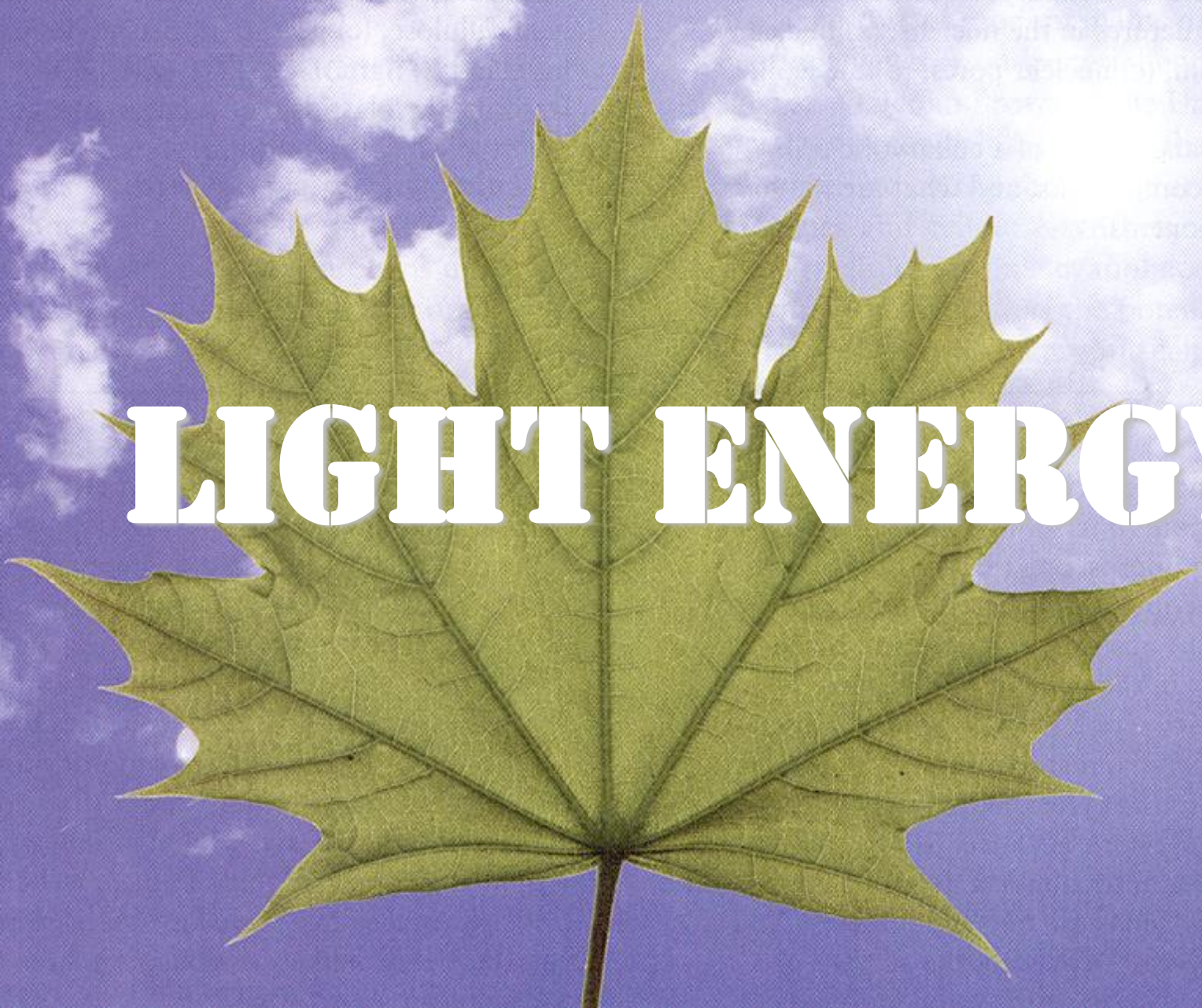


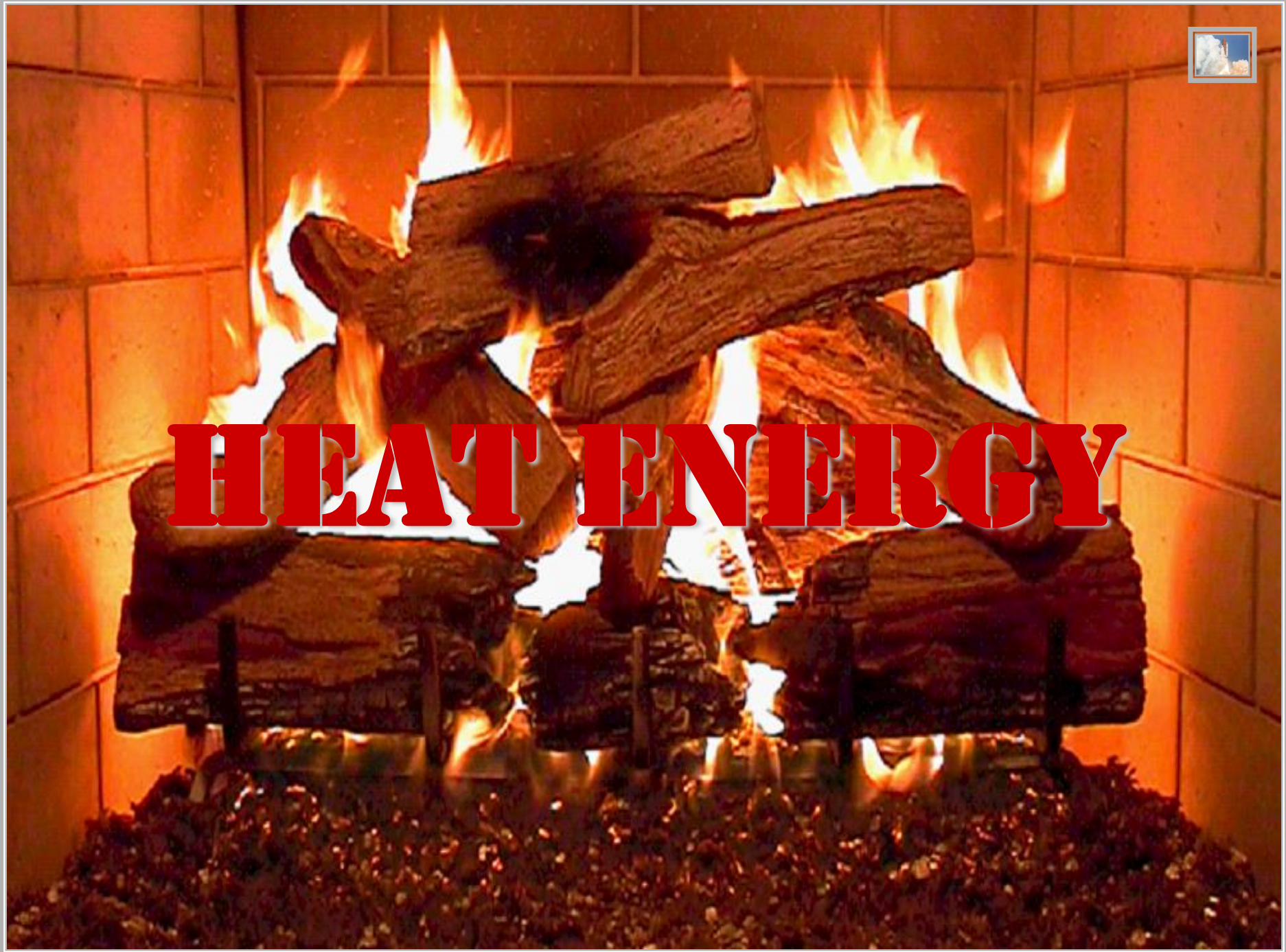


LIGHT ENERGY





HEAT ENERGY





CHEMICAL ENERGY



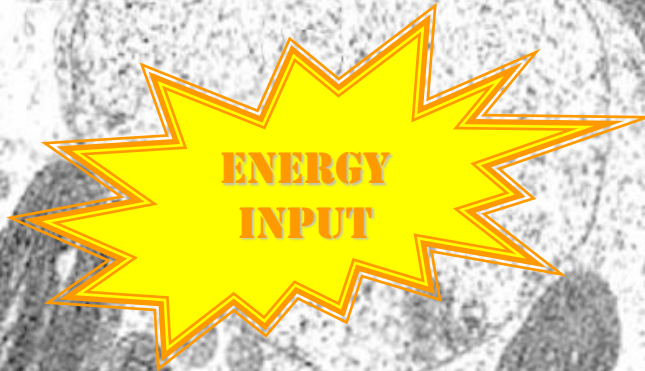


BIOCHEMICAL REACTION



BIOCHEMICAL REACTION

ENERGY INPUT



BIOCHEMICAL REACTION

ENERGY INPUT

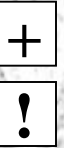


ENERGY
FORM



BIOCHEMICAL REACTION

CHEMICAL ENERGY



CHEMICAL
ENERGY



BIOCHEMICAL REACTION



CHEMICAL ENERGY

CHEMICAL
ENERGY



CHEMICAL ENERGY
DRIVES

BIOCHEMICAL REACTIONS



CHEM-ENERGY

ESSENTIAL

CELL

METABOLISM



**ANGIOSPERMS
EXPEND
CHEM-ENERGY
FOLLOWING
THERMODYNAMICS**

THERMODYNAMIC LAWS

THERMODYNAMICS



THERMODYNAMICS

**STUDY ENERGY
TRANSFORMATION
&
TRANSFER**

THERMODYNAMICS

THERMODYNAMICS



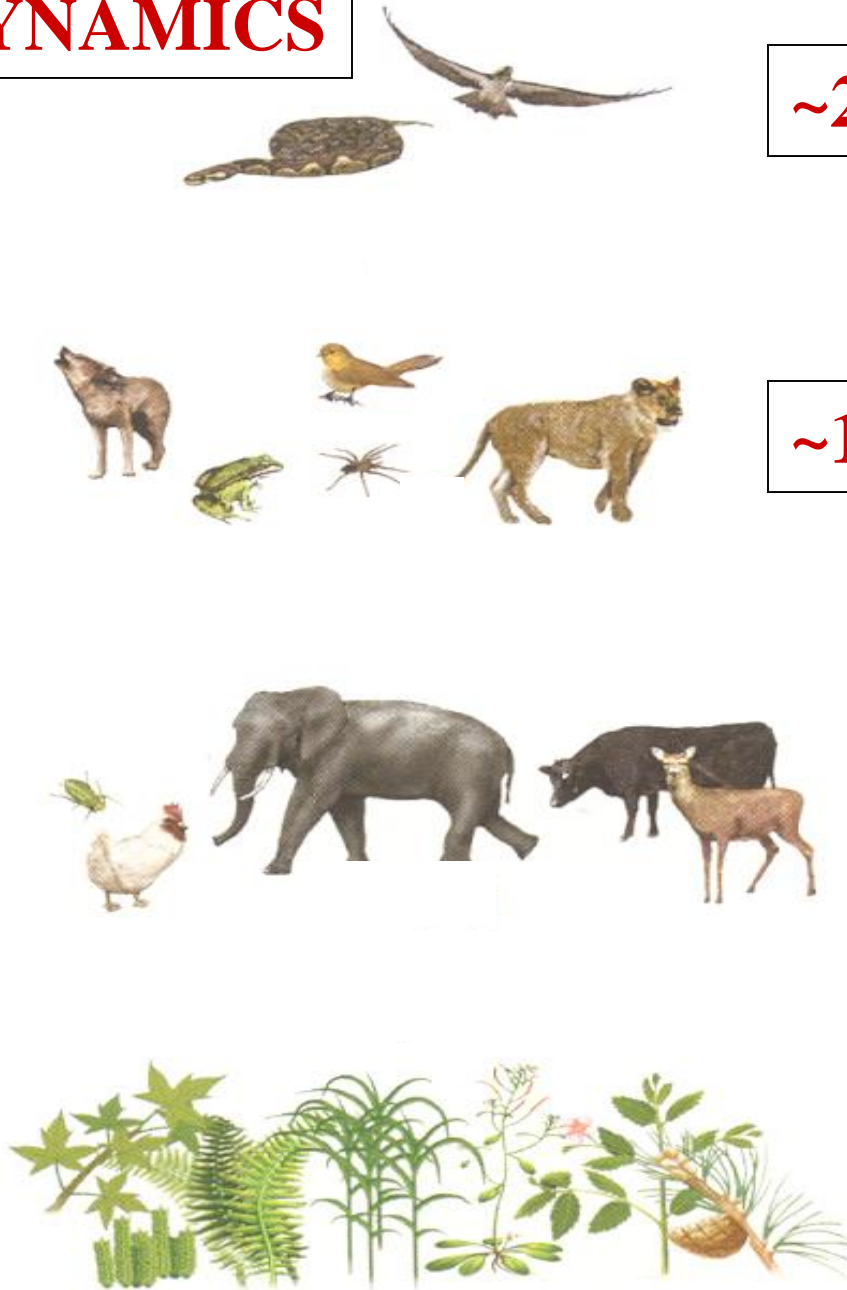
~2 CARNIVORES

~1 CARNIVORES

HERBIVORES

PRODUCERS

**FOOD
CHAIN**



 = CHEMICAL ENERGY

THERMODYNAMICS



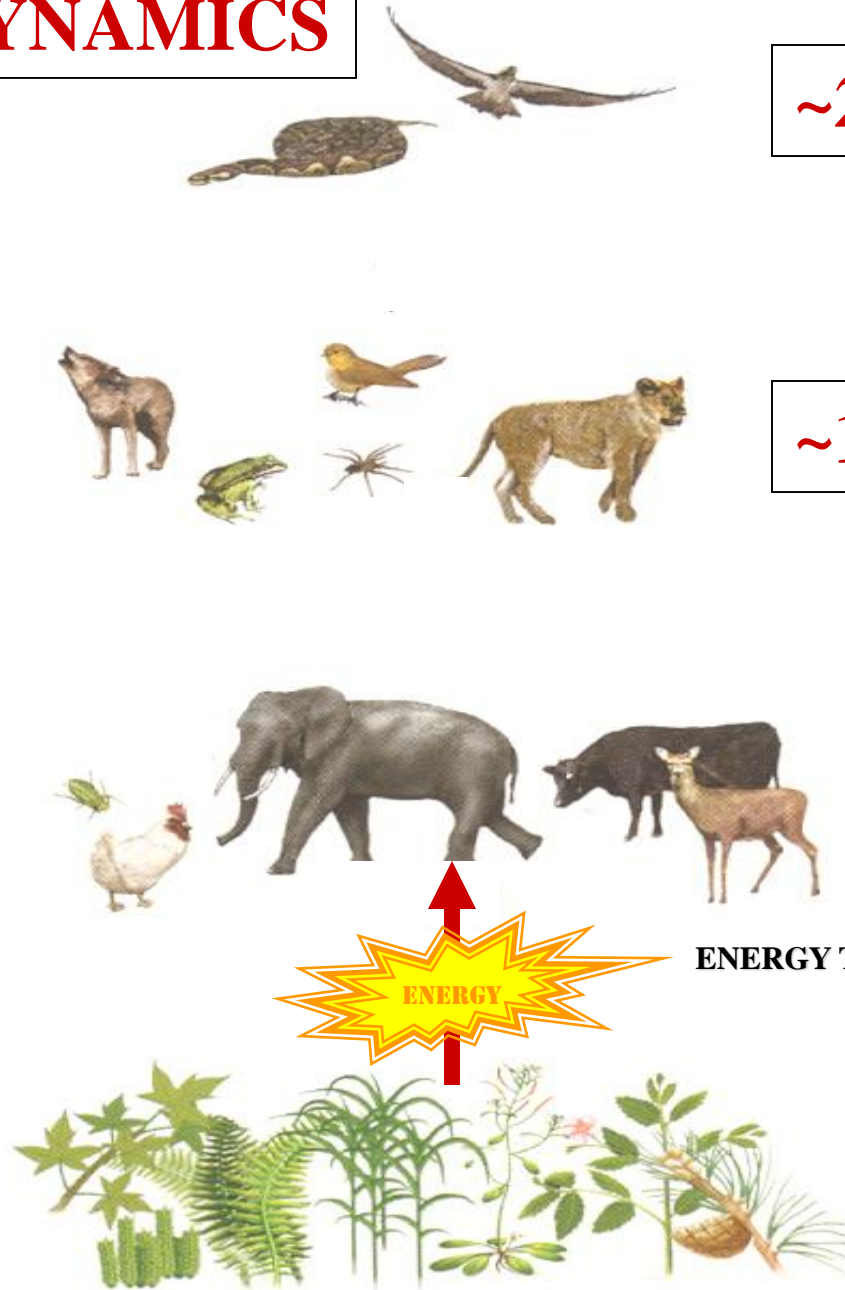
~2 CARNIVORES

~1 CARNIVORES

HERBIVORES

PRODUCERS

**FOOD
CHAIN**

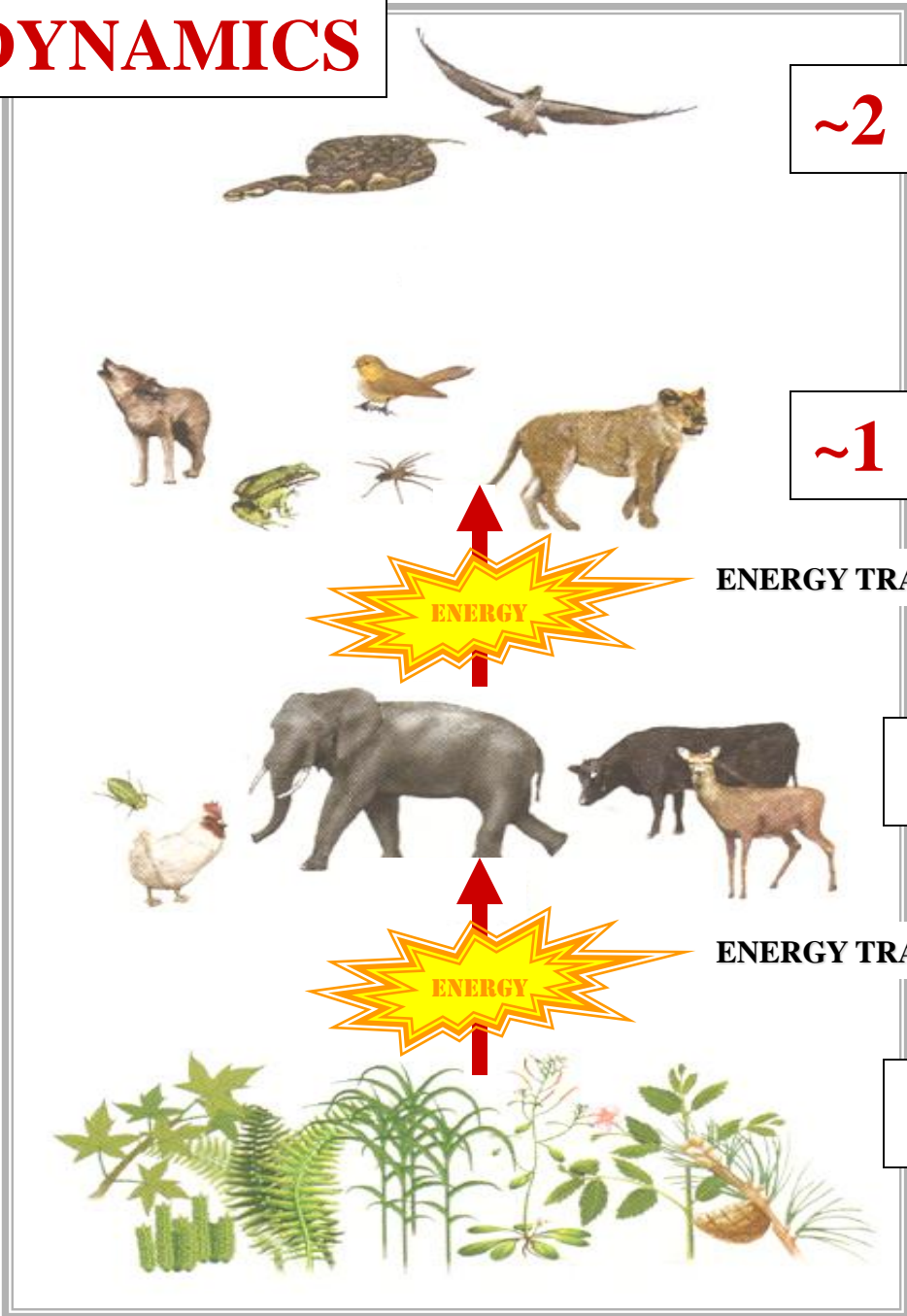


 = **CHEMICAL ENERGY**

THERMODYNAMICS



FOOD CHAIN



~2 CARNIVORES

~1 CARNIVORES

HERBIVORES

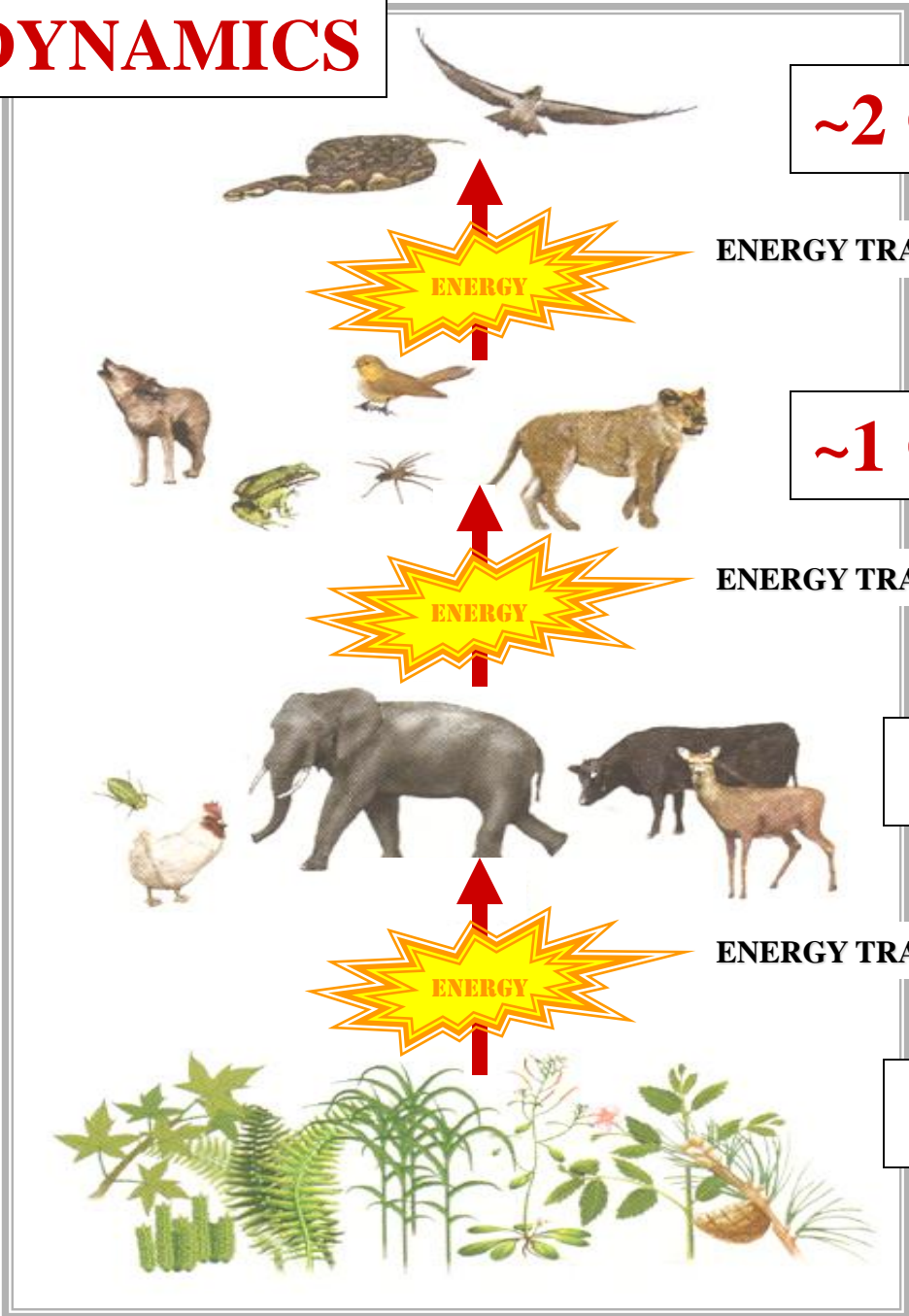
PRODUCERS

 = CHEMICAL ENERGY

THERMODYNAMICS



FOOD CHAIN



~2 CARNIVORES

ENERGY TRANSFORMATION & TRANSFER

~1 CARNIVORES

ENERGY TRANSFORMATION & TRANSFER

