C

CHARACTER POLARITY

CHARACTER POLARITY

CHARACTER POLARITY

CHARACTER STATE EVOLUTION

CHARACTER POLARITY

CHARACTER POLARITY

CHARACTER STATE EVOLUTION

CHARACTER STATE DIRECTION

CHARACTER POLARITY

CHARACTER POLARITY

2X

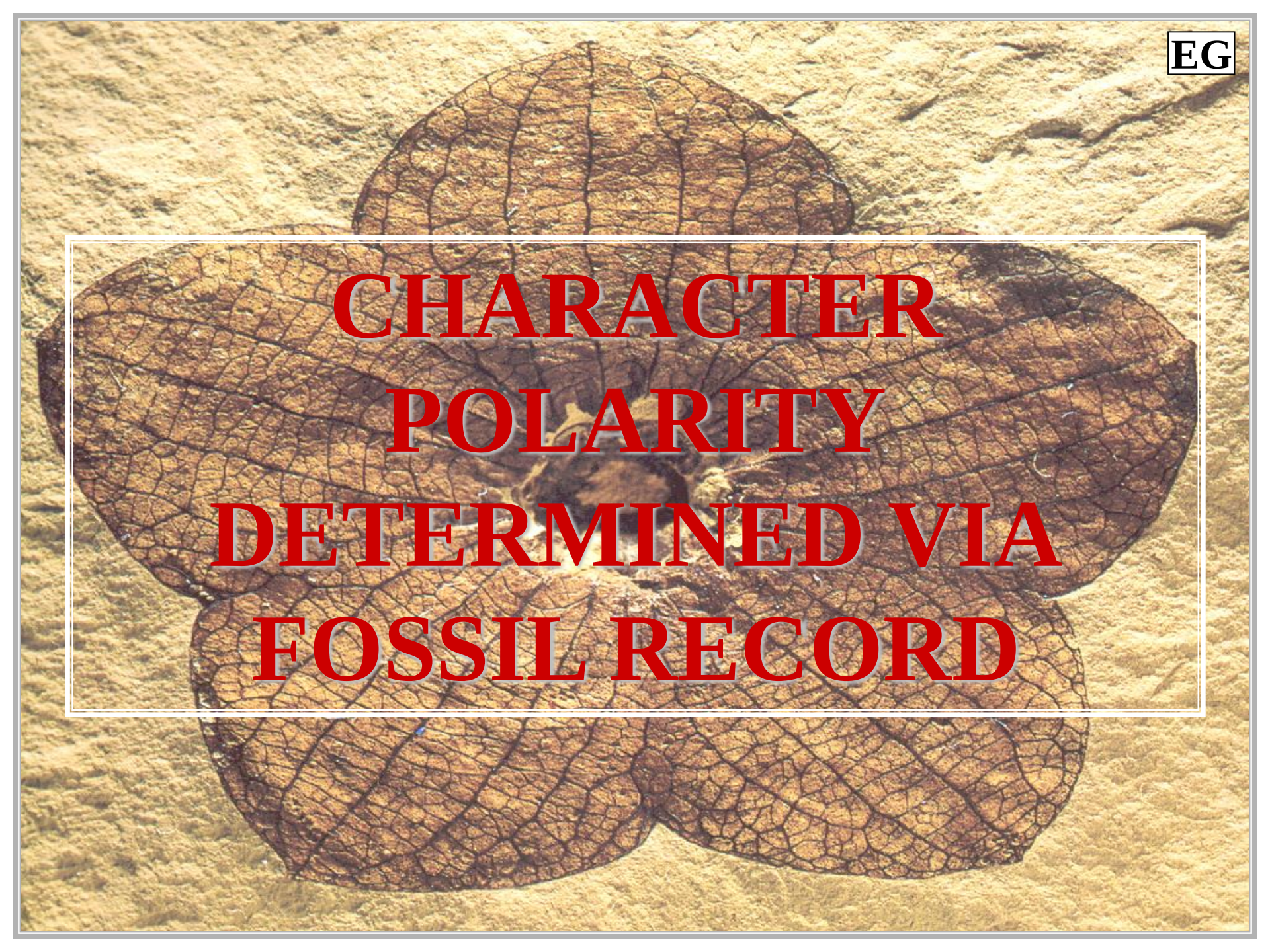
+

CHARACTER STATE EVOLUTION

CHARACTER STATE DIRECTION

DETERMINED VIA FOSSIL RECORD

CHARACTER POLARITY


EG
CHARACTER
POLARITY
DETERMINED VIA
FOSSIL RECORD

CHARACTER POLARITY

!!!DO NOT COPY!!!

