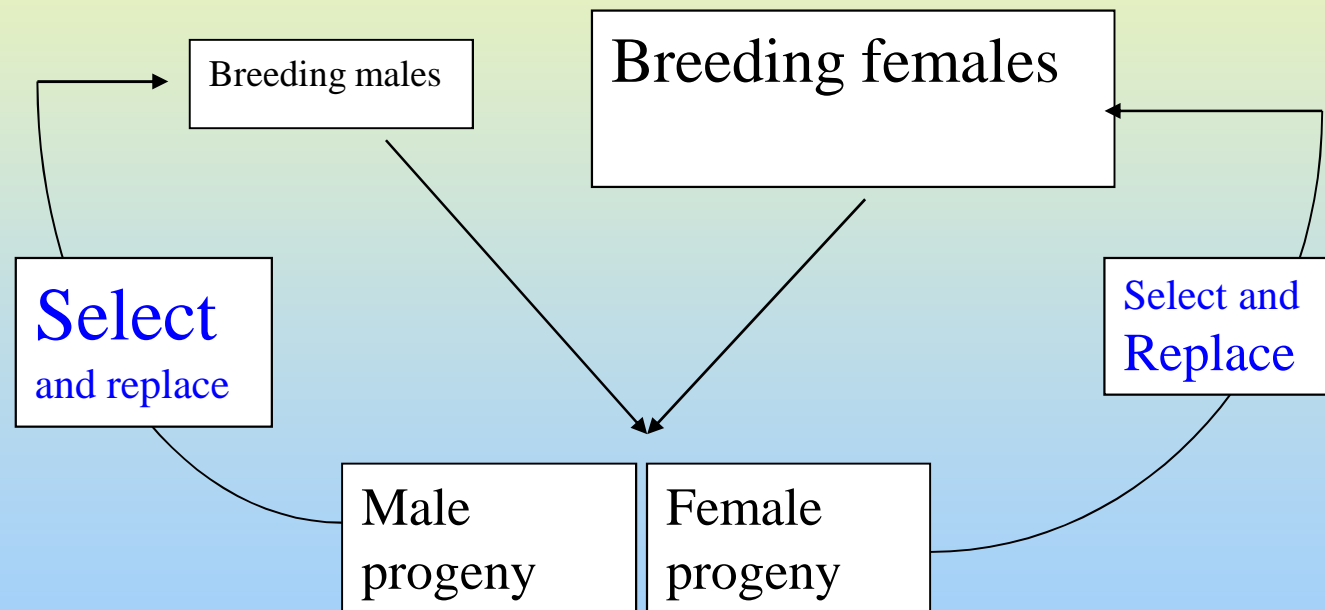- Other issues

Why do we need a design?

- Genetic Improvement
    - Which animals to measure
    - Where to select them
    - Mating strategy → best to best