HERBIVORES

ENERGY TRANSFORMATION & TRANSFER

PRODUCERS

 = CHEMICAL ENERGY

FIRST THERMODYNAMIC LAW

**FIRST
THERMODYNAMIC
LAW**



1ST THERMODYNAMIC LAW

ENERGY CANNOT BE
CREATED OR DESTROYED

1ST THERMODYNAMIC LAW

1ST THERMODYNAMIC LAW

ENERGY CANNOT BE
CREATED OR DESTROYED

ENERGY CAN CHANGE
FORM

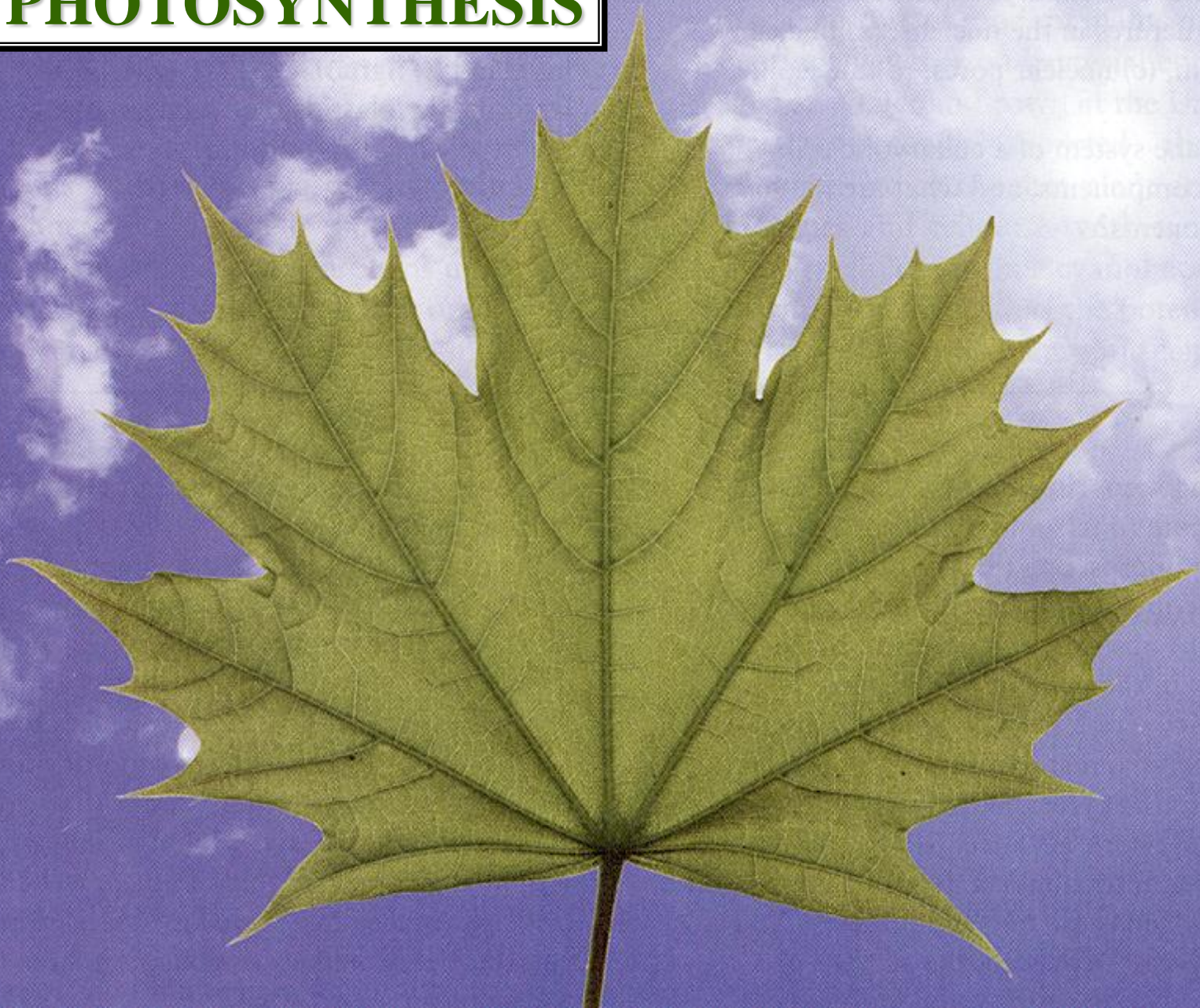
1ST THERMODYNAMIC LAW



FIRST
THERMODYNAMIC
LAW
EXAMPLE

PHOTOSYNTHESIS

L



PHOTOSYNTHESIS

C



LIGHT
ENERGY

PHOTOSYNTHESIS

G



CHEMICAL
ENERGY

PHOTOSYNTHESIS



GLUCOSE



= CHEMICAL ENERGY



***FIRST
THERMODYNAMIC
LAW
ENERGY
CAN CHANGE
FORM***

SECOND THERMODYNAMIC LAW

SECOND

THERMODYNAMIC

LAW

2ND THERMODYNAMIC LAW



ENERGY CAN BE
TRANSFERRED

2ND THERMODYNAMIC LAW

2ND THERMODYNAMIC LAW

ENERGY CAN BE
TRANSFERRED

ENERGY DISSIPATES TO
ENVIRONMENT AS HEAT

2ND THERMODYNAMIC LAW



SECOND
THERMODYNAMIC
LAW
EXAMPLE



**CHEMICAL
ENERGY**

**CHEMICAL
ENERGY**



BIOCHEMICAL REACTION

CELL METABOLISM

**CHEMICAL
ENERGY**

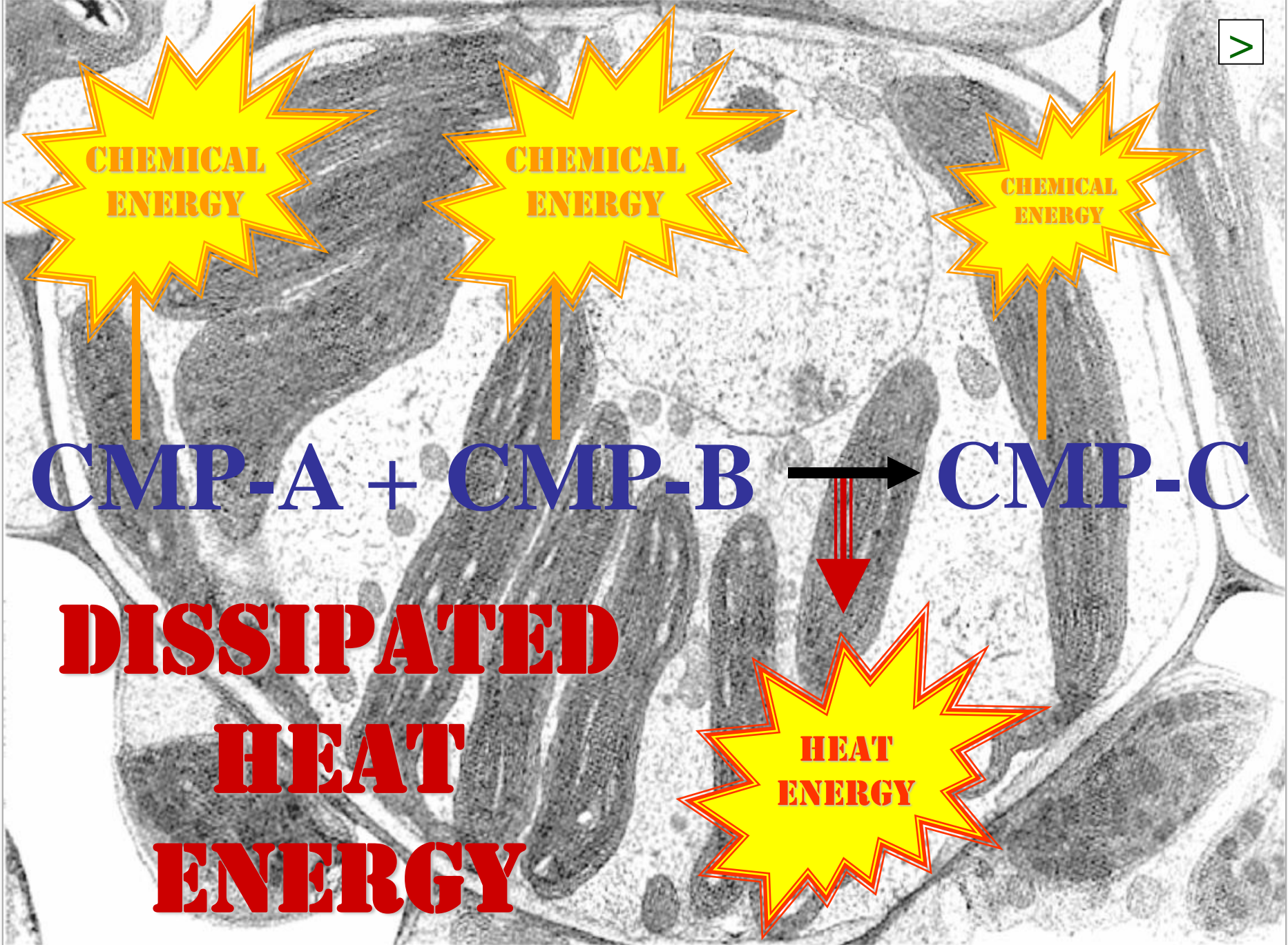
**CHEMICAL
ENERGY**

**CHEM
ENERGY**



BIOCHEMICAL REACTION

CELL METABOLISM



**CHEMICAL
ENERGY**

**CHEMICAL
ENERGY**

**CHEMICAL
ENERGY**



**DISSIPATED
HEAT
ENERGY**

**HEAT
ENERGY**



S

***SECOND
THERMODYNAMIC
LAW
ENERGY
CAN BE
TRANSFERRED***



THERMODYNAMIC LAWS

SUMMARY

THERMODYNAMICS



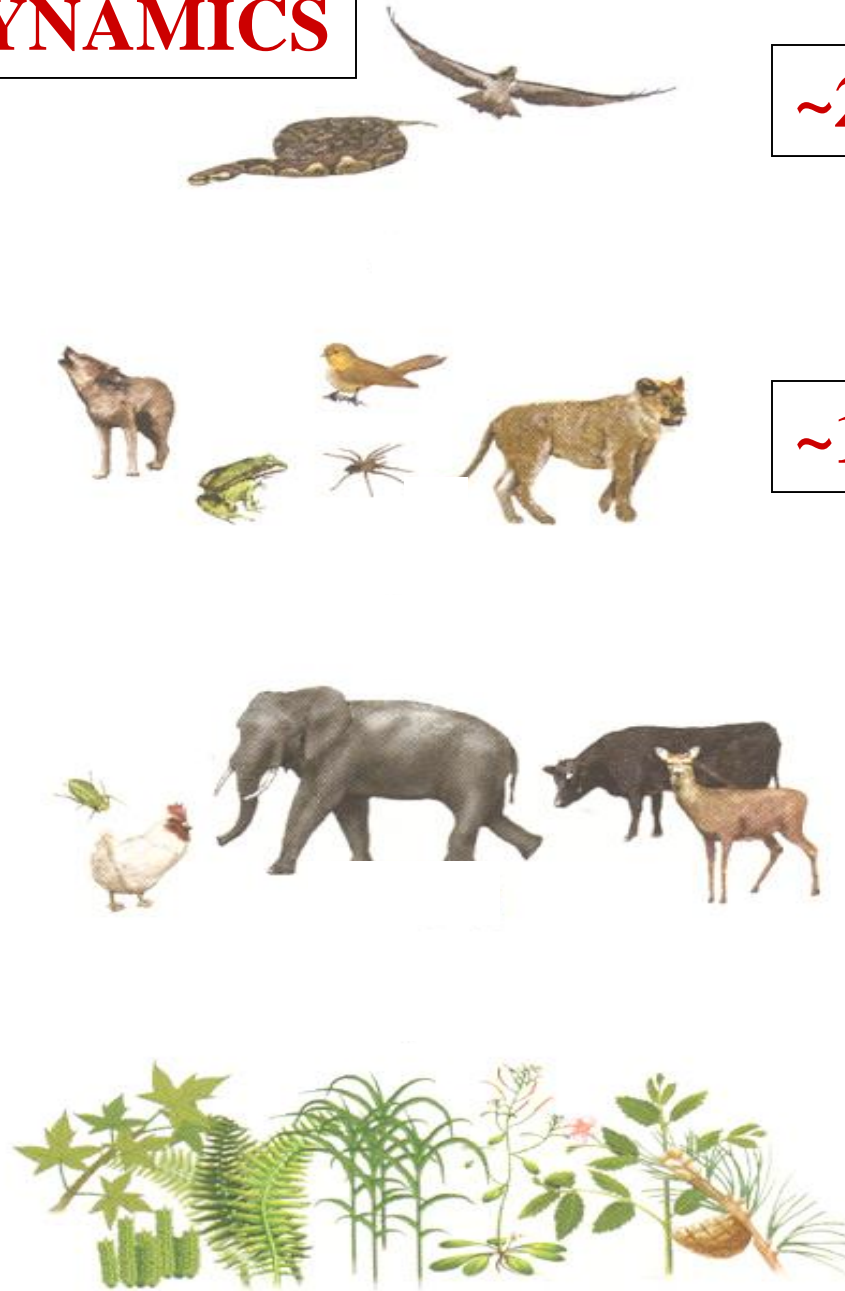