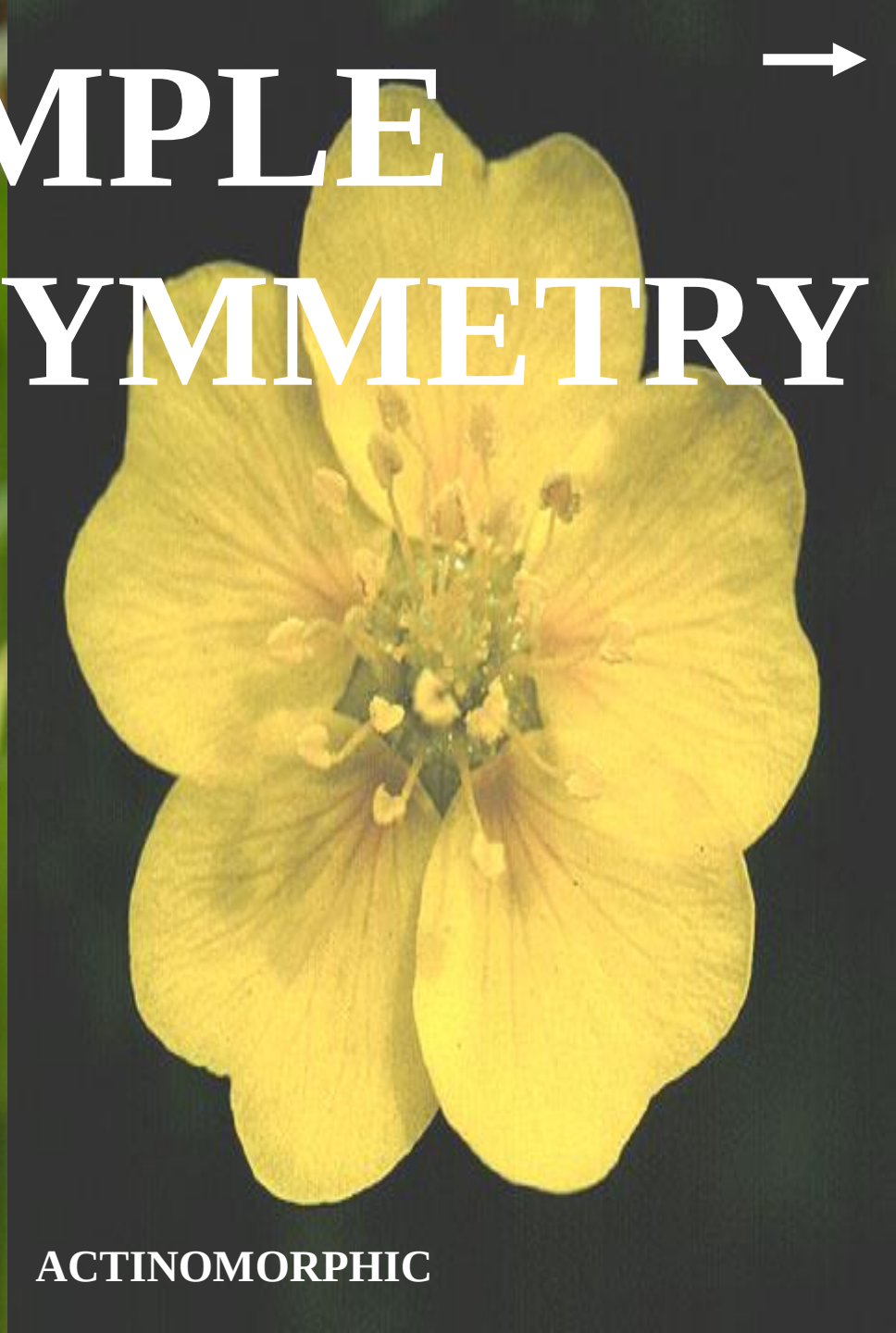
CHARACTER POLARITY

!!!DO NOT COPY!!!