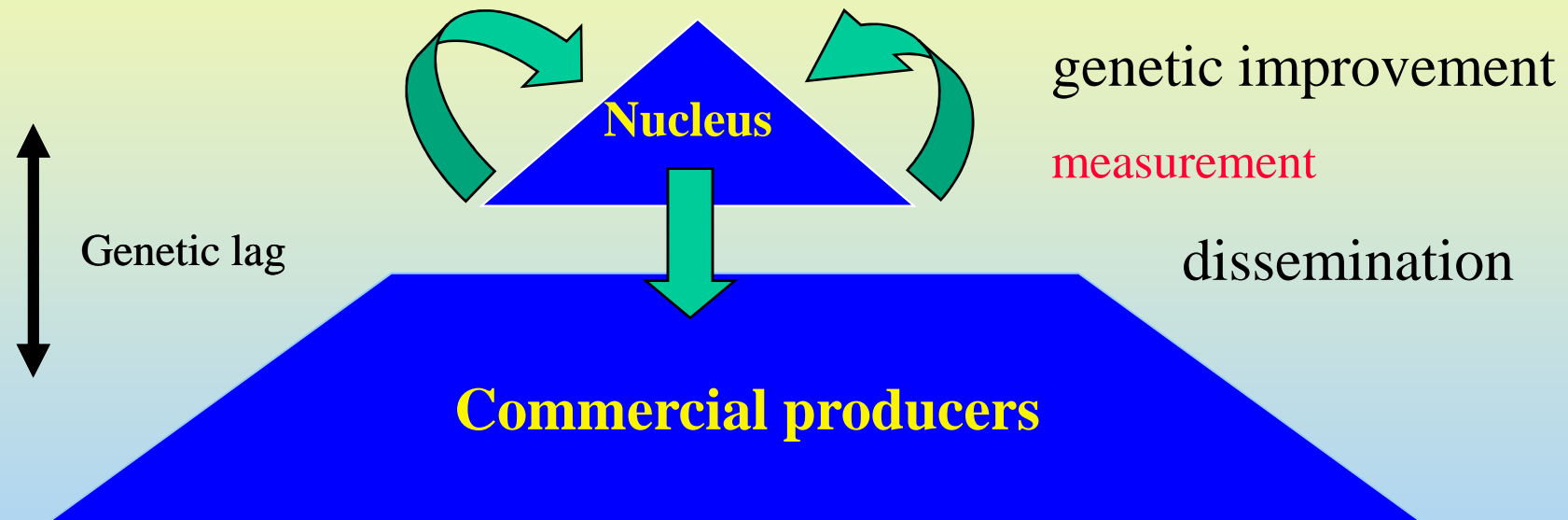- Dissemination of Genetic Superiority
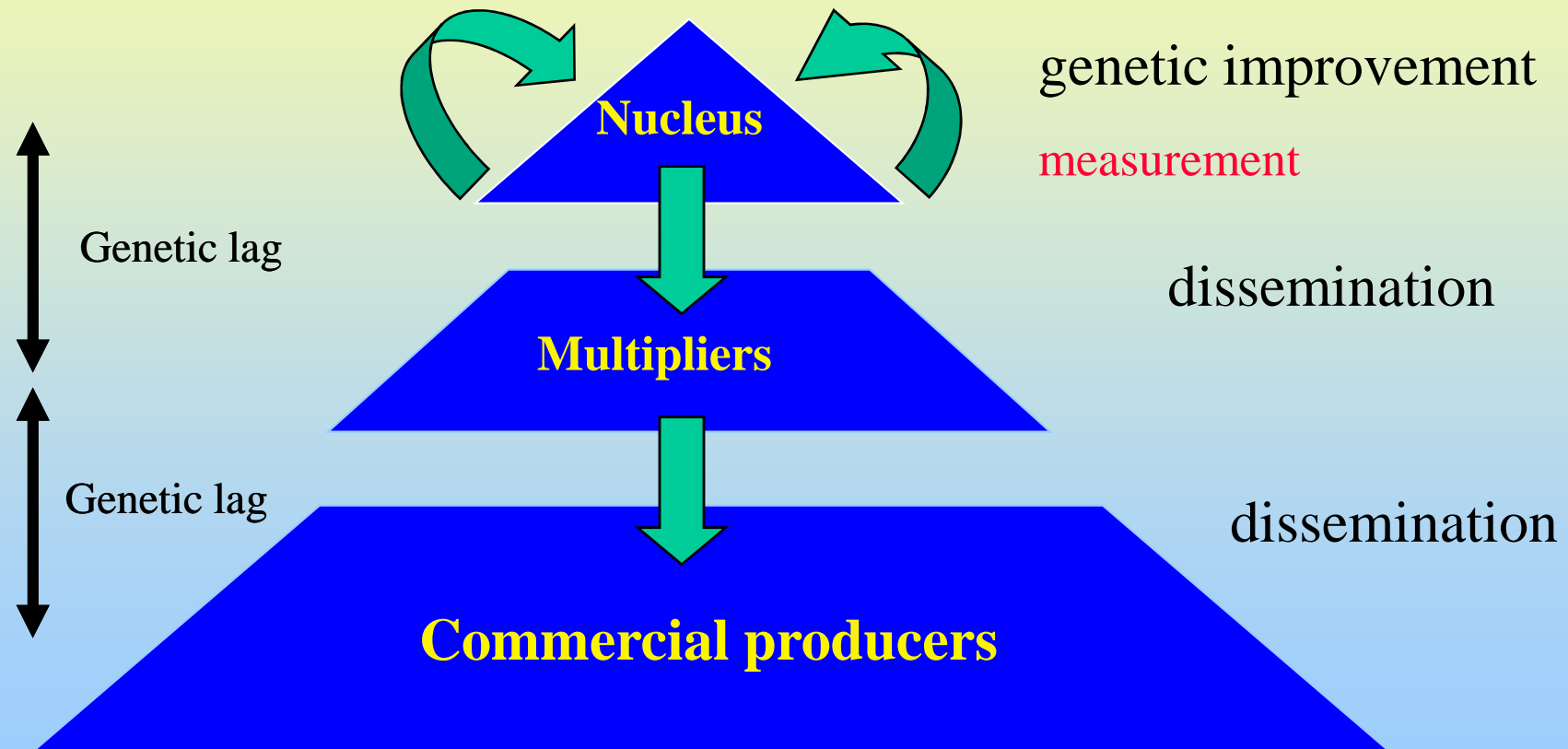
Design examples

- One-tier breeding program
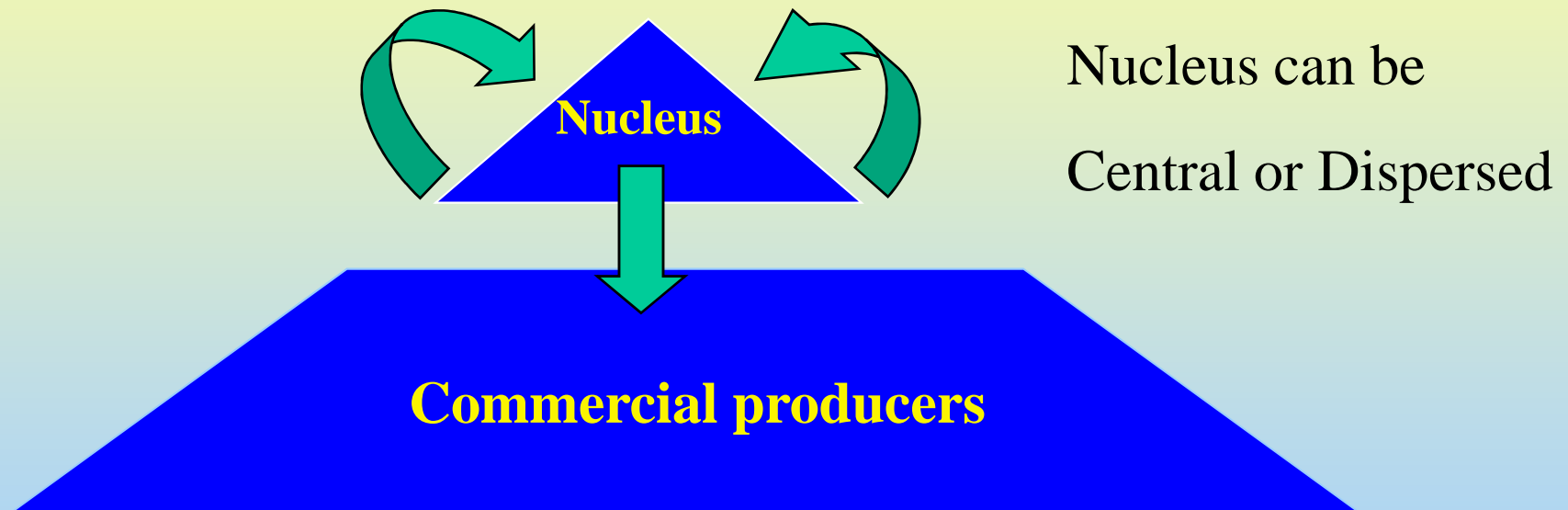
Design examples