~2 CARNIVORES

~1 CARNIVORES

HERBIVORES

PRODUCERS

**FOOD
CHAIN**



 = CHEMICAL ENERGY

THERMODYNAMICS



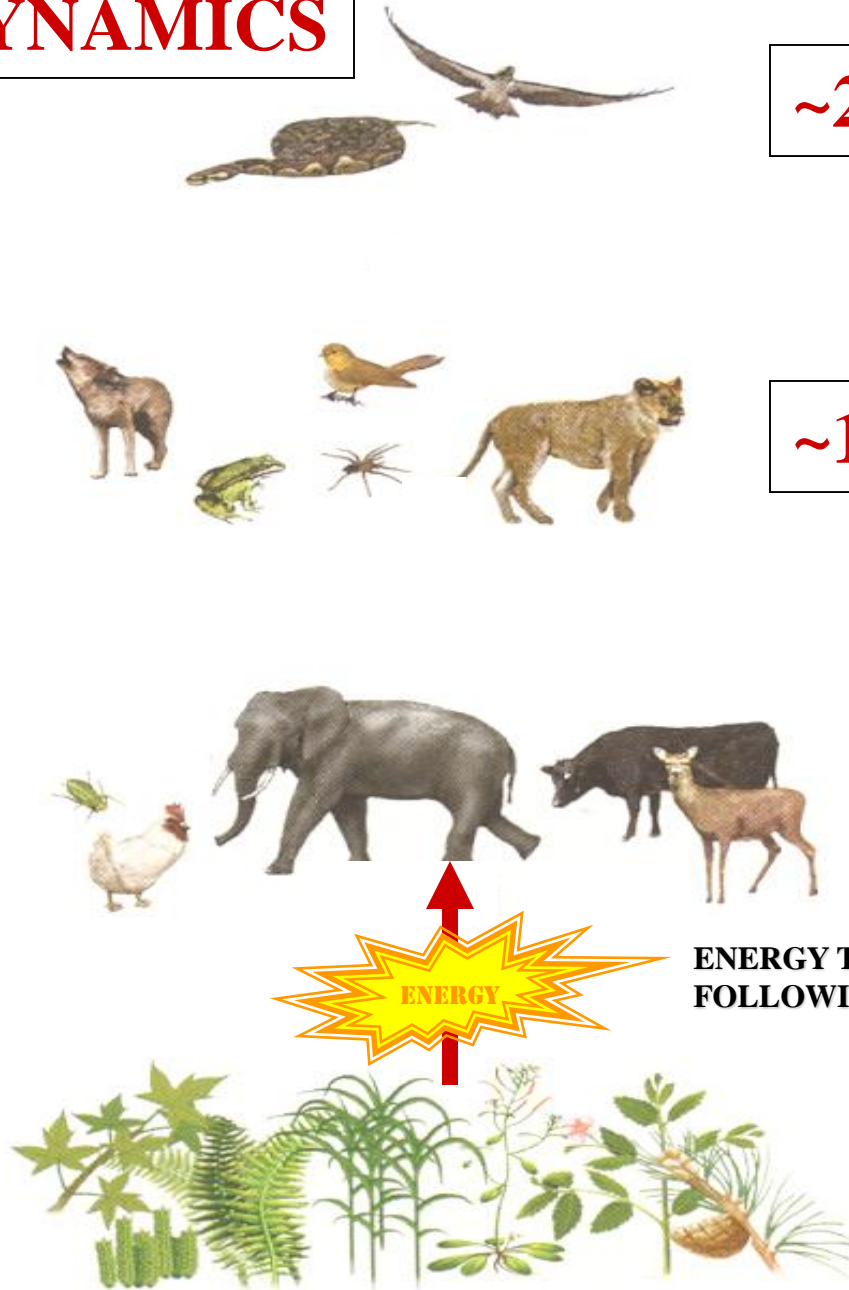
~2 CARNIVORES

~1 CARNIVORES

HERBIVORES

PRODUCERS

**FOOD
CHAIN**

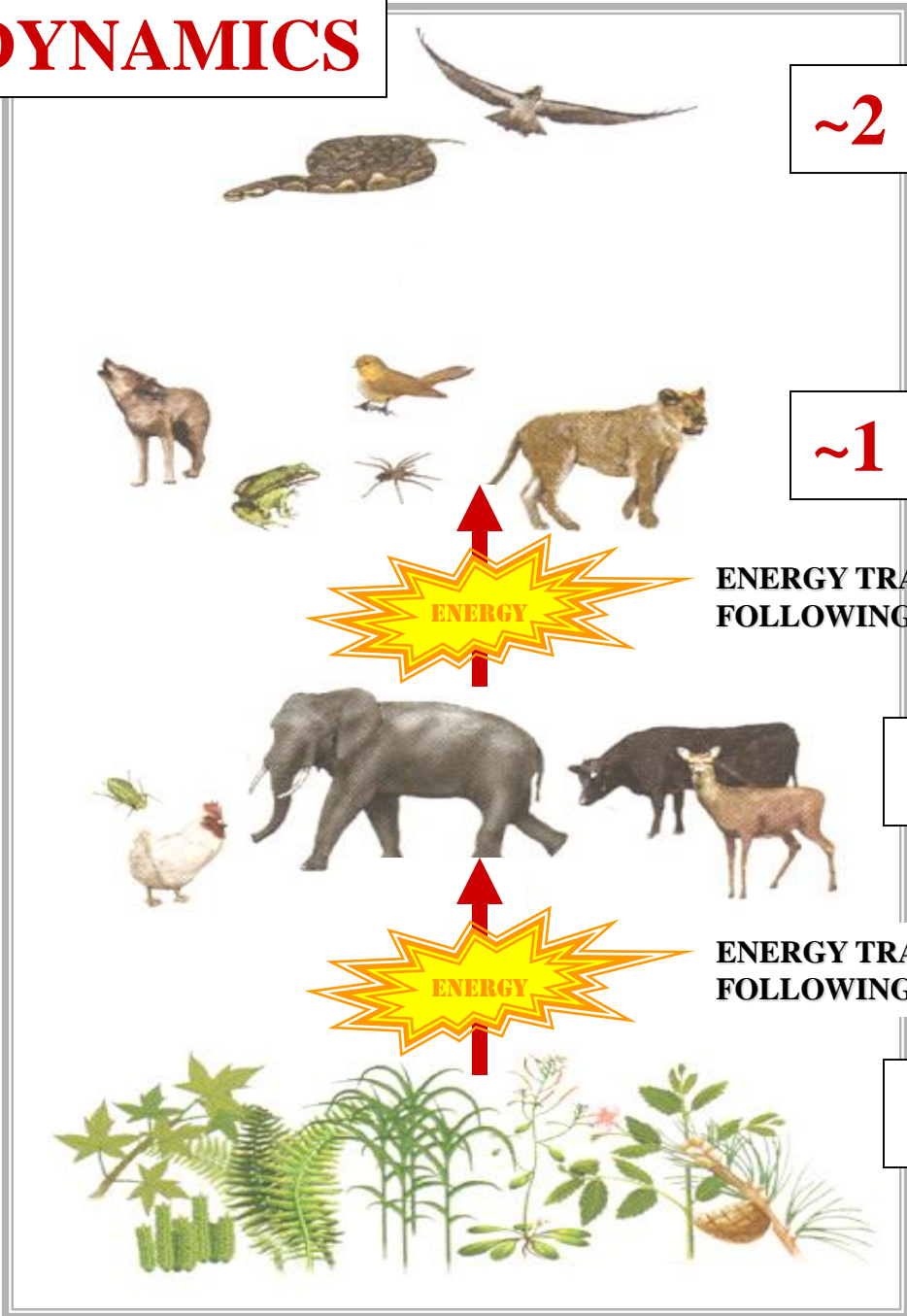


 = **CHEMICAL ENERGY**

THERMODYNAMICS



FOOD CHAIN



~2 CARNIVORES

~1 CARNIVORES

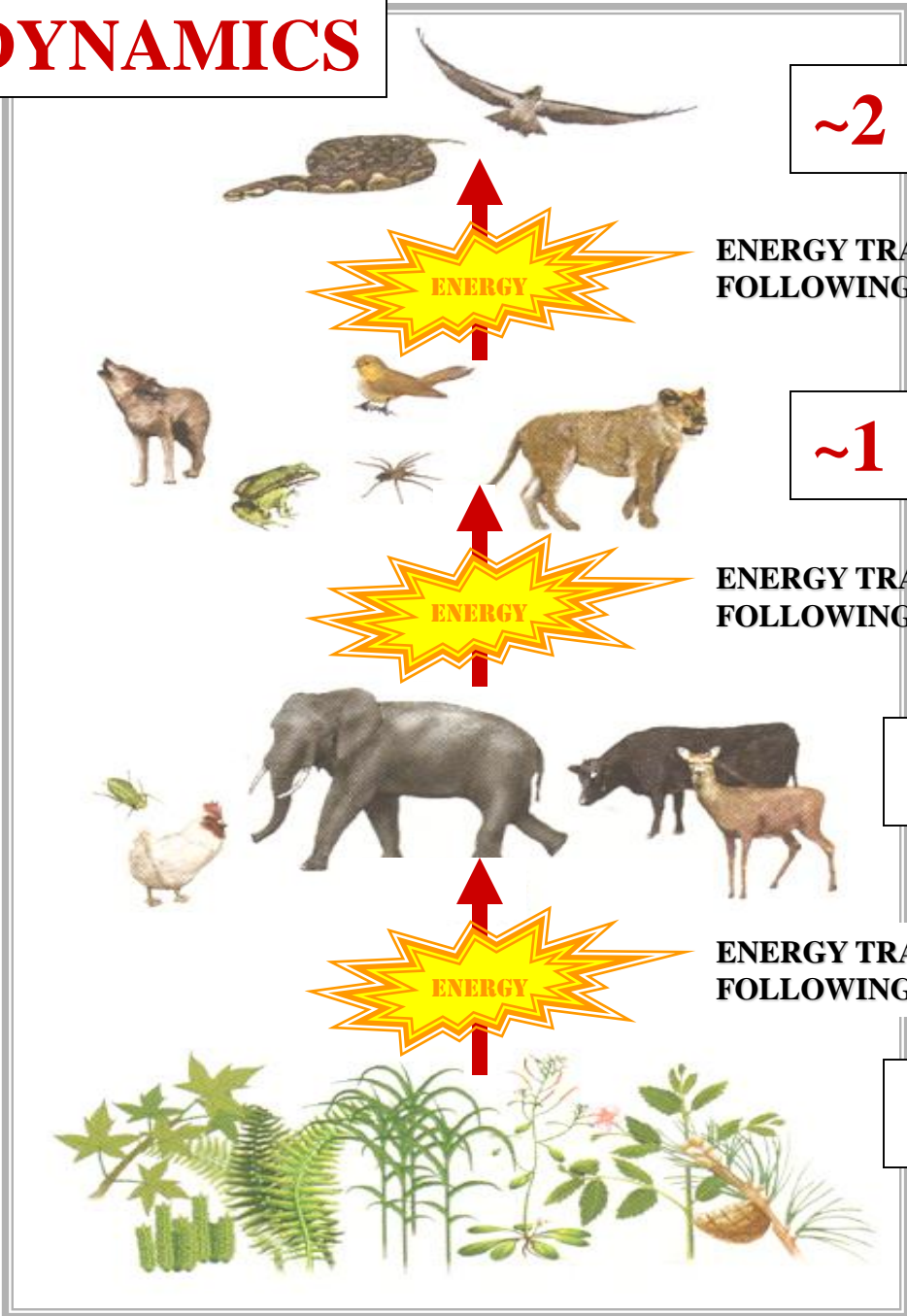
HERBIVORES

PRODUCERS

 = CHEMICAL ENERGY

THERMODYNAMICS

FOOD CHAIN



~2 CARNIVORES

ENERGY TRANSFORMATION & TRANSFER FOLLOWING THERMODYNAMIC LAWS

~1 CARNIVORES

ENERGY TRANSFORMATION & TRANSFER FOLLOWING THERMODYNAMIC LAWS

HERBIVORES

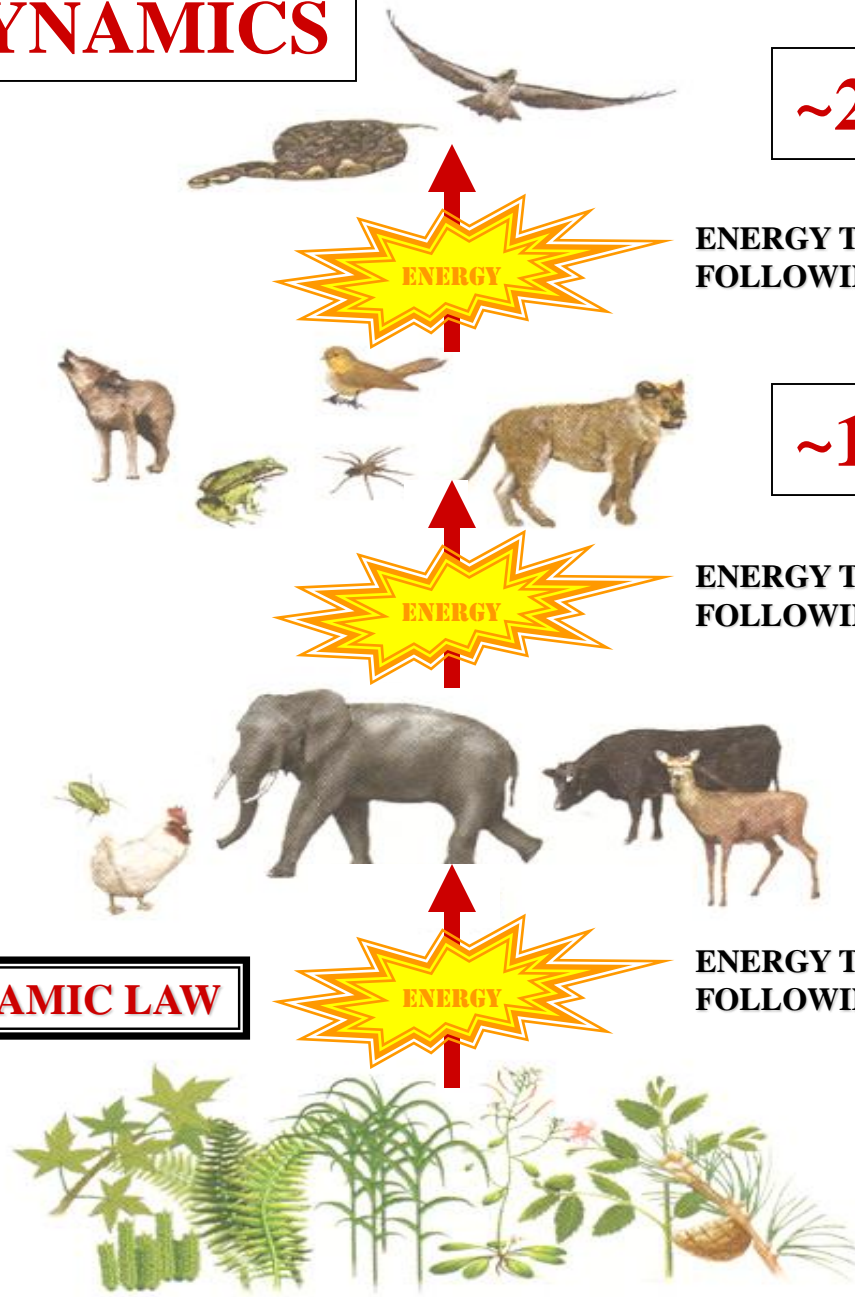
ENERGY TRANSFORMATION & TRANSFER FOLLOWING THERMODYNAMIC LAWS

PRODUCERS

 = CHEMICAL ENERGY

THERMODYNAMICS

FOOD CHAIN



~2 CARNIVORES

ENERGY TRANSFORMATION & TRANSFER FOLLOWING THERMODYNAMIC LAWS

~1 CARNIVORES

ENERGY TRANSFORMATION & TRANSFER FOLLOWING THERMODYNAMIC LAWS

HERBIVORES

1ST THERMODYNAMIC LAW

ENERGY TRANSFORMATION & TRANSFER FOLLOWING THERMODYNAMIC LAWS

PRODUCERS

 = CHEMICAL ENERGY

THERMODYNAMICS



~2 CARNIVORES

2ND THERMODYNAMIC LAW

ENERGY TRANSFORMATION & TRANSFER
FOLLOWING THERMODYNAMIC LAWS

**FOOD
CHAIN**

~1 CARNIVORES

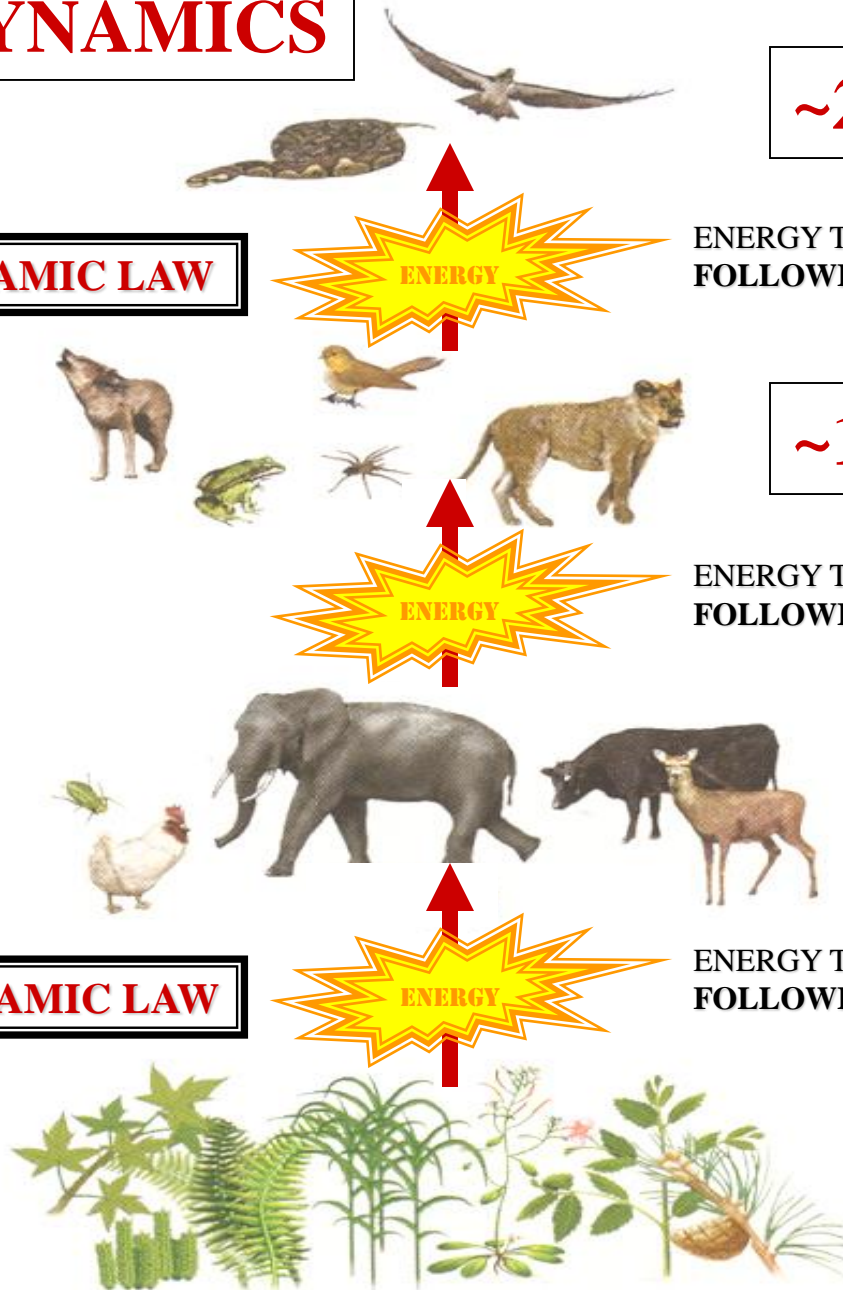
ENERGY TRANSFORMATION & TRANSFER
FOLLOWING THERMODYNAMIC LAWS