EXAMPLE FLOWER SYMMETRY

EXAMPLE FLOWER SYMMETRY

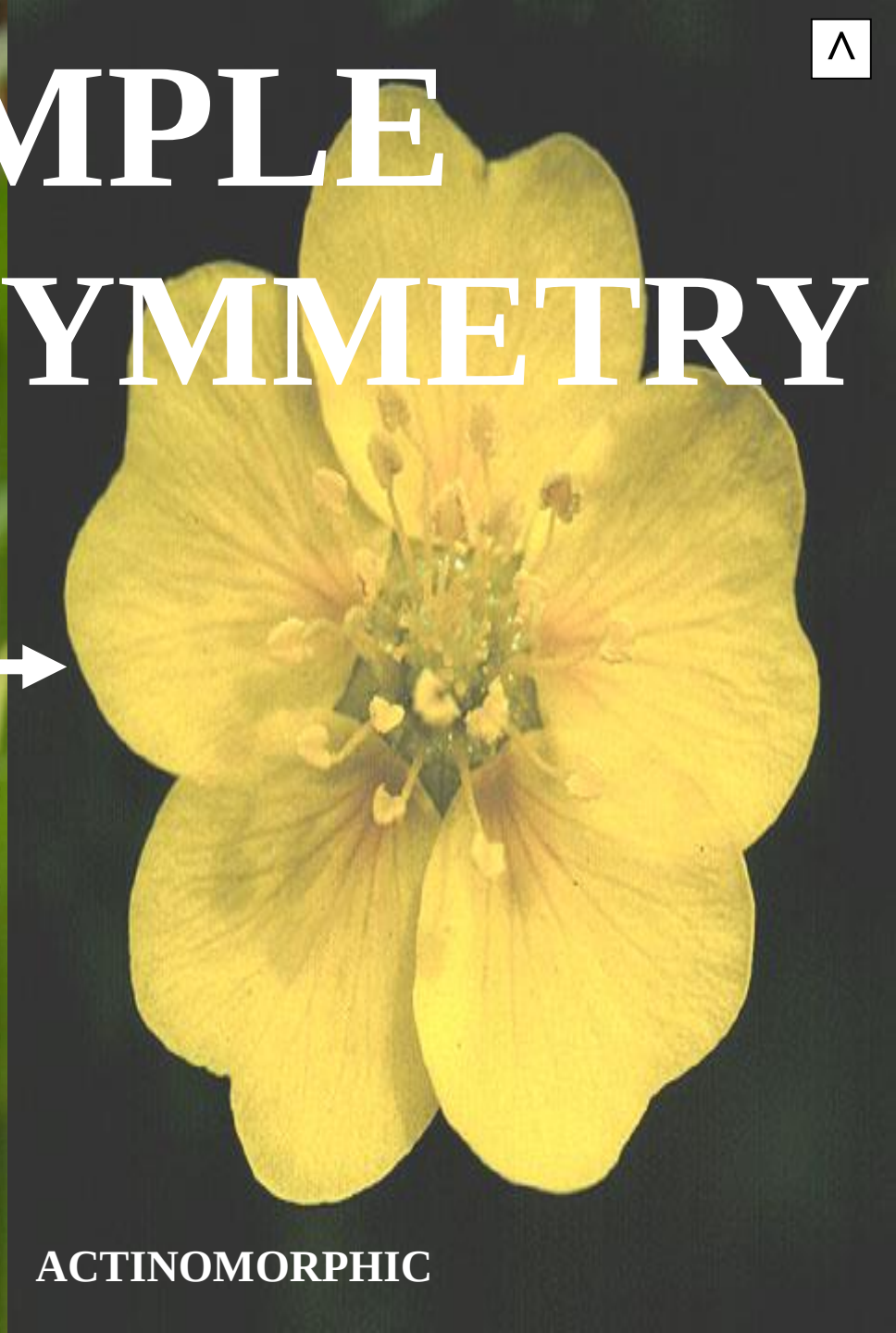
ZYGOMORPHIC