- Two-tier breeding program

Design examples

- 3-tier breeding program

Design examples

- Two-tier breeding program

Nucleus

Commercial producers

Nucleus can be

Central or Dispersed
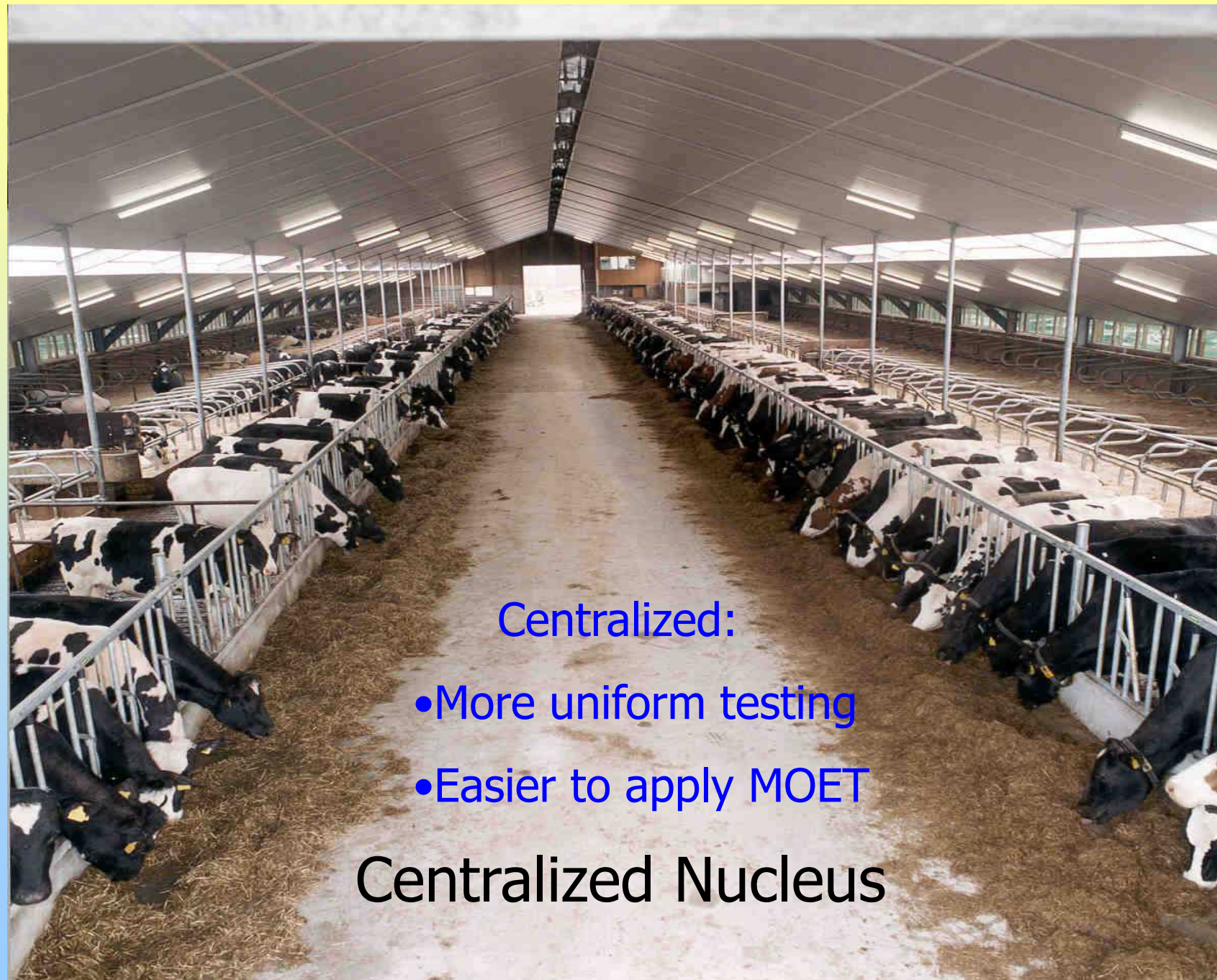
Centralized:

- More uniform testing
- Easier to apply MOET

Centralized Nucleus

- Central Nucleus

Nucleus

Nucleus: could be defined as

"the mothers and fathers of the future bulls"
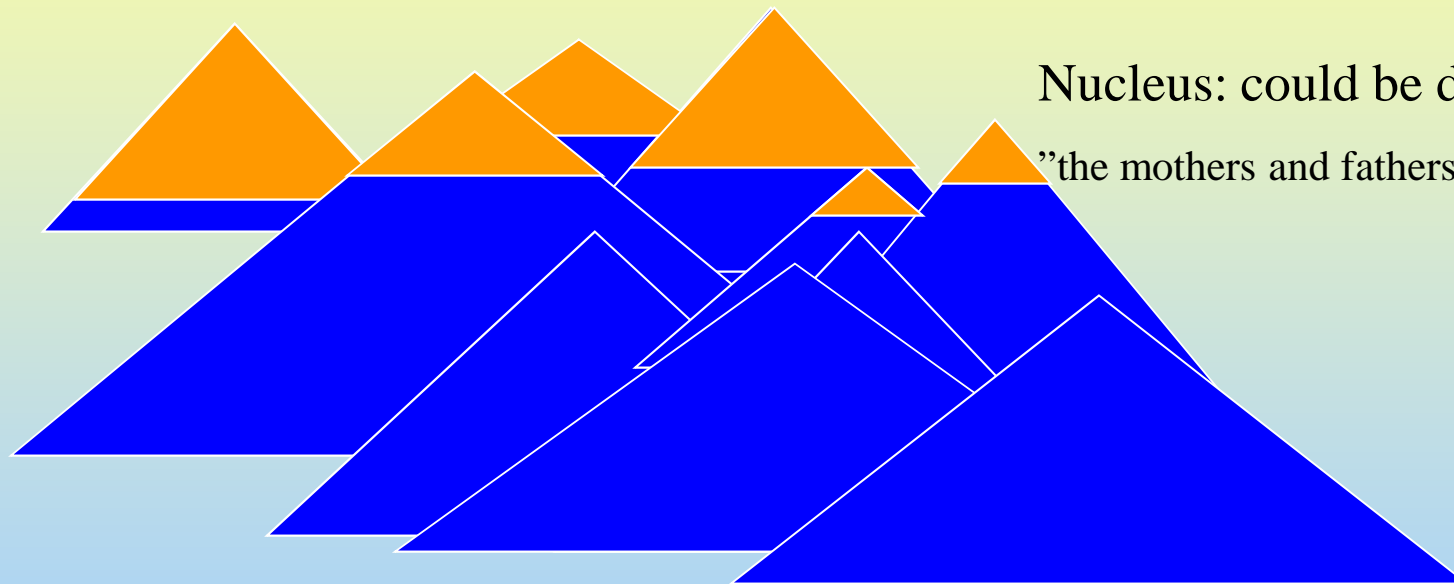
Commercial producers

4 pathways: selection of sires for sires
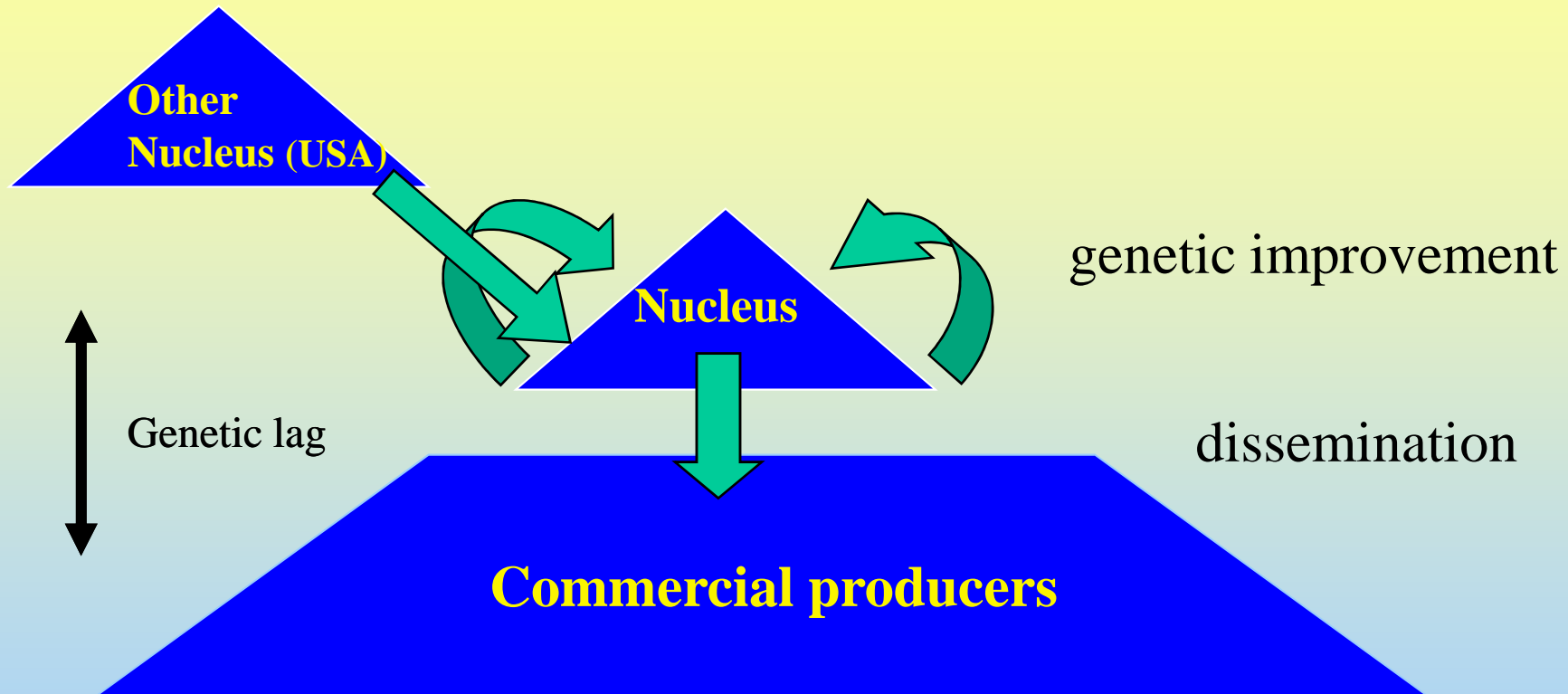
sires for cows

dams for sires

dams for cows

- Dispersed Nucleus

Nucleus: could be defined as

"the mothers and fathers of the future bulls"