HERBIVORES

1ST THERMODYNAMIC LAW

ENERGY TRANSFORMATION & TRANSFER
FOLLOWING THERMODYNAMIC LAWS

PRODUCERS



 = CHEMICAL ENERGY



E

**ANGIOSPERMS
EXPEND
CHEM-ENERGY
FOLLOWING
THERMODYNAMICS**



**ANGIOSPERMS
EXPEND
CHEM-ENERGY
TO LOWER
ENTROPY**

ENTROPY

ENTROPY

ENTROPY



ORGANIZATION MEASURE

ENTROPY

ENTROPY



ORGANIZATION MEASURE

HIGH ORGANIZATION =
LOW ENTROPY

ENTROPY

ENTROPY



ORGANIZATION MEASURE

HIGH ORGANIZATION =
LOW ENTROPY

LOW ORGANIZATION =
HIGH ENTROPY

ENTROPY



ENTROPY: APPLIED



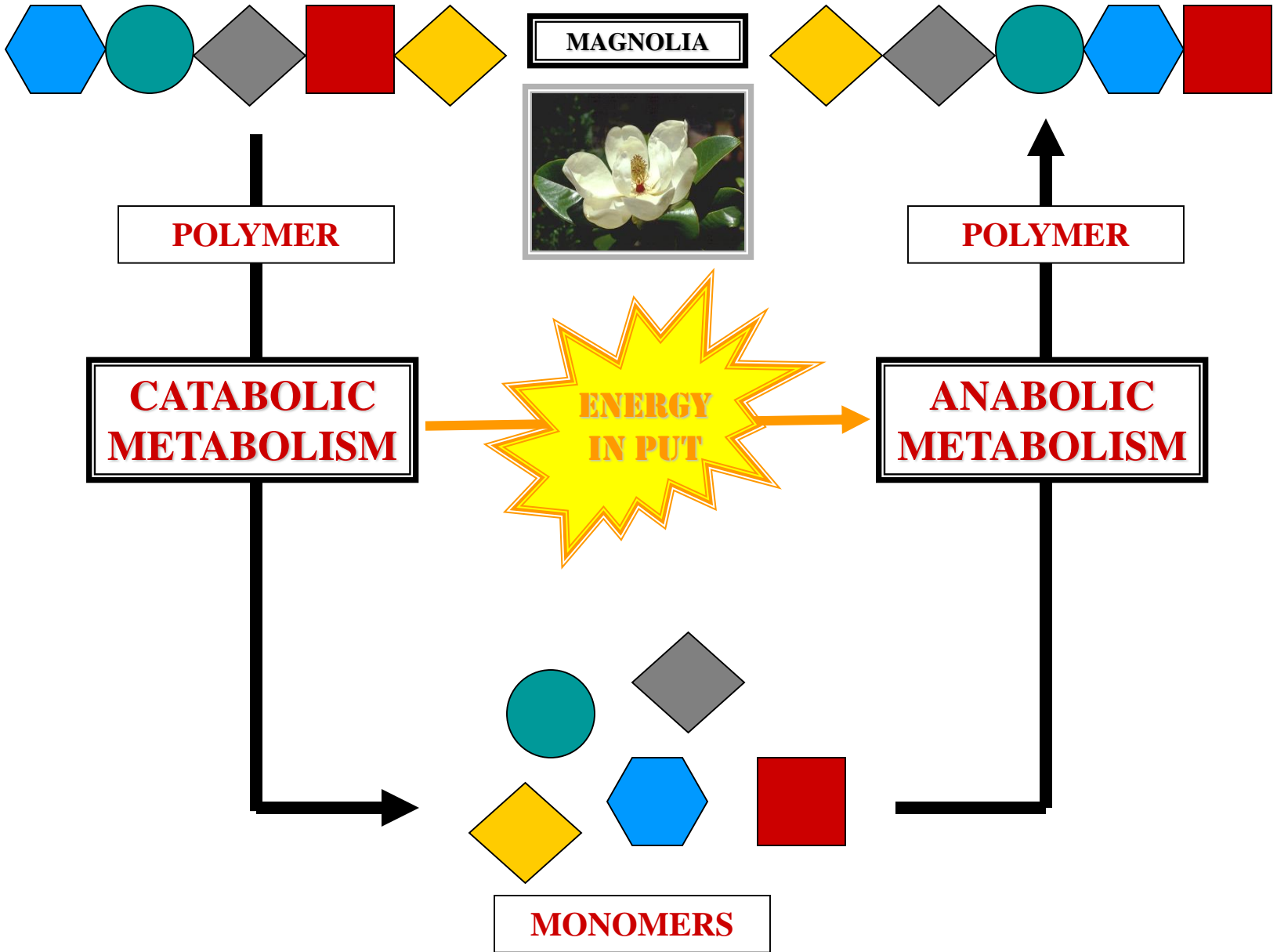
DEAD ANGIOSPERM

DEAD ANGIOSPERM

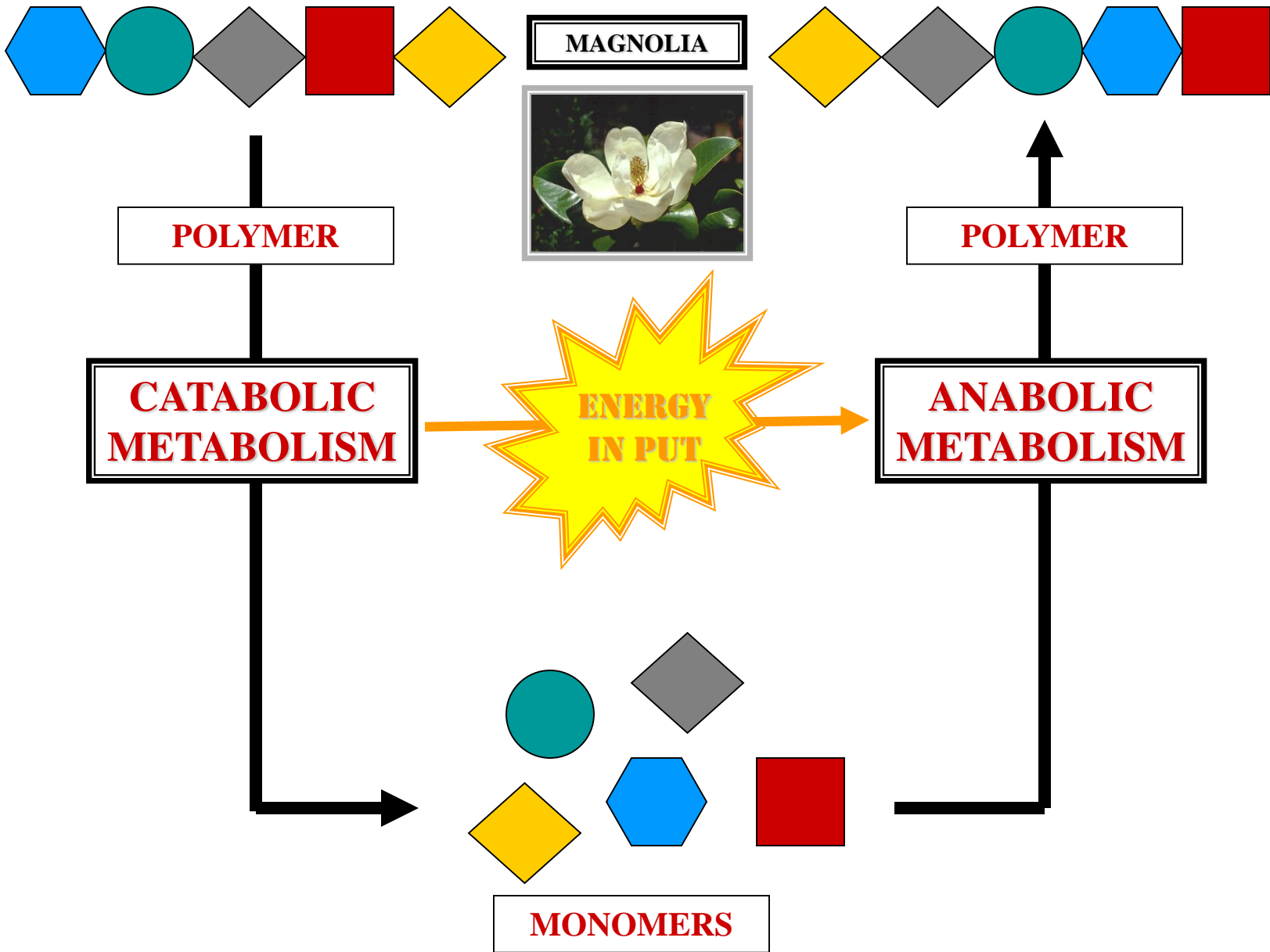


DEAD ANGIOSPERM

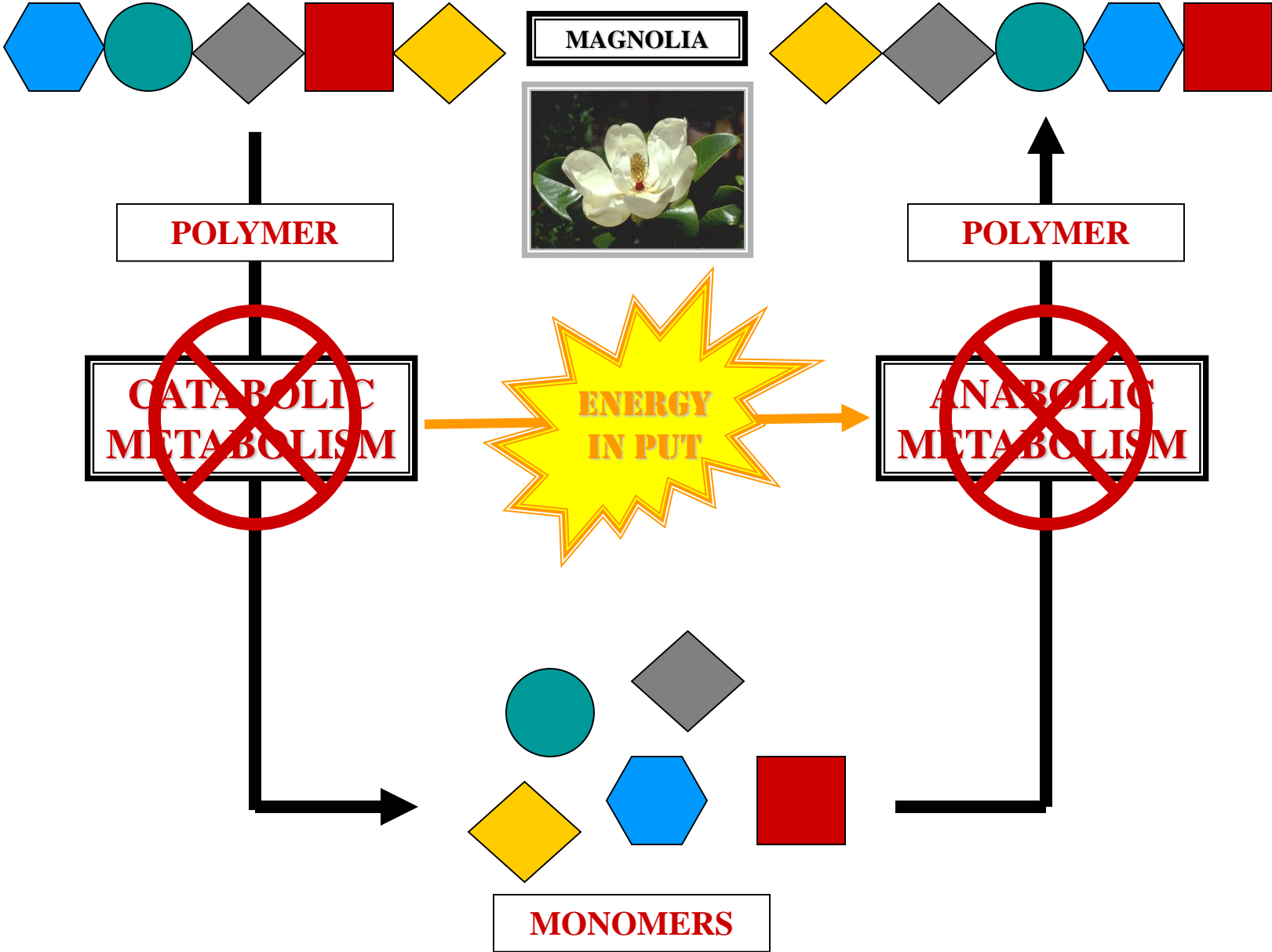
MAGNOLIA



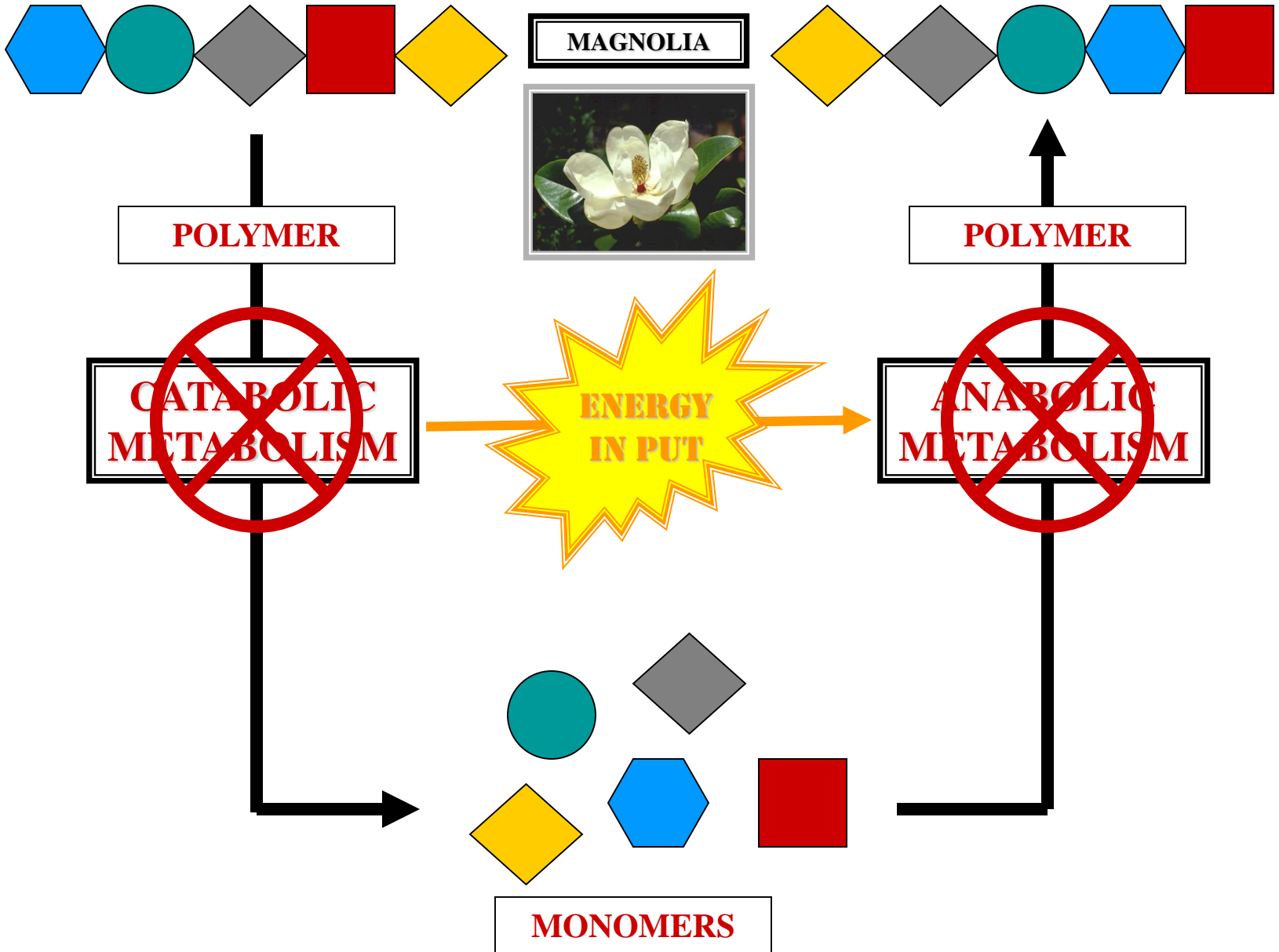
METABOLISM



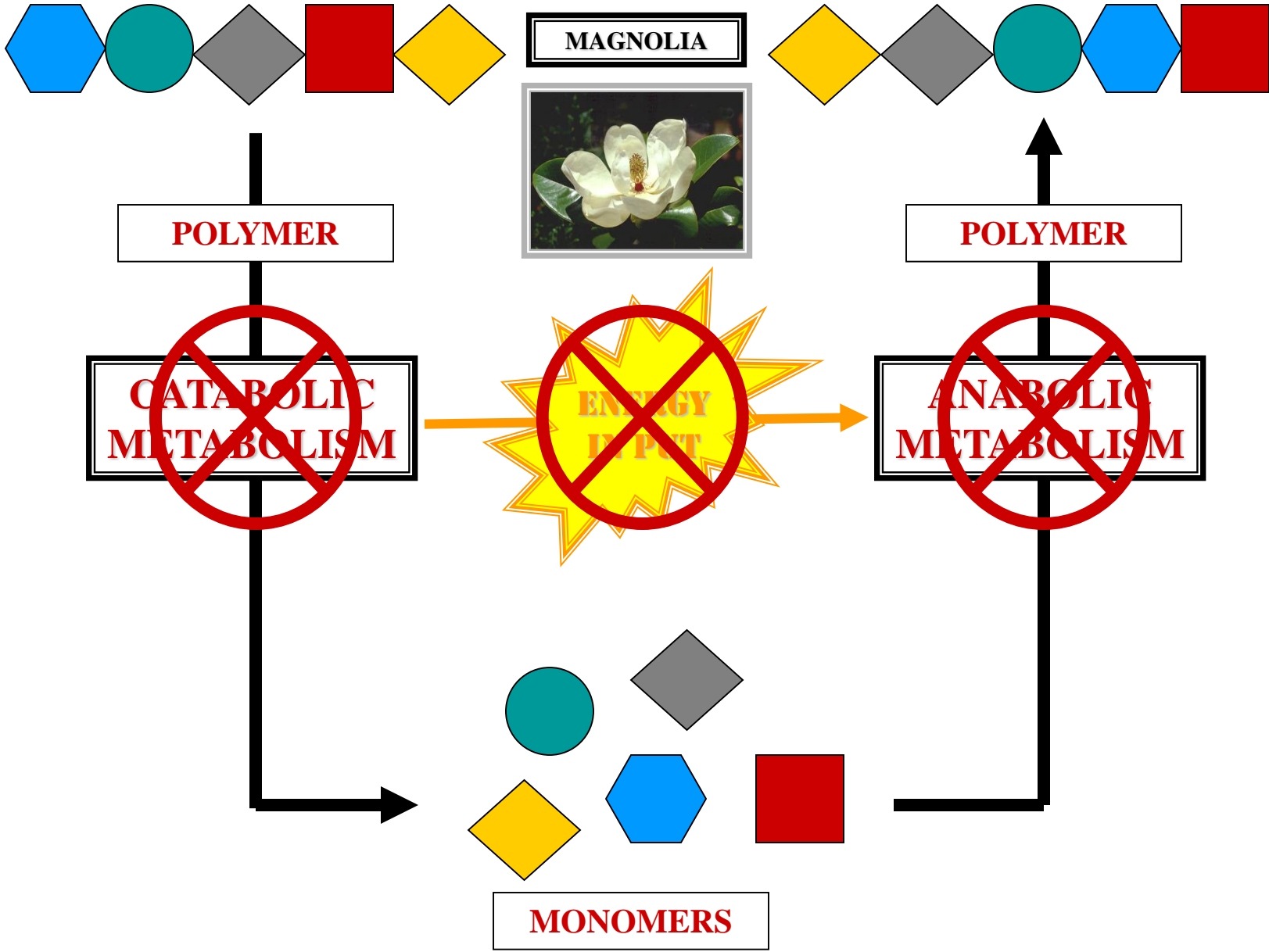
NO METABOLISM



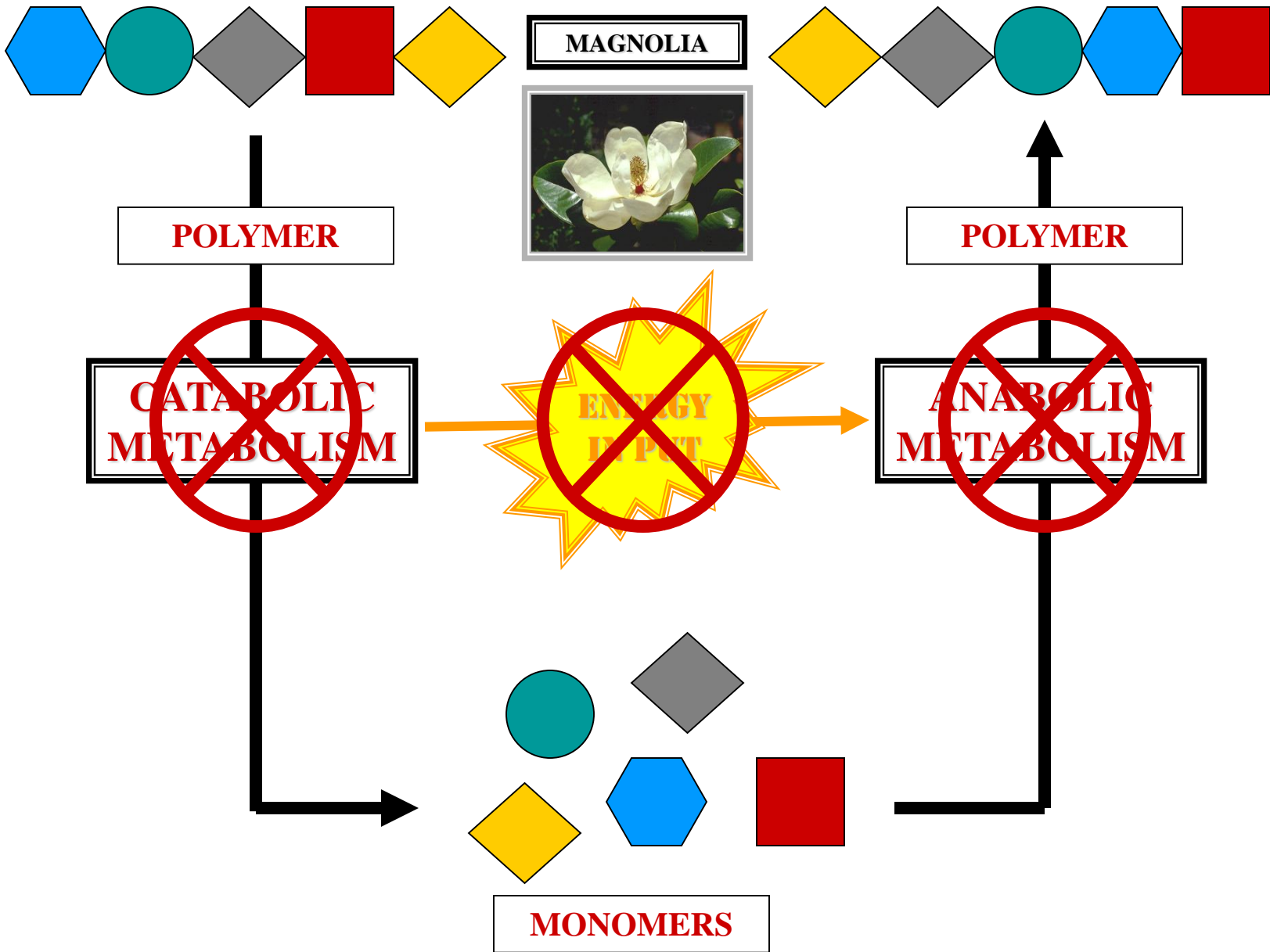
ENERGY



NO ENERGY INPUT

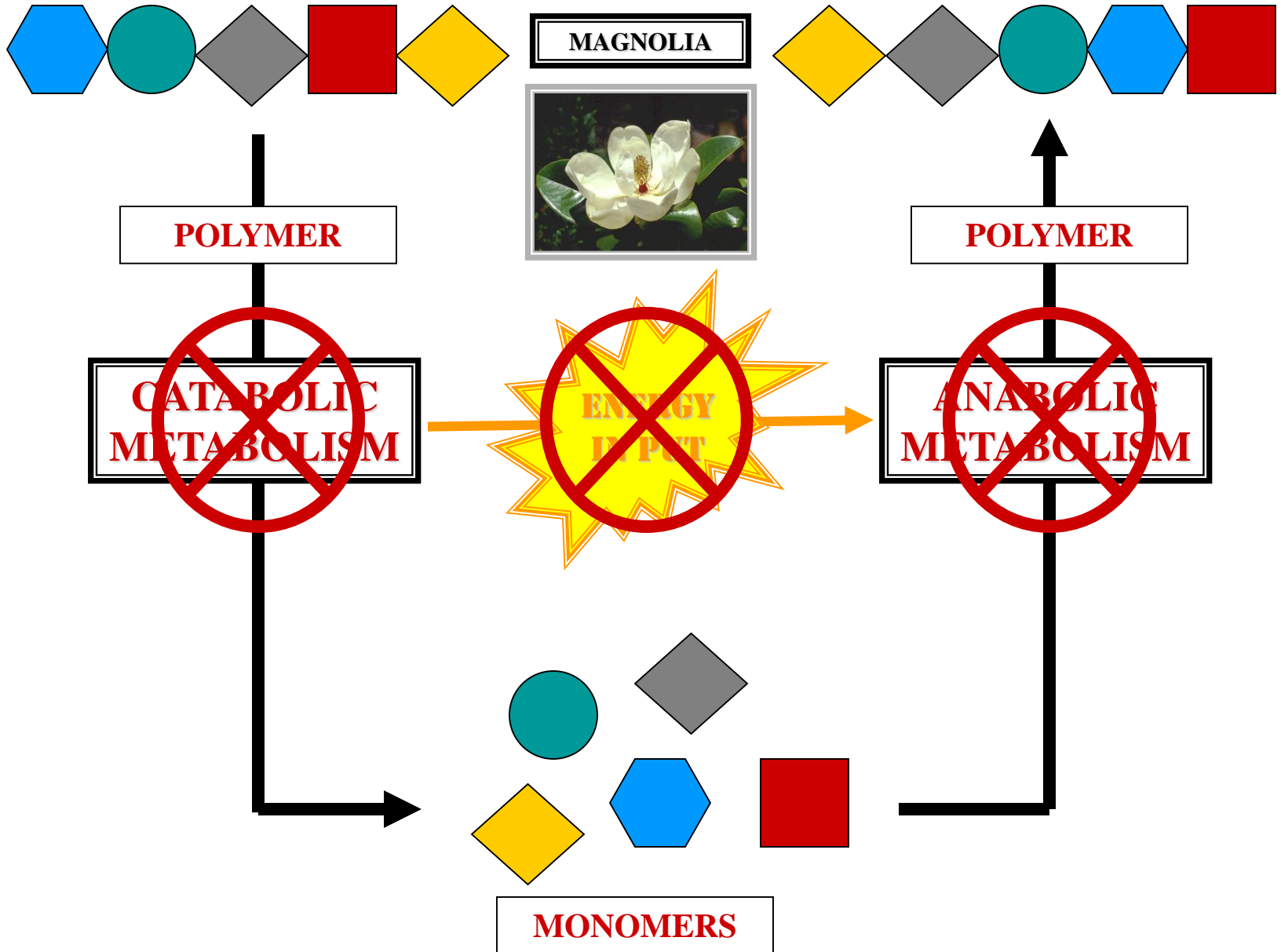


ORGANIZATION

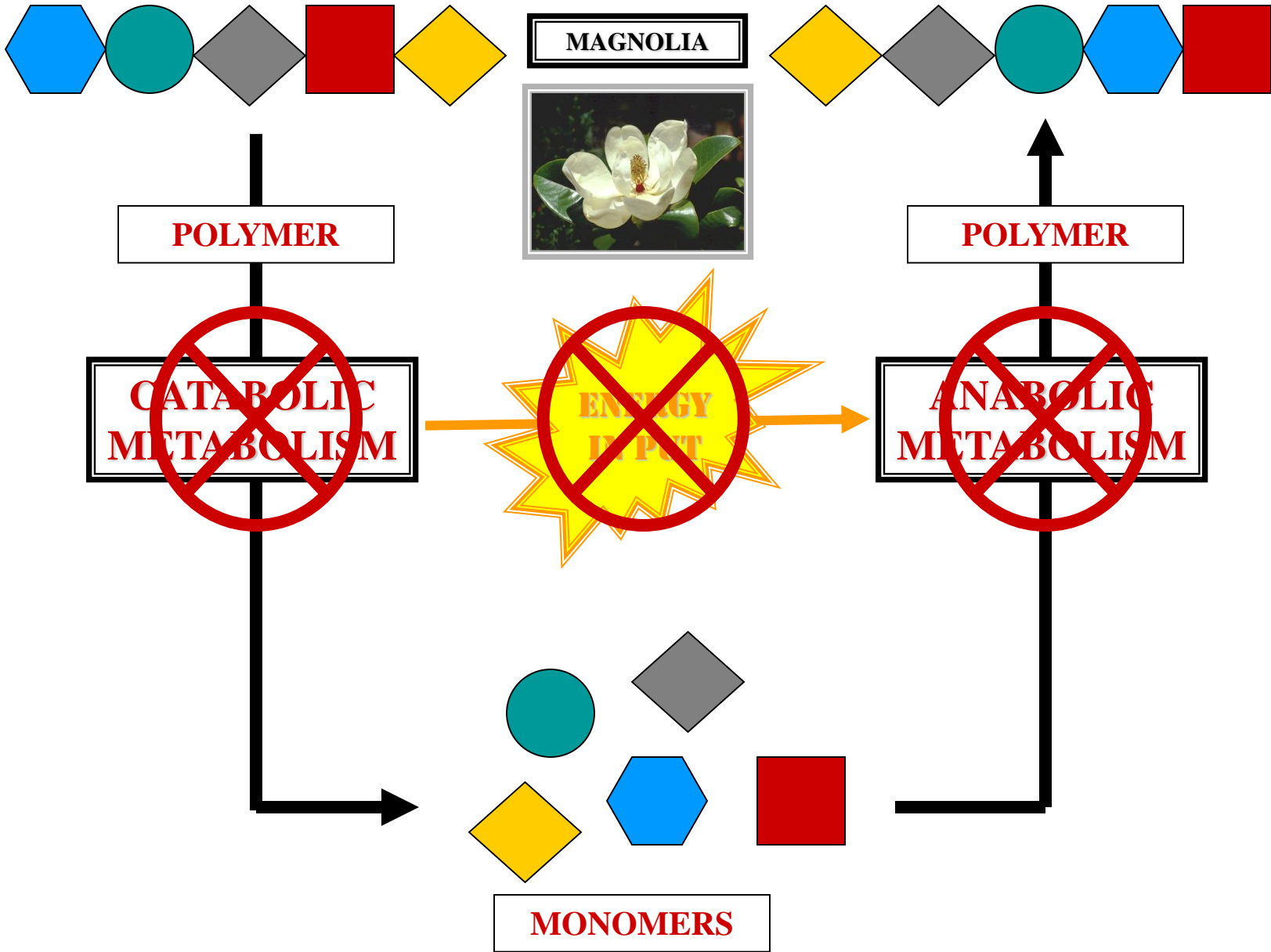


LOW ORGANIZATION

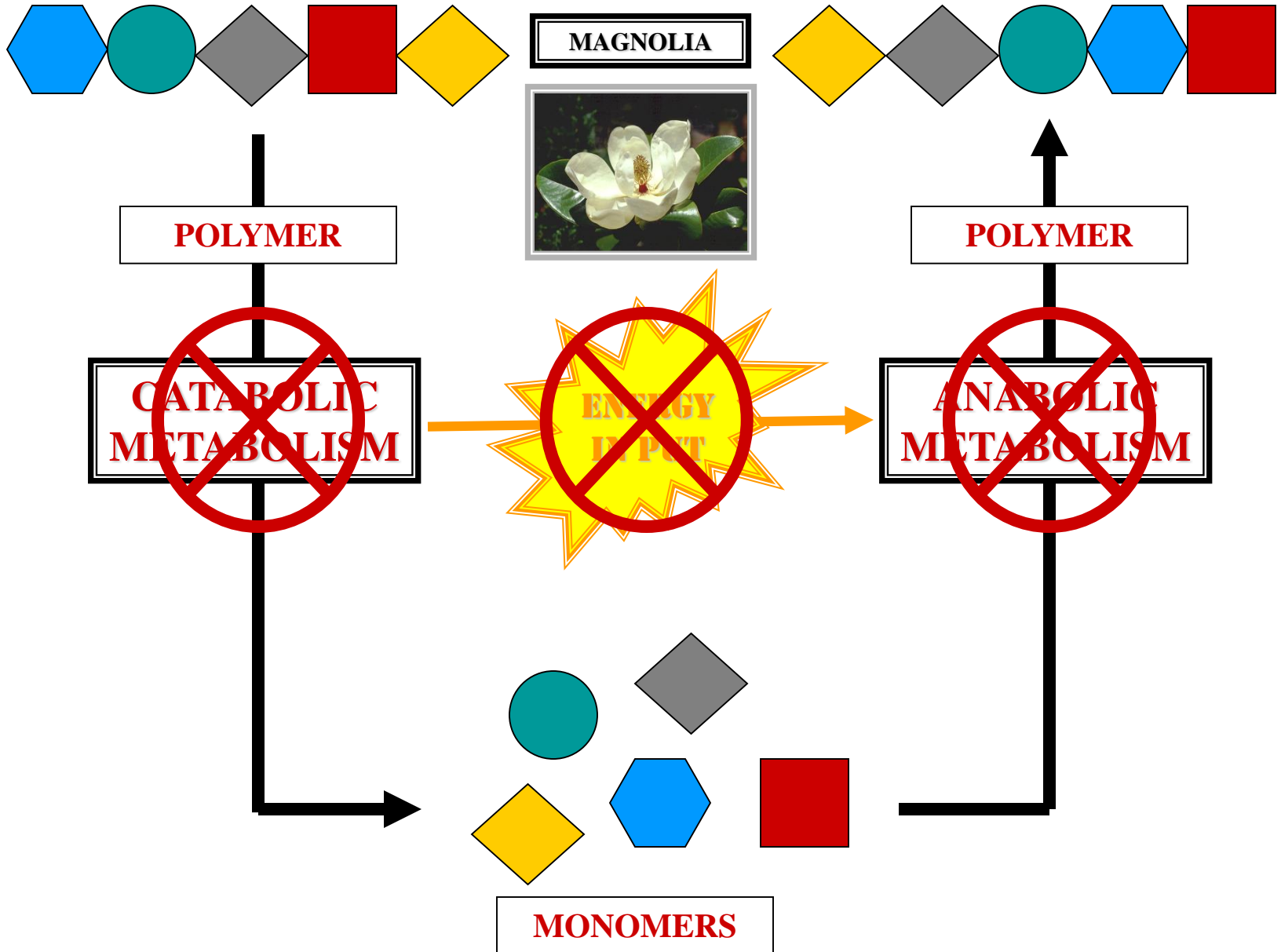
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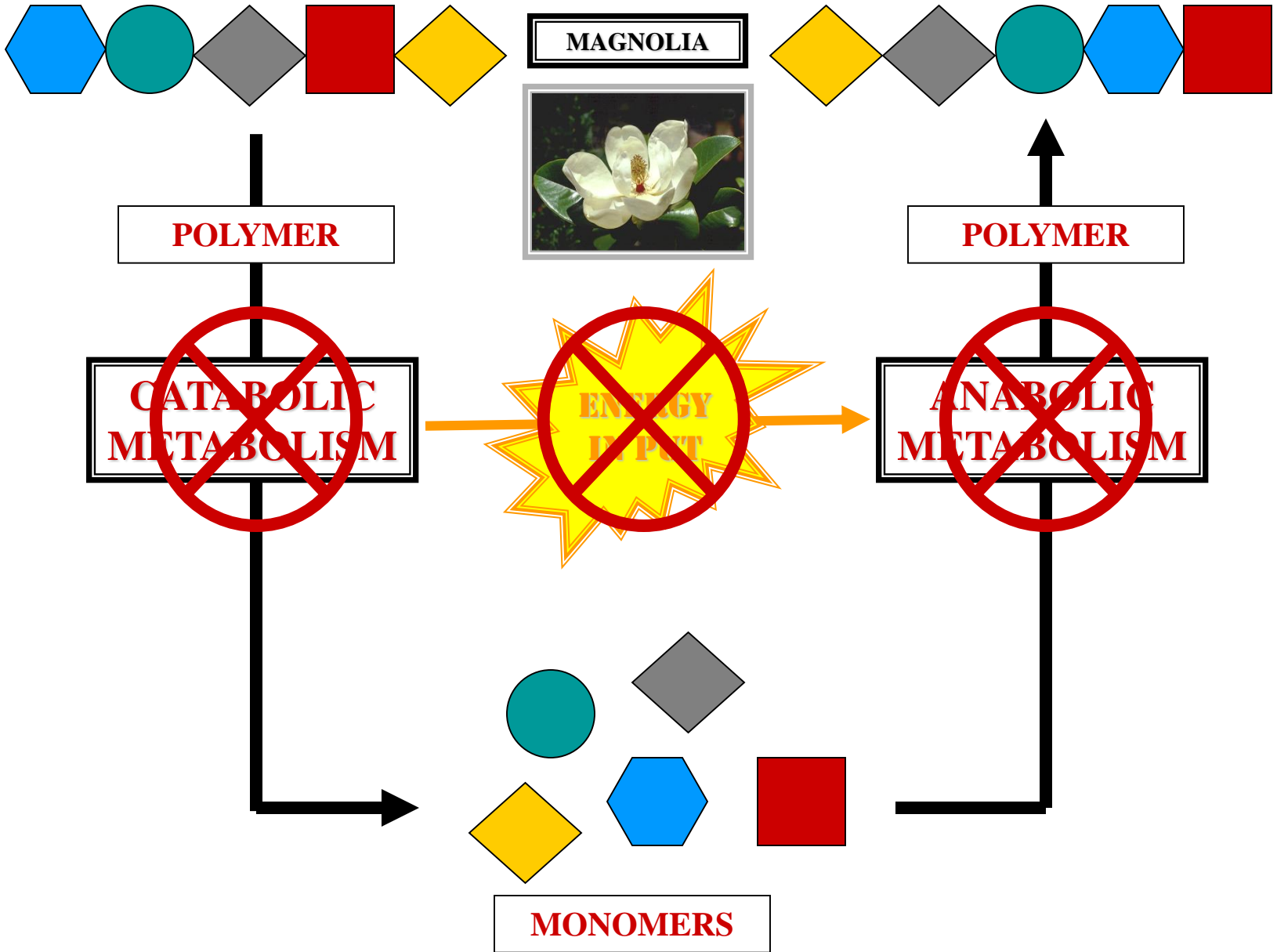
ENTROPY