Local 'nucleus' can in fact be multiplier

Other
Nucleus (USA)

Nucleus

genetic improvement

Genetic lag

dissemination

Commercial producers
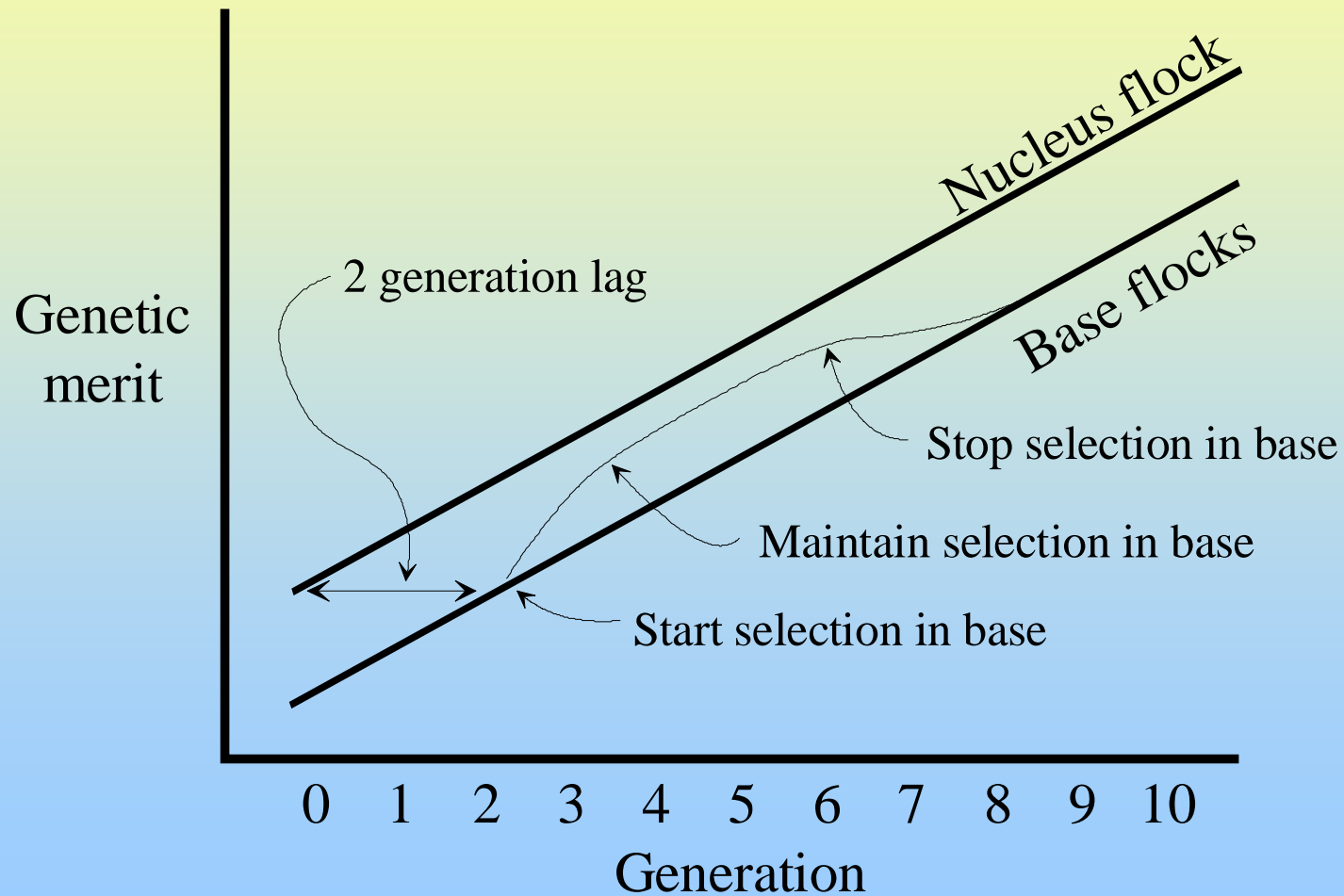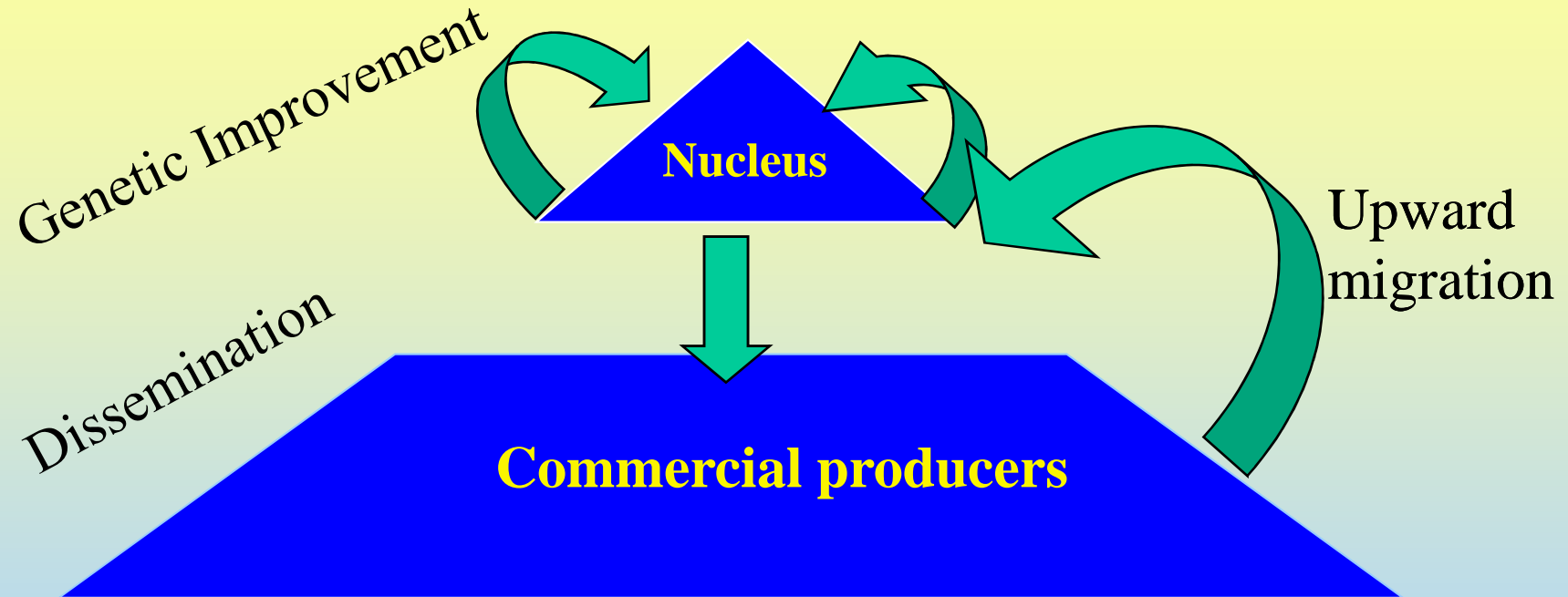
Closed nucleus breeding schemes