HIGH ENTROPY



DEAD MAGNOLIA





LIVING ANGIOSPERM

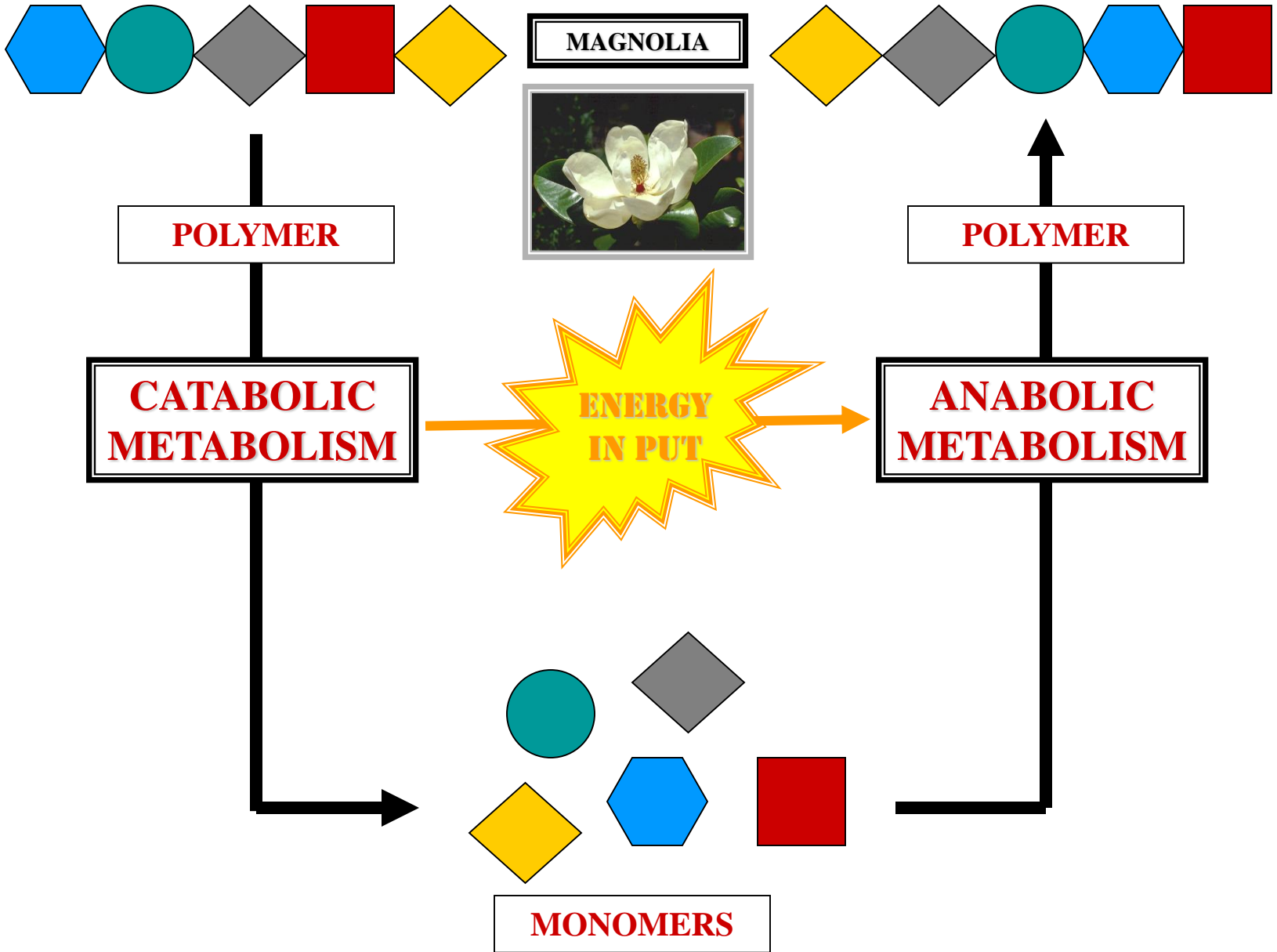
LIVING ANGIOSPERM

+

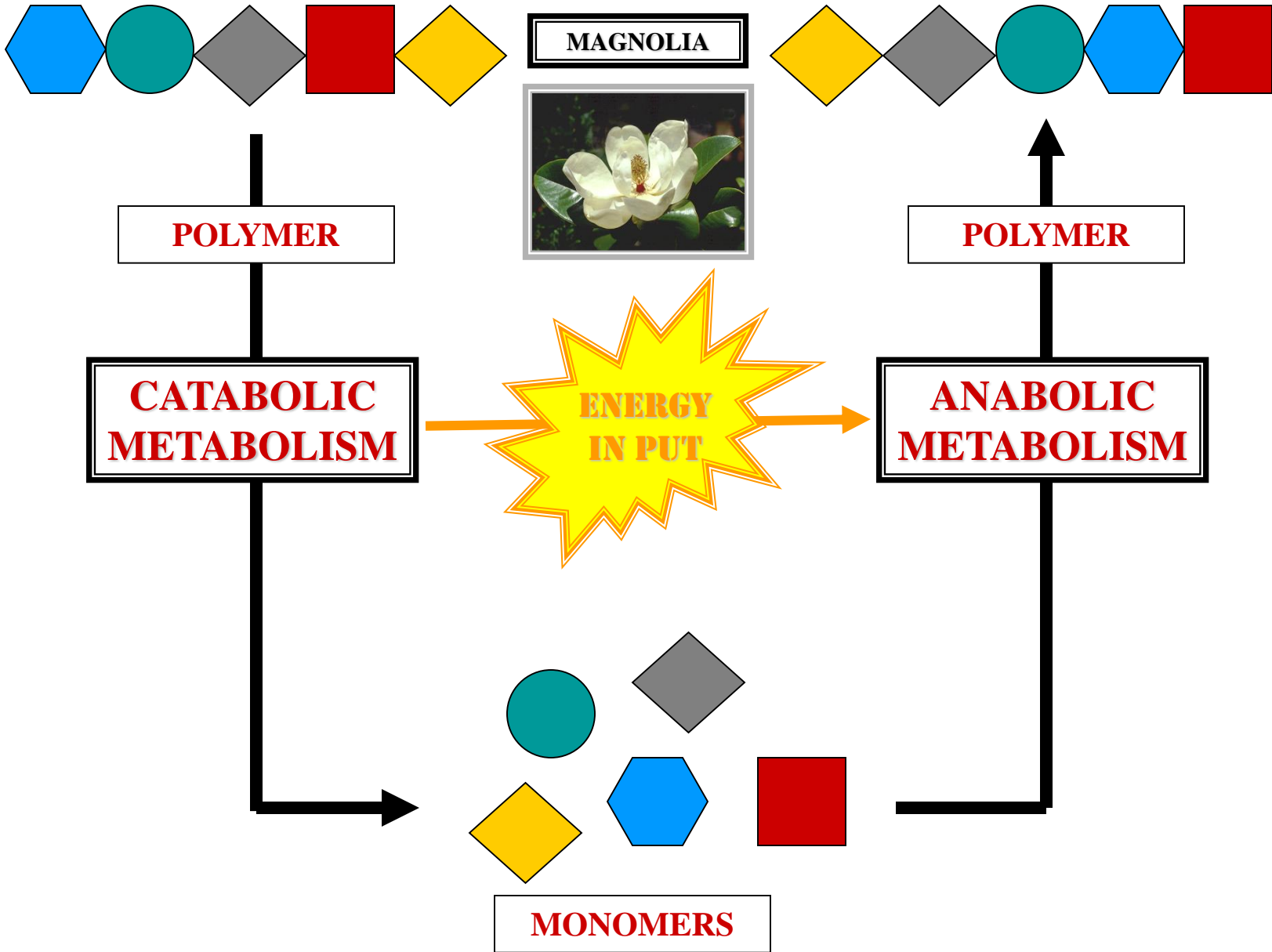


LIVING ANGIOSPERM

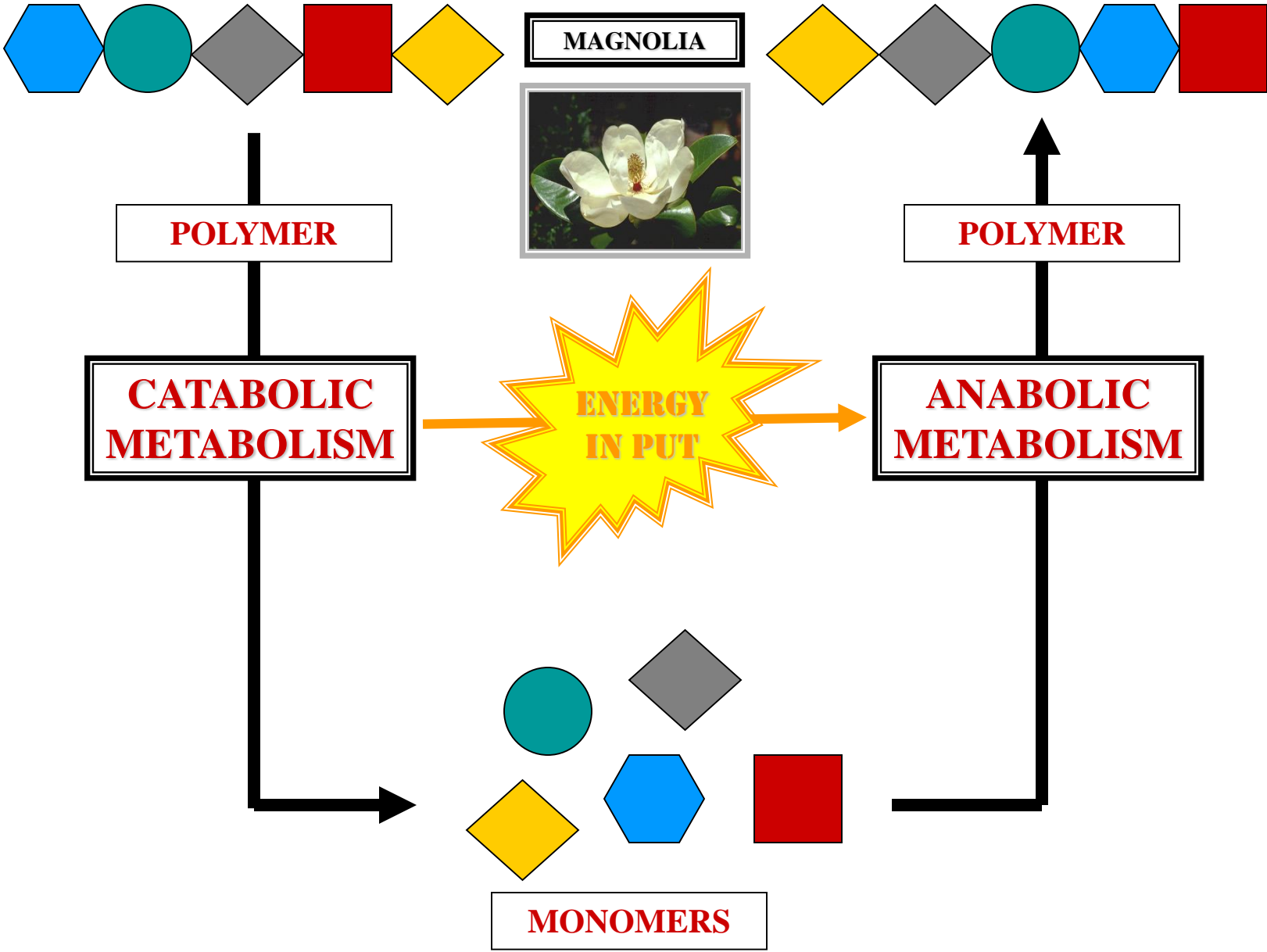
MAGNOLIA



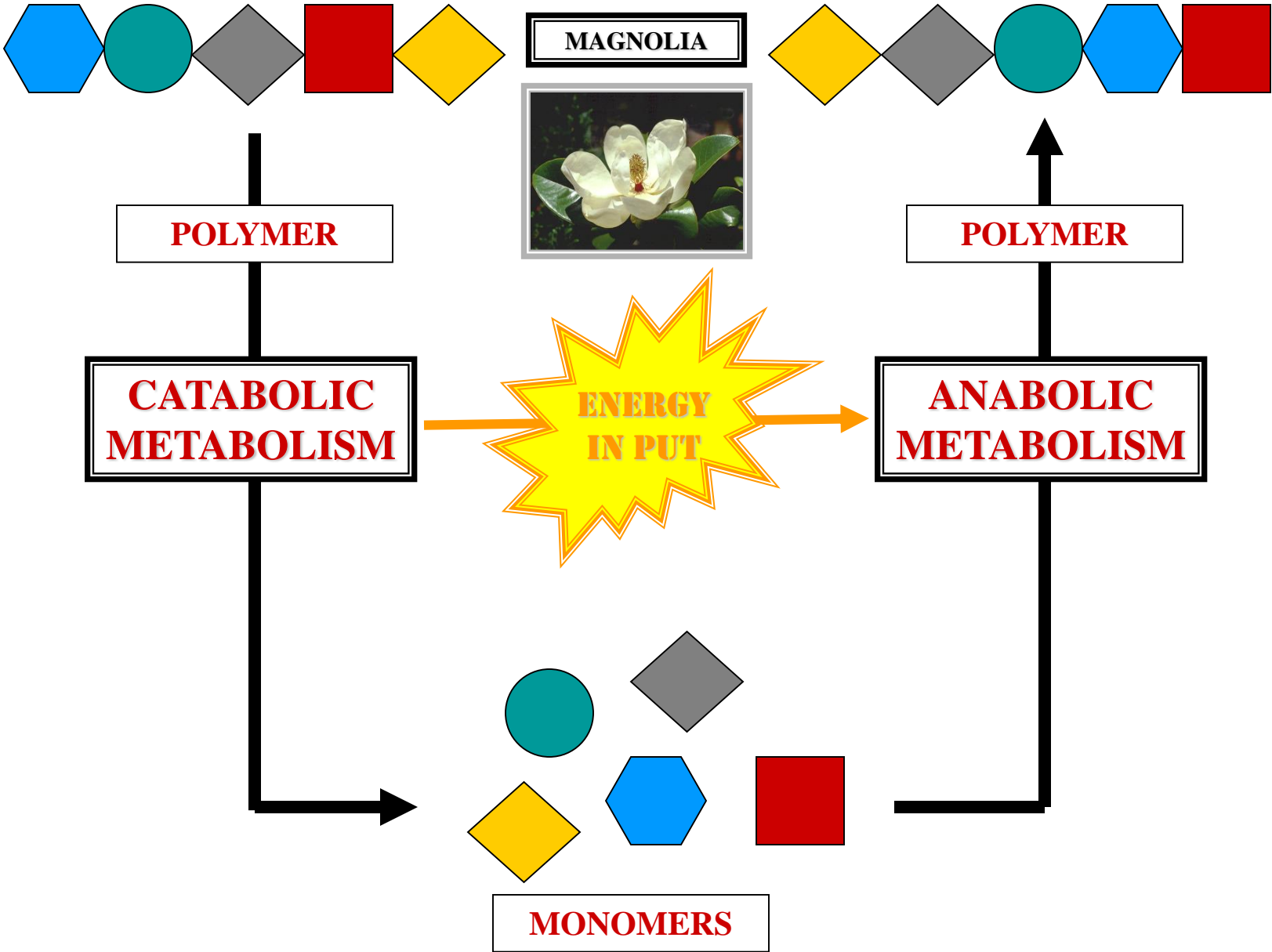
METABOLISM



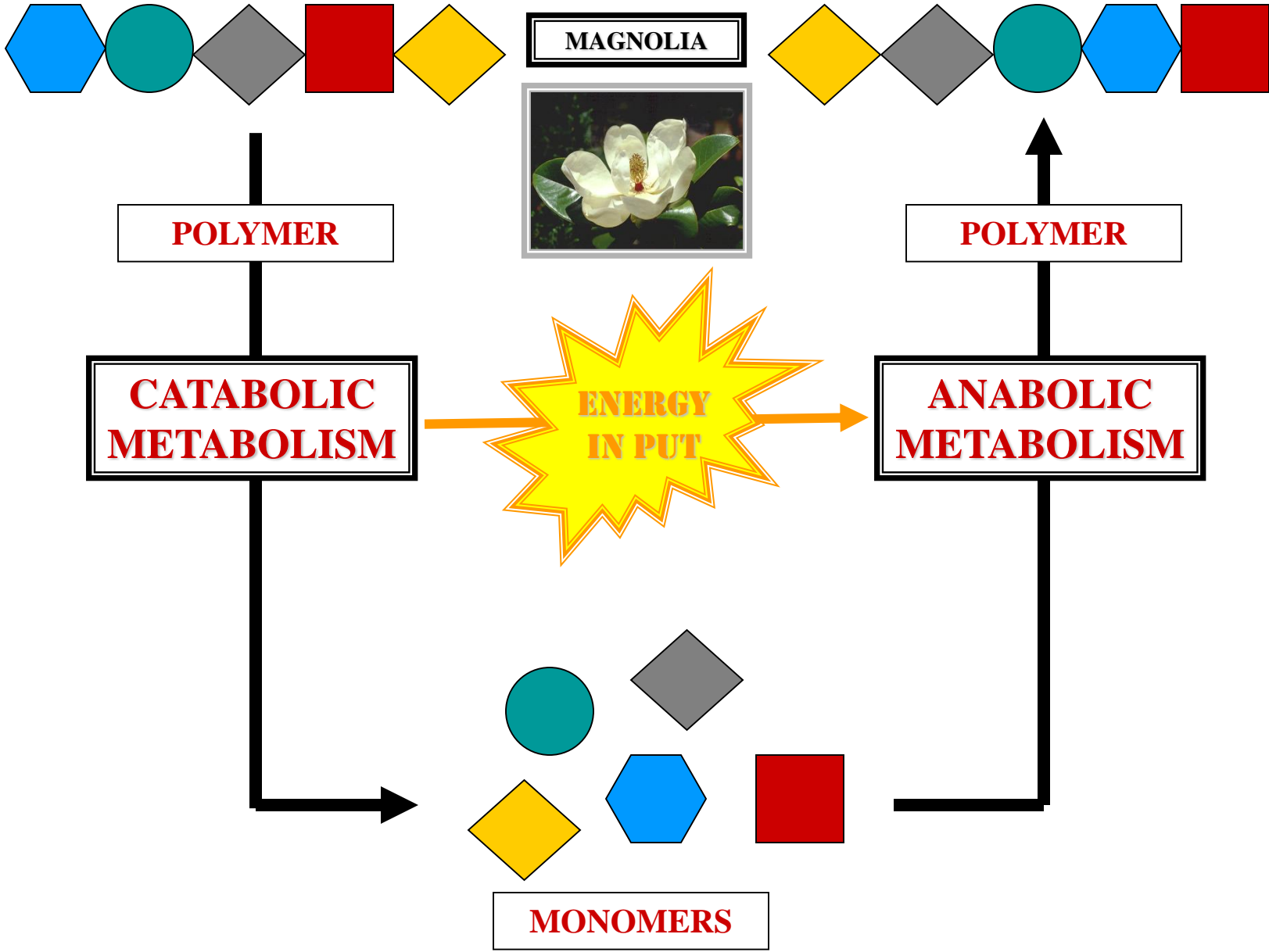
YES METABOLISM



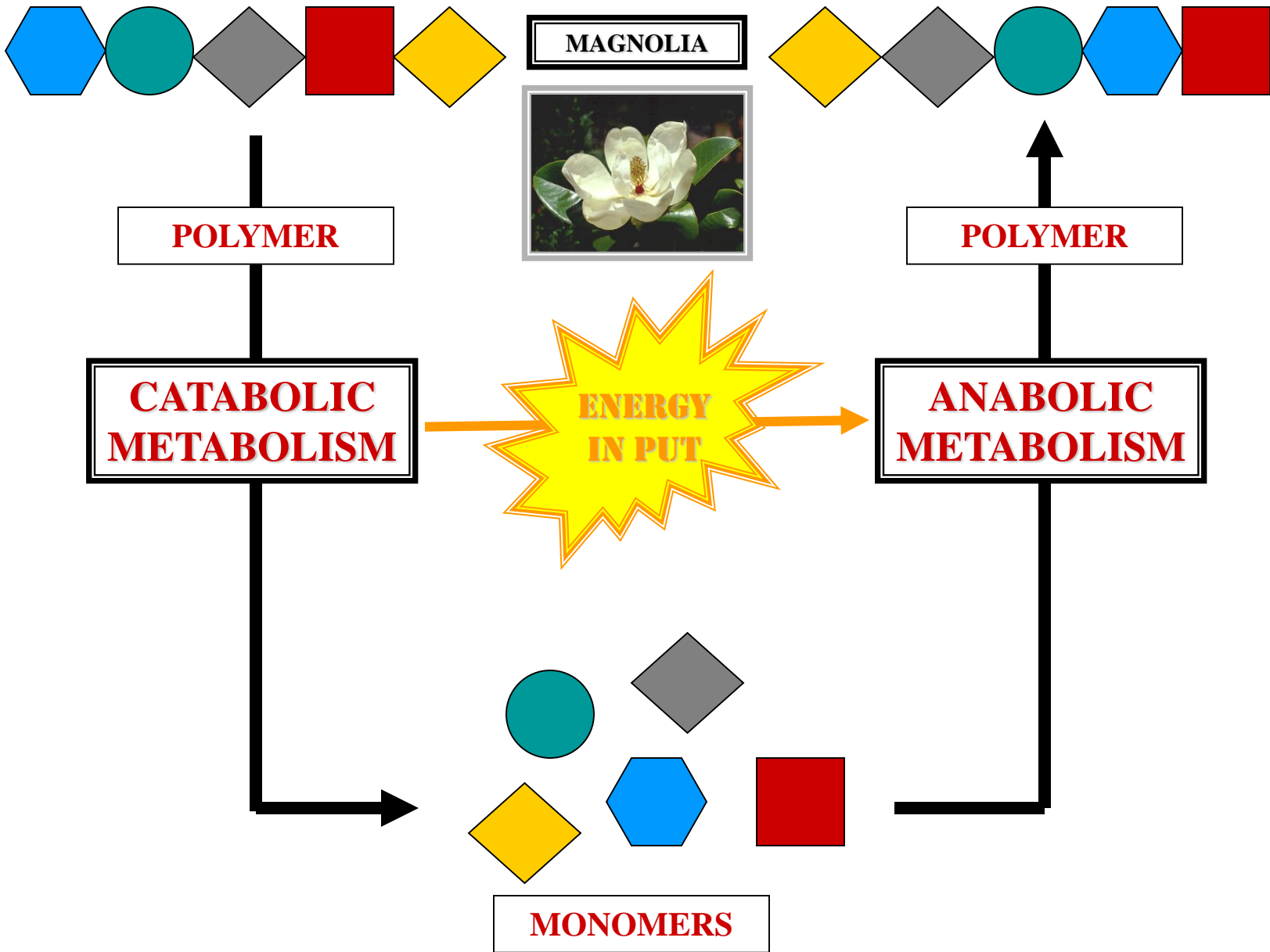
ENERGY



YES ENERGY INPUT

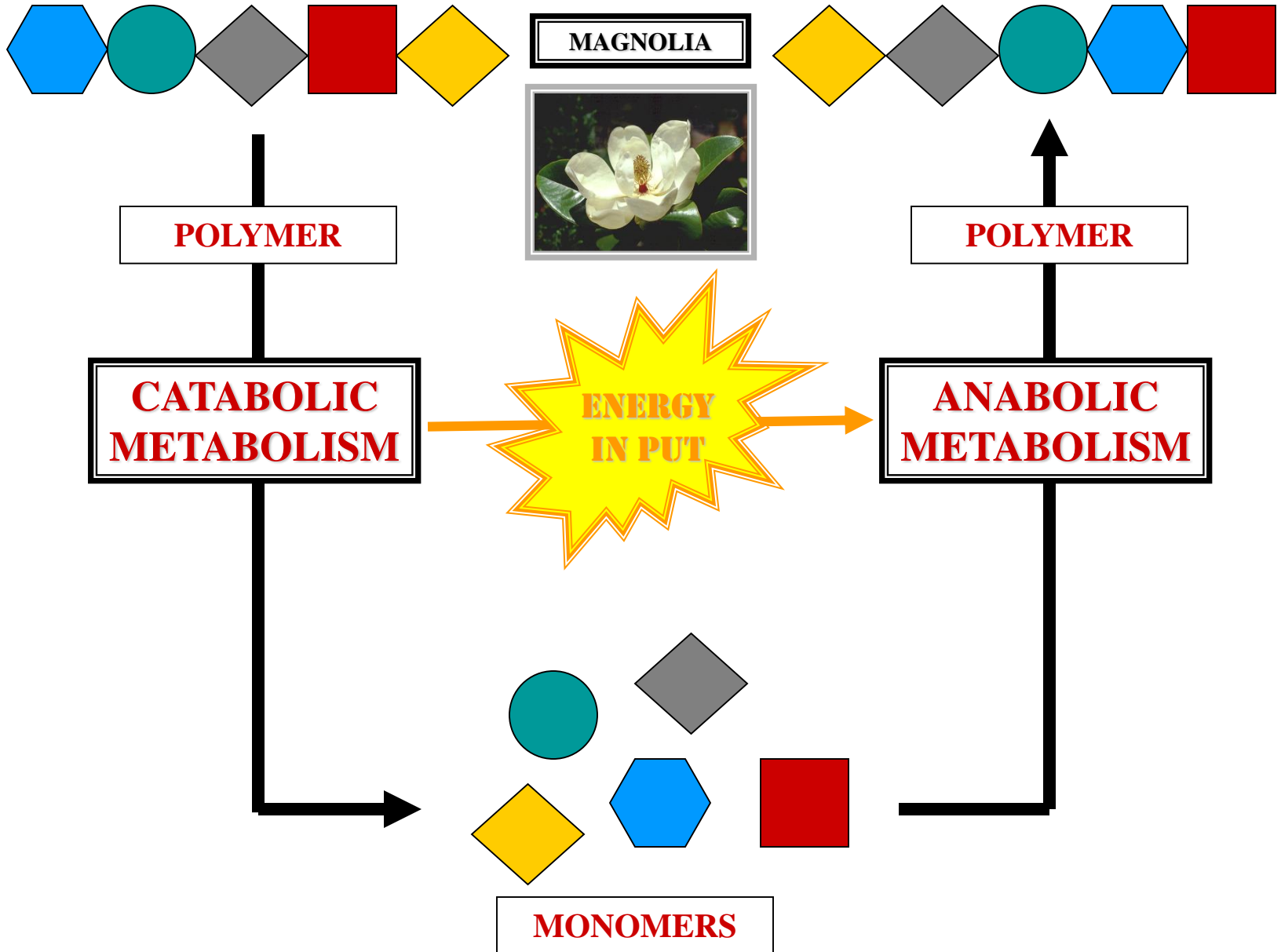


ORGANIZATION

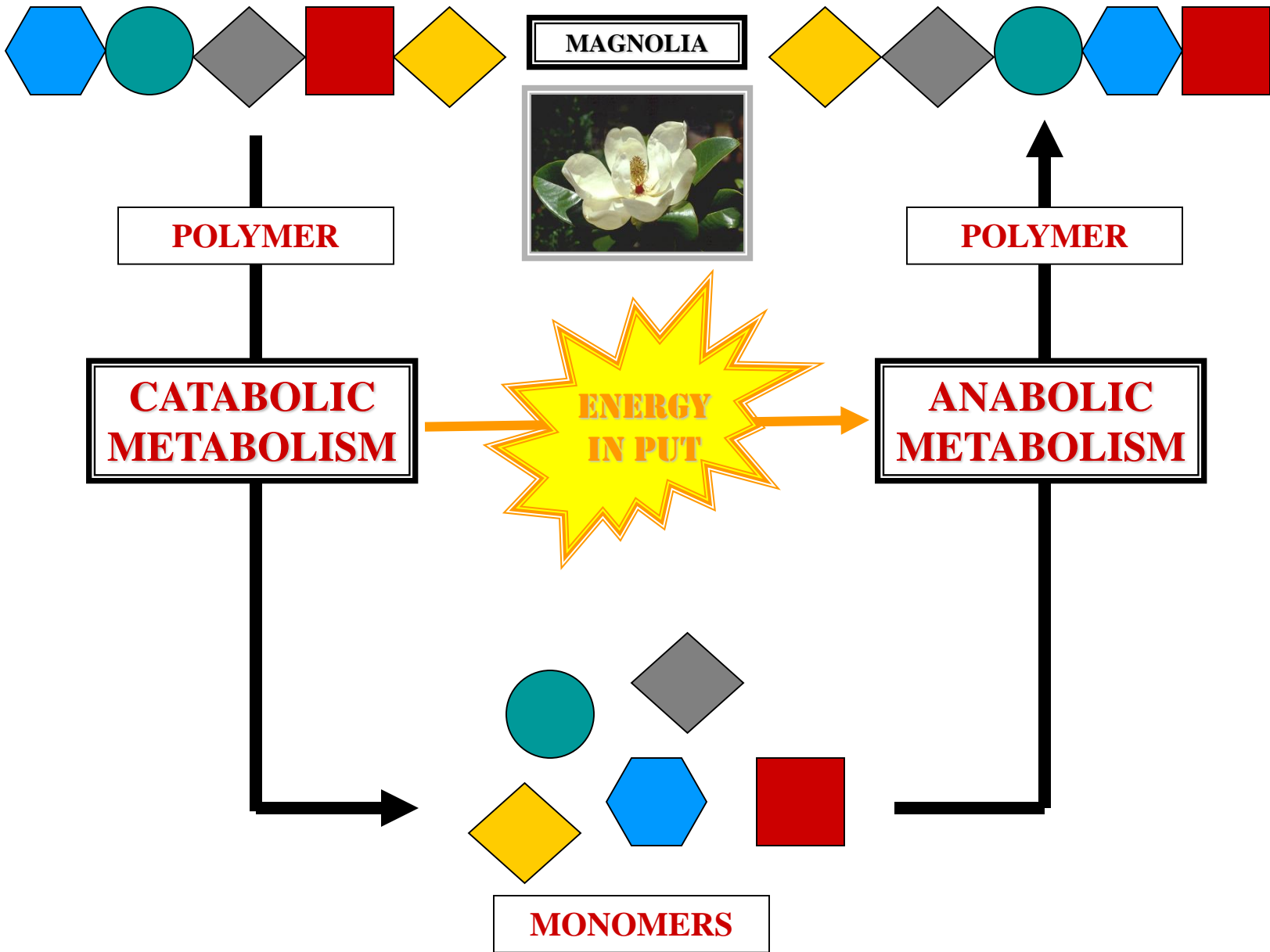


HIGH ORGANIZATION

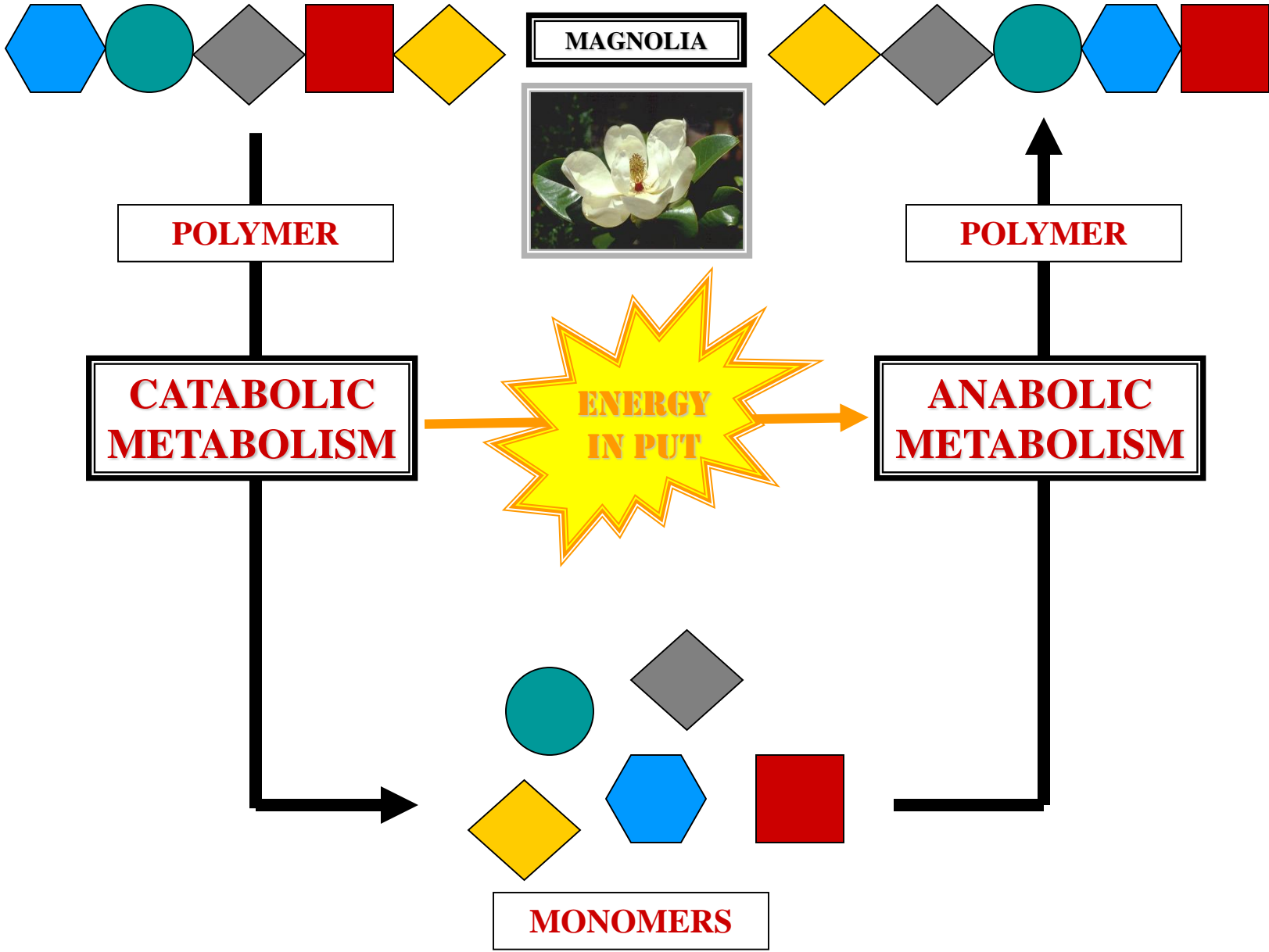
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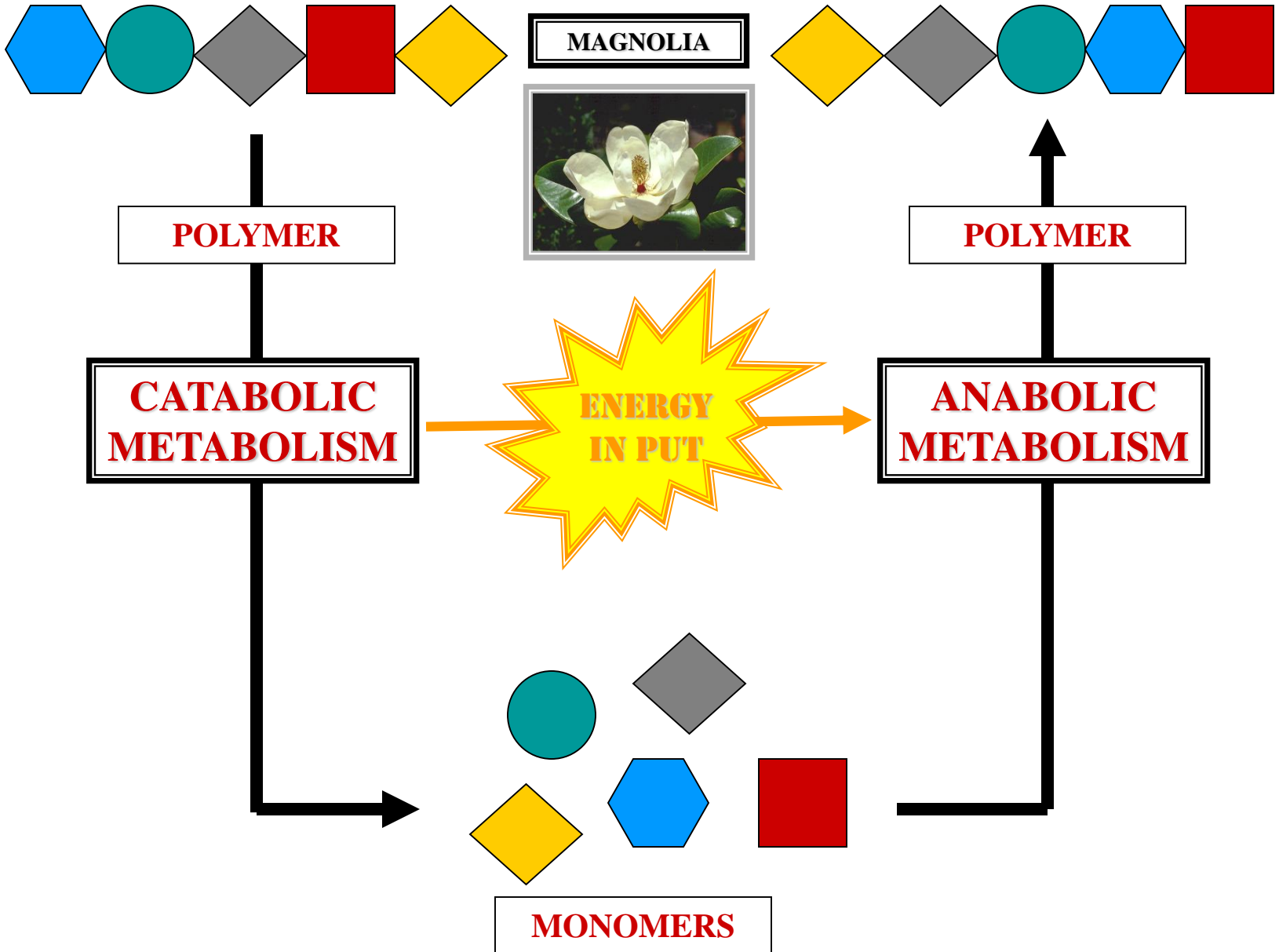