1. Selection only permanently effective in nucleus.

2. Nucleus objectives impact on whole scheme.

3. Lag …

4. Common in pigs and poultry

Closed nucleus breeding schemes

Design examples

Open Nucleus

Genetic Improvement

Dissemination

Nucleus

Upward migration

Commercial producers
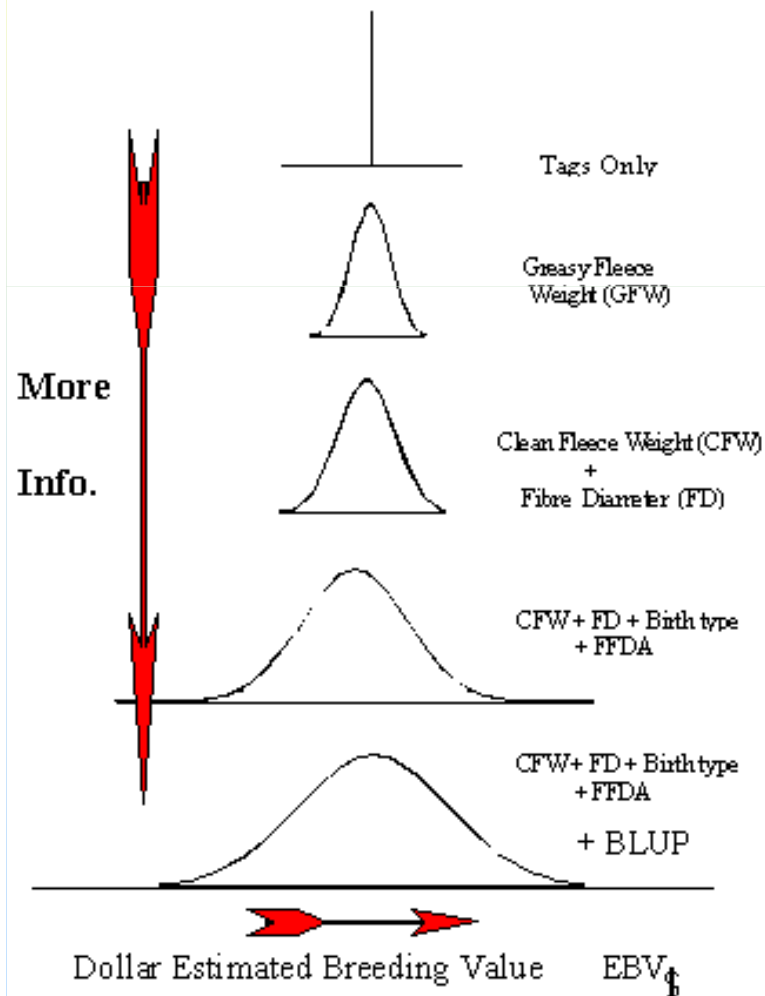
More genetic improvement (about 15%)

Data collection (records/pedigree) also needed in base but usually more intensive in nucleus

Open nucleus systems

- Select the best animals from lower tiers to compare for being nucleus parents

- degree of 'openness depends on
    - difference between nucleus and commercial
    - spread of their breeding values

- other nuclei
- Common in dairy

Open nucleus breeding schemes

More information gives more Spread in EBV's

More Info.

Tags Only

Greasy Fleece Weight (GFW)

Clean Fleece Weight (CFW) + Fibre Diameter (FD)

CFW + FD + Birth type + FFDA

CFW + FD + Birth type + FFDA + BLUP

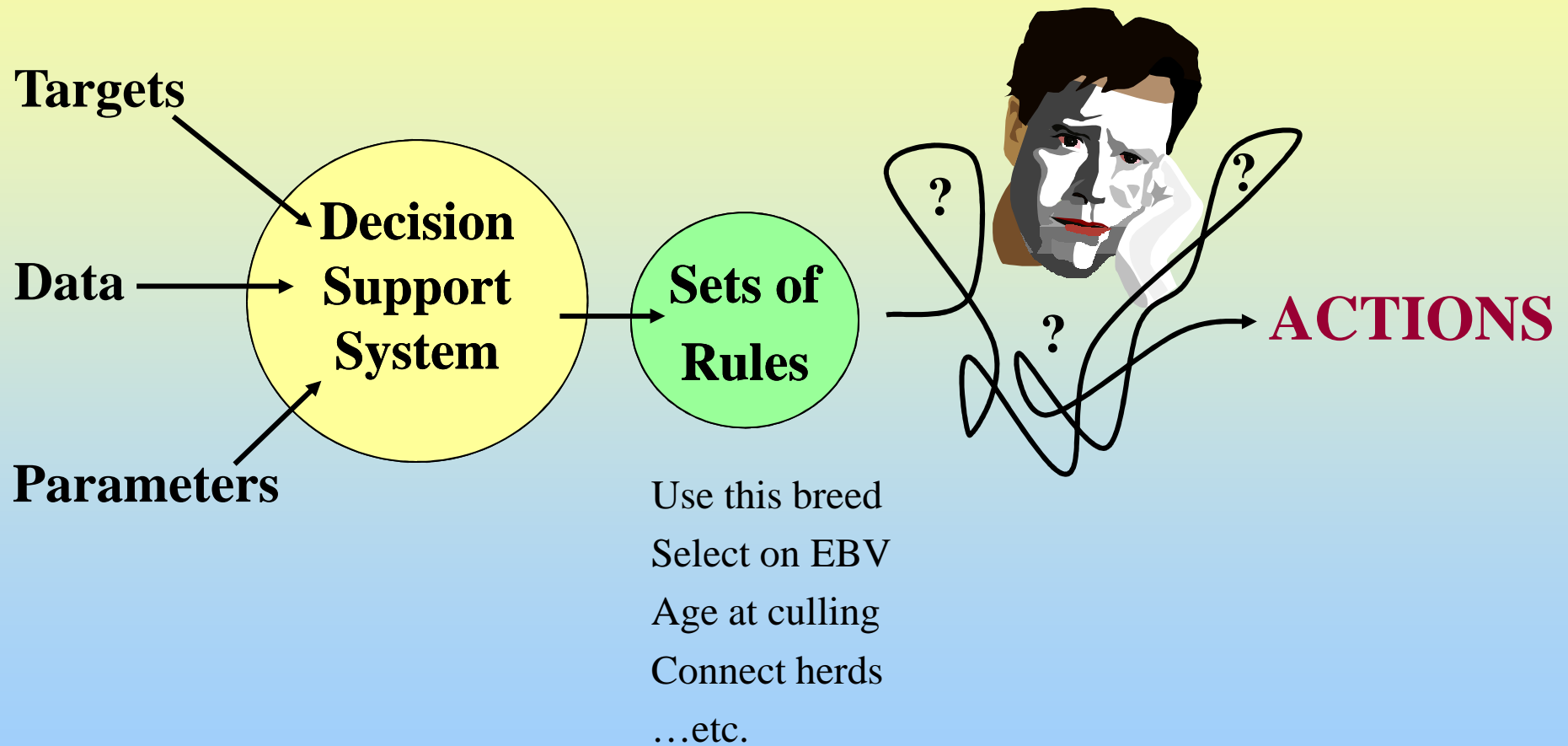Dollar Estimated Breeding Value   EBV $

- More information in nucleus

  → more spread of values

  → more selected from nucleus

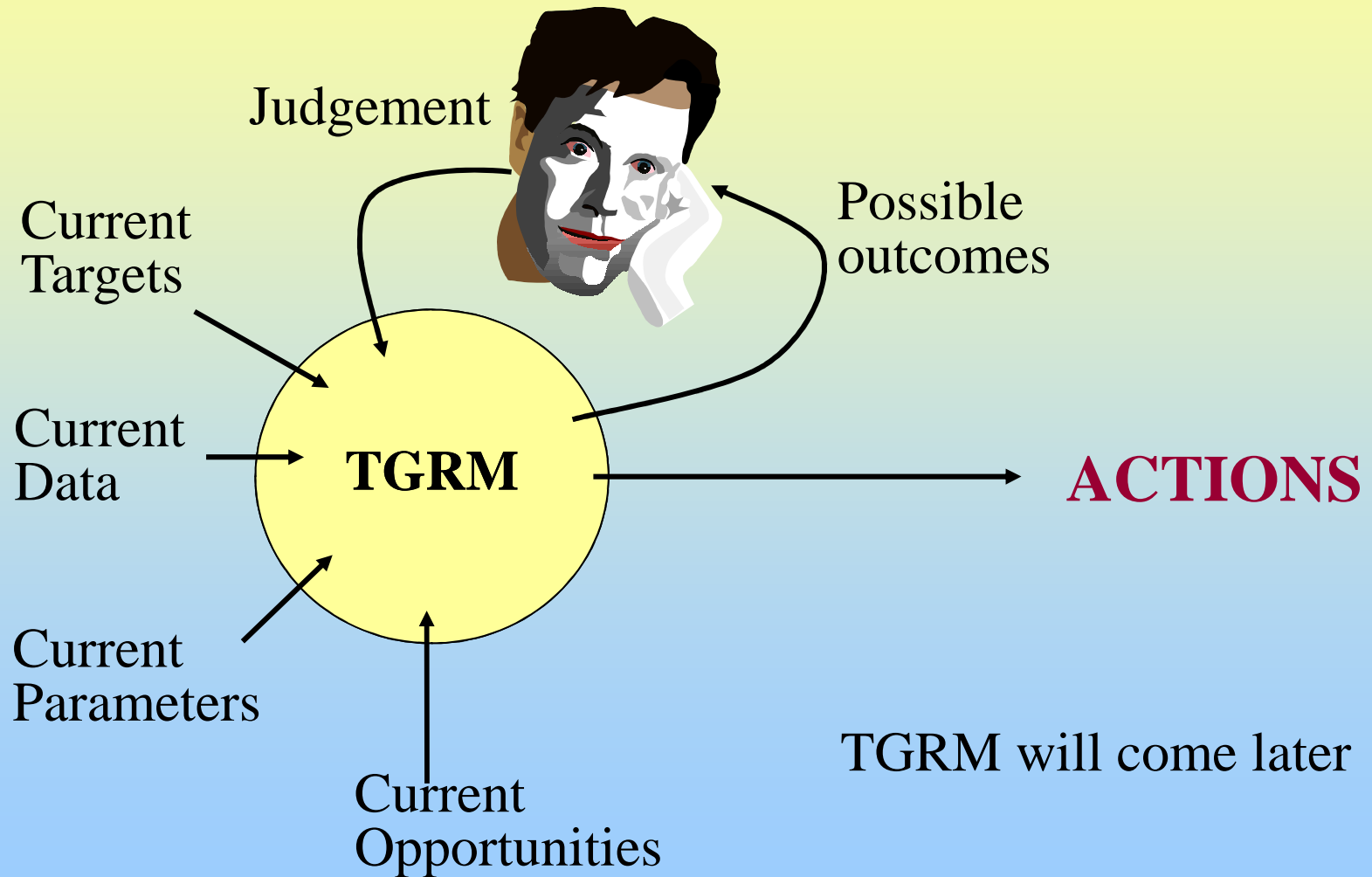# Implementation of programs ...

- ## Rules-based approach:
  - "Start joining on 1st February"
  - "Use best 10 rams mated to best 400 ewes"
  - "Set up a rotational cross"

- ## Tactical approach
  - Maximise impact of selection and mating, based on *prevailing* animals, markets, costs, constraints and opportunities.

Rules-based approach to Design

Targets

Data

Parameters

Decision Support System → Sets of Rules → ? ? ? → **ACTIONS**

Use this breed
Select on EBV
Age at culling
Connect herds
…etc.

Tactical approach to Design
Action Decision Systems

Judgement

Current Targets

Current Data

Current Parameters

TGRM

Possible outcomes

Current Opportunities

ACTIONS

TGRM will come later !!

Tactical approach to Design

- **Determine the consequences of your actions**