ENTROPY



LOW ENTROPY



LIVING MAGNOLIA





*LIVING ANGIOSPERMS
MAINTAIN
LOW ENTROPY
VIA
METABOLISM
METABOLIC PATHWAYS*

METABOLIC PATHWAYS

METABOLIC PATHWAY

METABOLIC PATHWAY

**SPECIFIC SEQUENCE
BIOCHEMICAL REACTIONS**

METABOLIC PATHWAY

**METABOLIC
PATHWAY
EXAMPLE**

GLYCOLYSIS

GLUCOSE

GLYCOLYSIS

HEXOKINASE

ATP

EGY

ADP

GLUCOSE-6-PHOSPHATE

PHOSPHOGLUCOISOMERASE

FRUCTOSE-6-PHOSPHATE

PHOSPHOFRUCTOKINASE

ATP

EGY

ADP

FRUCTOSE-1-6-PHOSPHATE

+

 = ENERGY



FRUCTOSE-1-6-PHOSPHATE

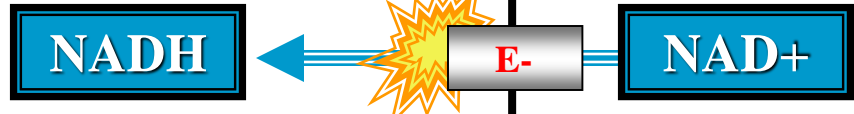
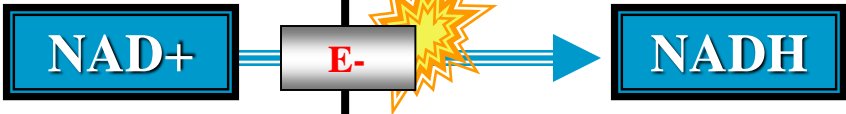
**ALDOLASE
ISOMERASE**