  (or … develop an <u>objective function</u> which describes net utility as a function of selections and mate allocations).

    - eg. Predicted merit one generation ahead
    - eg. Predicted merit n generations ahead

- **Find the actions which maximise the consequences**
  (or … develop and implement a <u>mate selection algorithm</u> which maximises this objective function).

    - egs. linear programming and genetic algorithms
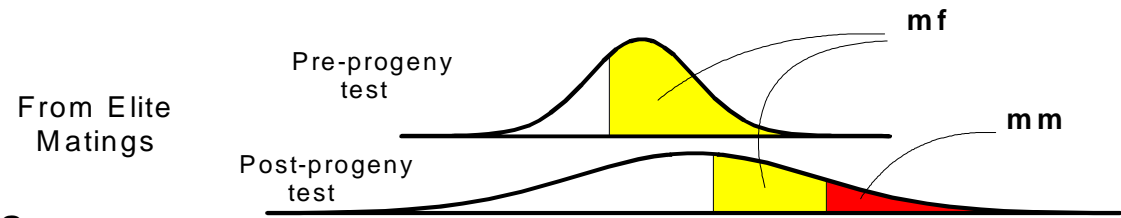
Dairy breeding structure

	males		females	
Elite matings:	to breed males	x	to breed males	... maybe 10,000 cows
	[mm	x	fm]	

	males		females	
Normal matings:	to breed females	x	to breed females	... maybe 10,000,000 cows
	[mf	x	ff]	

Dairy breeding structure

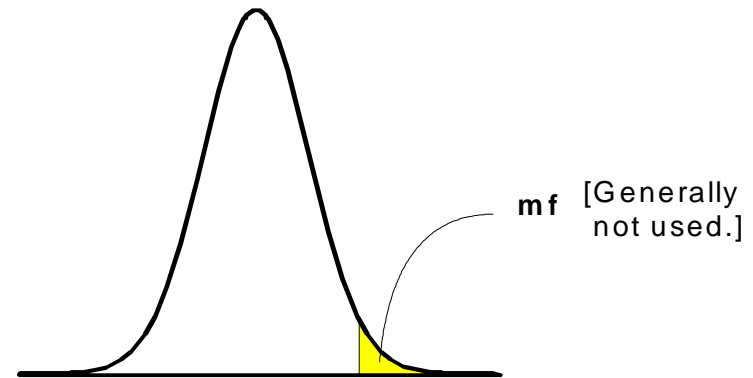|	
ELITE MATINGS	mm: 2 to 5 top progeny tested sires. fm: best cows selected on index, contract mated with mm semen to produce young bulls for progeny testing.
NORMAL MATINGS	mf: second best (but acceptable) progeny tested sires, plus young bulls for progeny testing. ff: ordinary cows, used for ordinary matings plus progeny testing.

Dairy structure is a geographically diffused open nucleus structure …