PHOSPHOGLYCERALDEHYDE - PGAL

PHOSPHOGLYCERALDEHYDE - PGAL

TRI-PHOSPHATE DEHYDROGENASE

TRI-PHOSPHATE DEHYDROGENASE



1-3-BISPHOSPHOGLYCERATE

1-3-BISPHOSPHOGLYCERATE

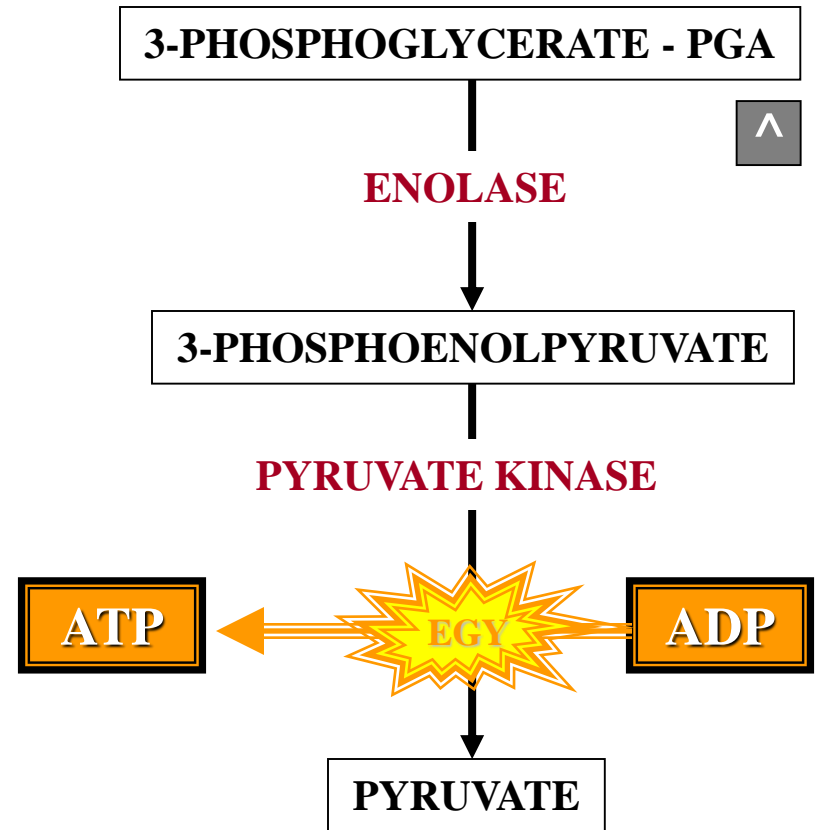
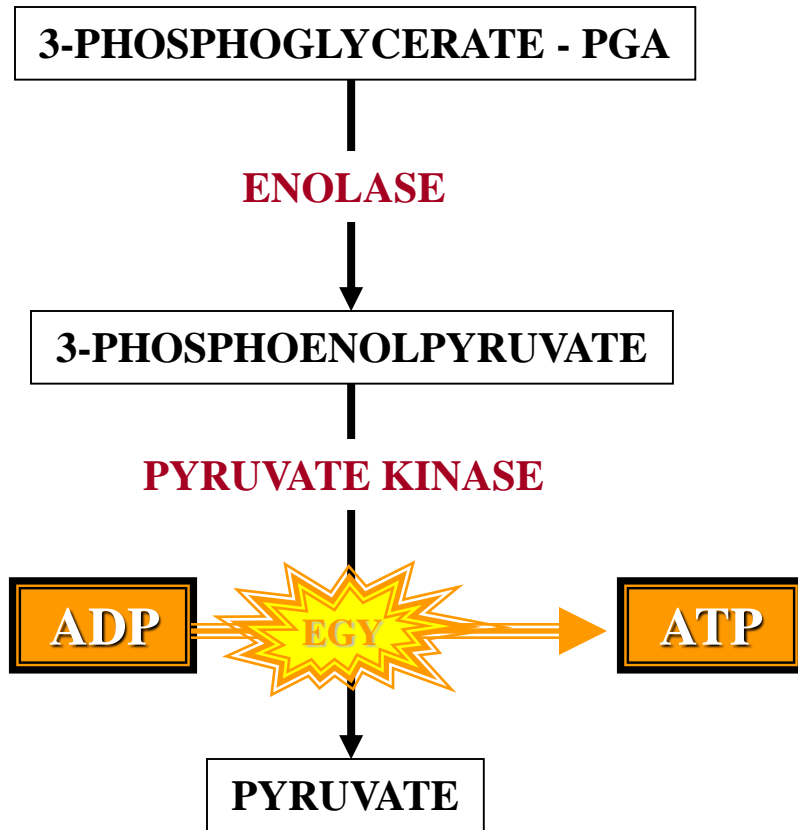
PHOSPHOGLYCEROKINASE

PHOSPHOGLYCEROKINASE



3-PHOSPHOGLYCERATE - PGA

3-PHOSPHOGLYCERATE - PGA



CONSISTS: SPECIFIC SEQUENCE BIO-CHEM RXTS

BLACK = SUBSTRATE/PRODUCT

RED = ENZYME

BIOCHEMICAL REACTION TYPES

**BIOCHEMICAL
REACTION
TYPES**

SUBSTRATE/ENZYZME RXTS

**BIOCHEMICAL
REACTION
TYPES**



BIOCHEMICAL REACTION TYPES

SUBSTRATE/ENZYMES RXNS

REDUCTION/OXIDATION RXNS

BIOCHEMICAL REACTION TYPES

SUBSTRATE
ENZYME
BIOCHEMICAL
REACTION

SUBSTRATE

SUBSTRATE

**BIOCHEMICAL
COMPOUND
ACTED UPON BY AN
ENZYME**

SUBSTRATE

ENZYMIE

ENZYME

**PROTEIN
BIOCHEMICAL
CATALYST**

ENZYME

CATALYST



CATALYST

ACCELERATES

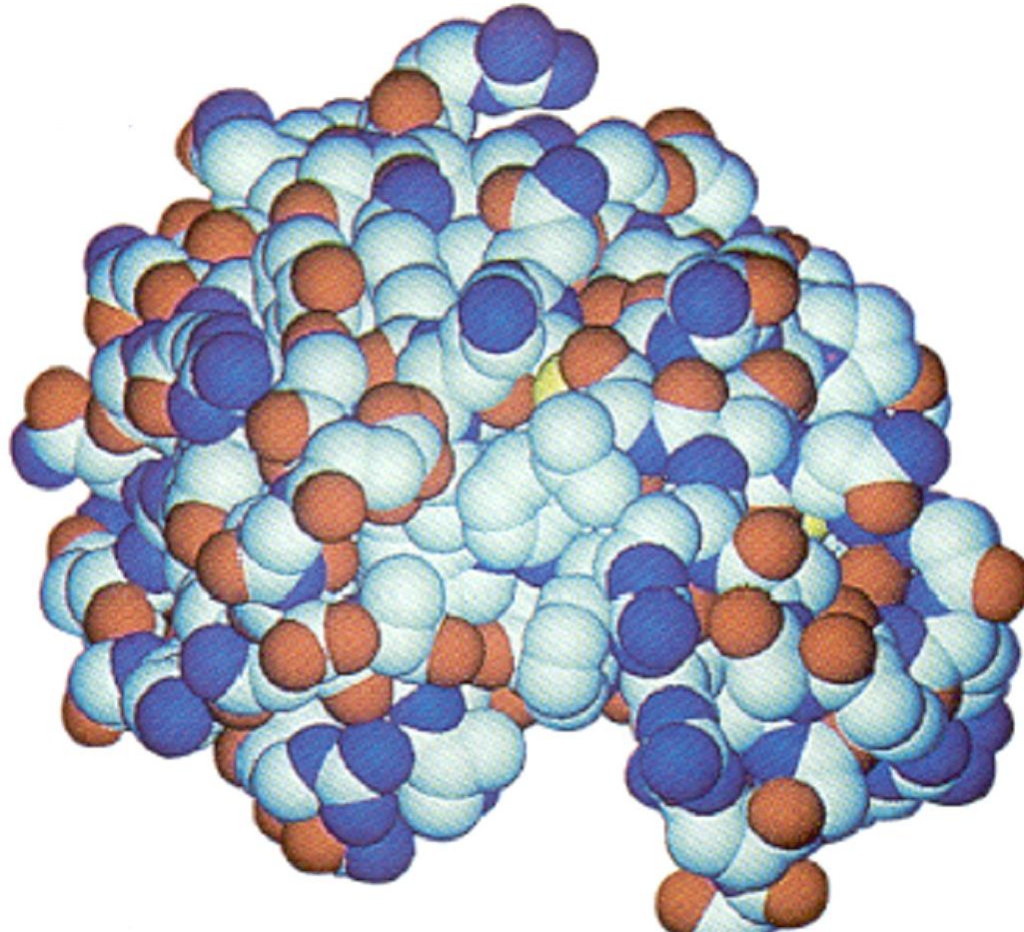
CHEMICAL REACTION

CATALYST



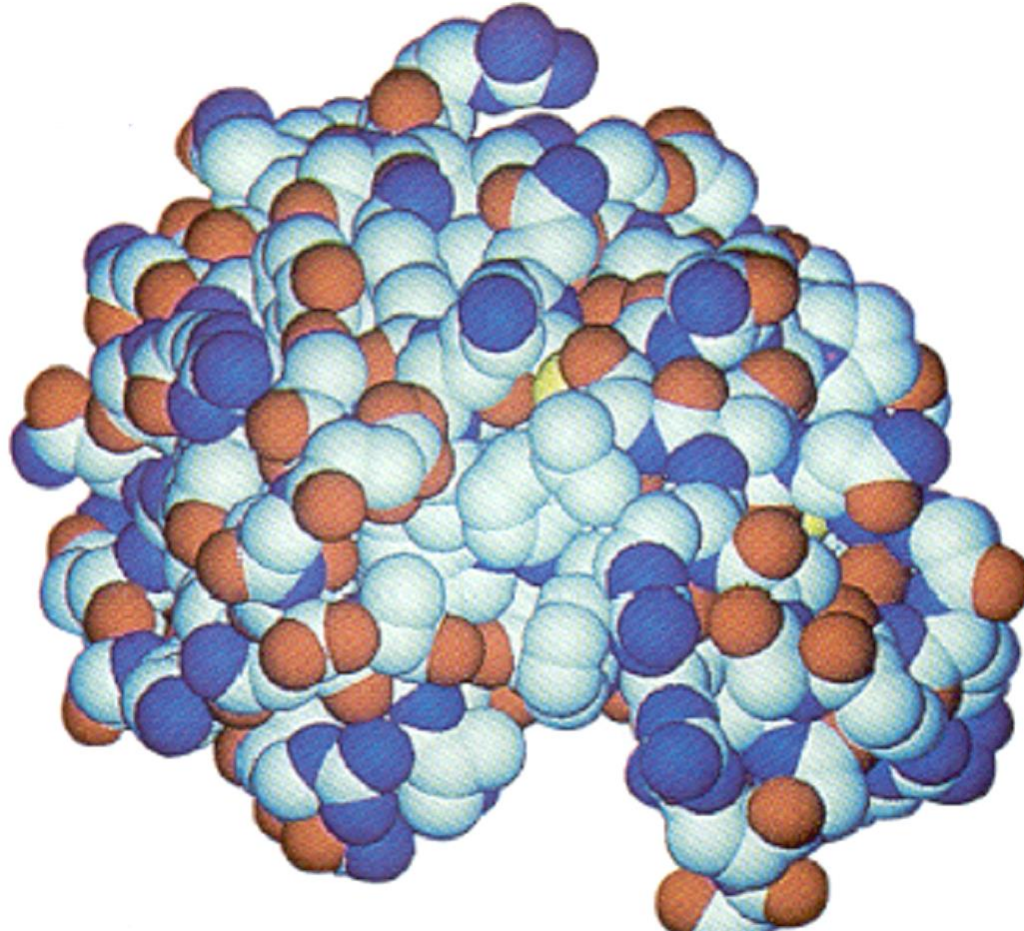
ENZYMIE FEATURES

PROTEIN ENZYME COMPUTER GENERATED MODEL



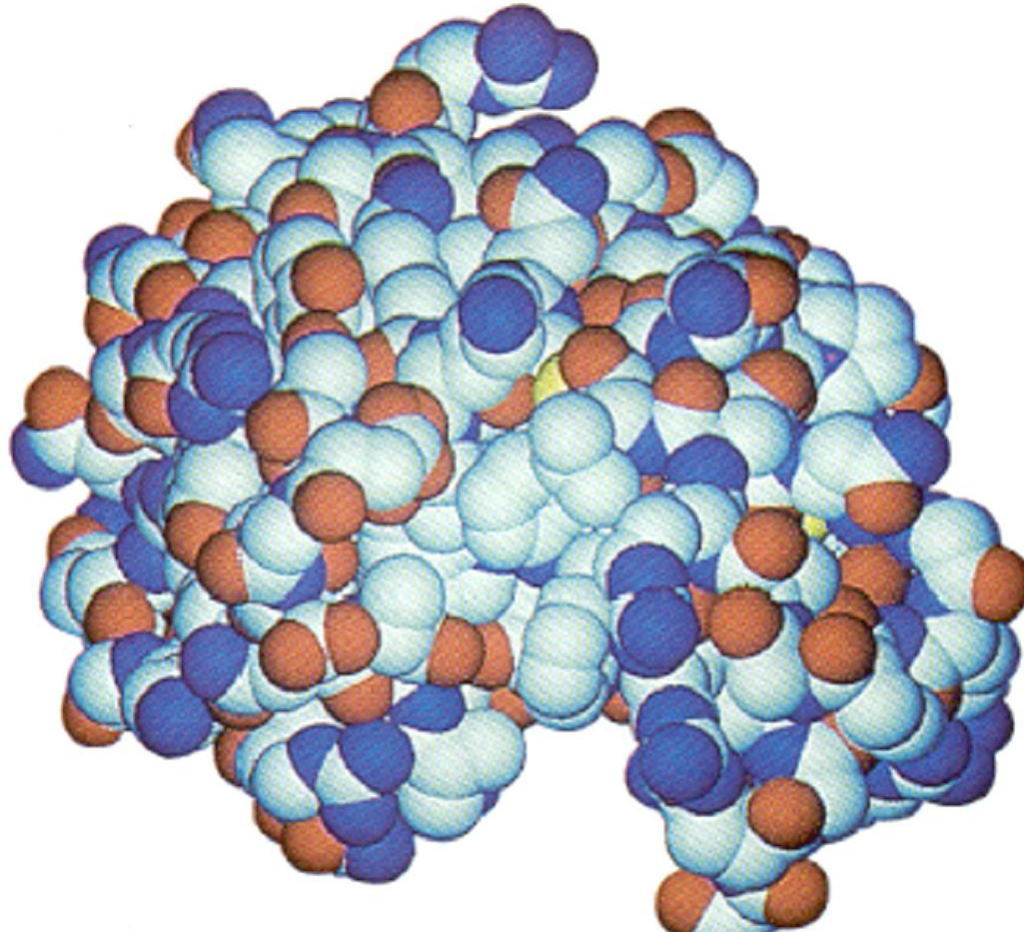
ENZYME

PROTEIN ENZYME COMPUTER GENERATED MODEL



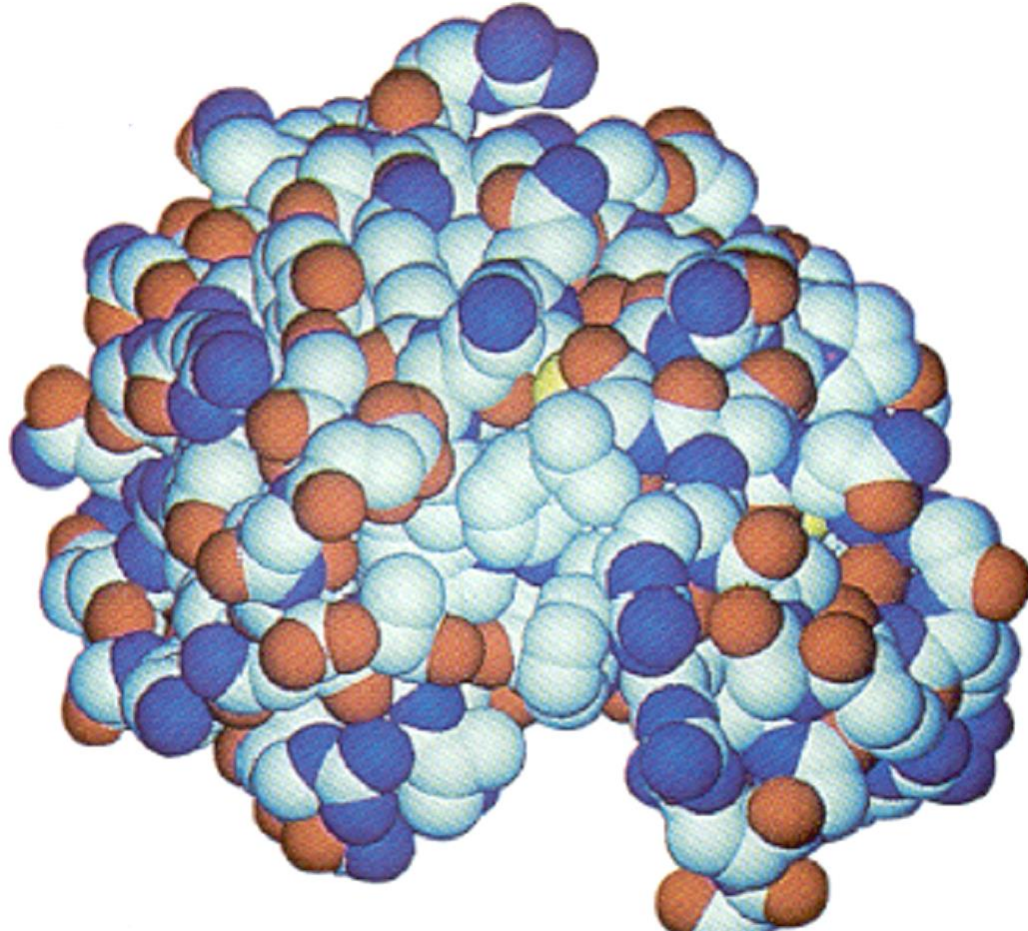
ENZYME: LARGE COMPLEX PROTEIN

PROTEIN ENZYME COMPUTER GENERATED MODEL



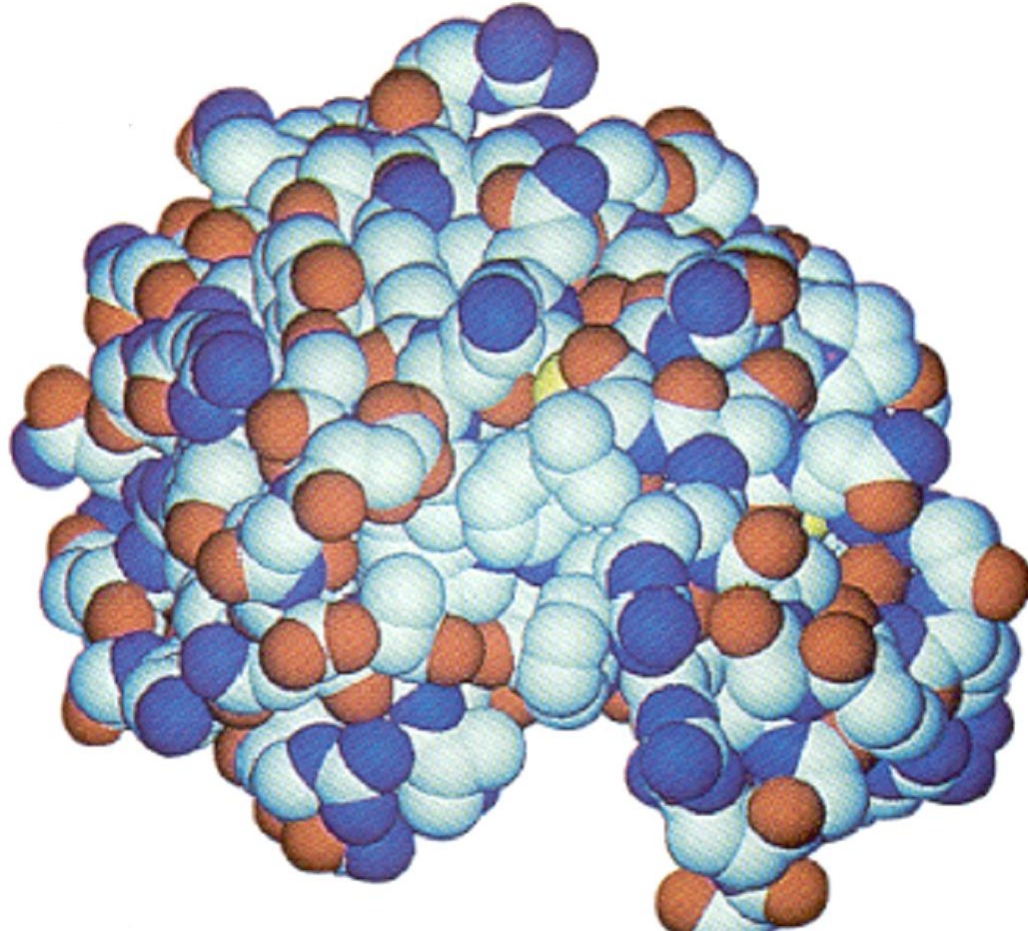
ENZYME: SUBSTRATE SPECIFIC

PROTEIN ENZYME COMPUTER GENERATED MODEL



ENZYME: ACCELERATES BIO-CHEM RXT

PROTEIN ENZYME COMPUTER GENERATED MODEL



ENZYME: LOWERS ACTIVATION ENERGY

ACTIVATION ENERGY