ACTINOMORPHIC

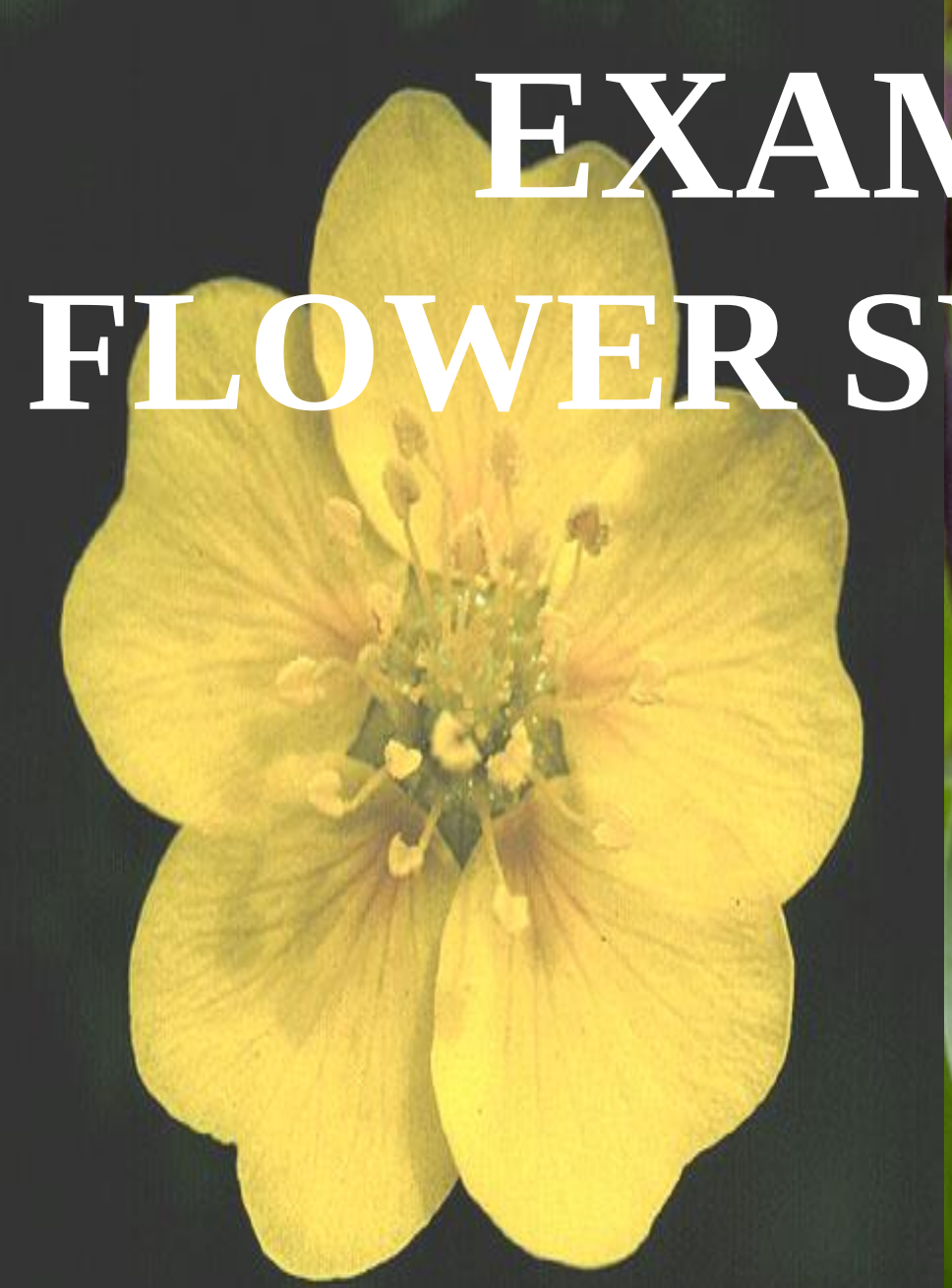
EXAMPLE FLOWER SYMMETRY

ZYGOMORPHIC

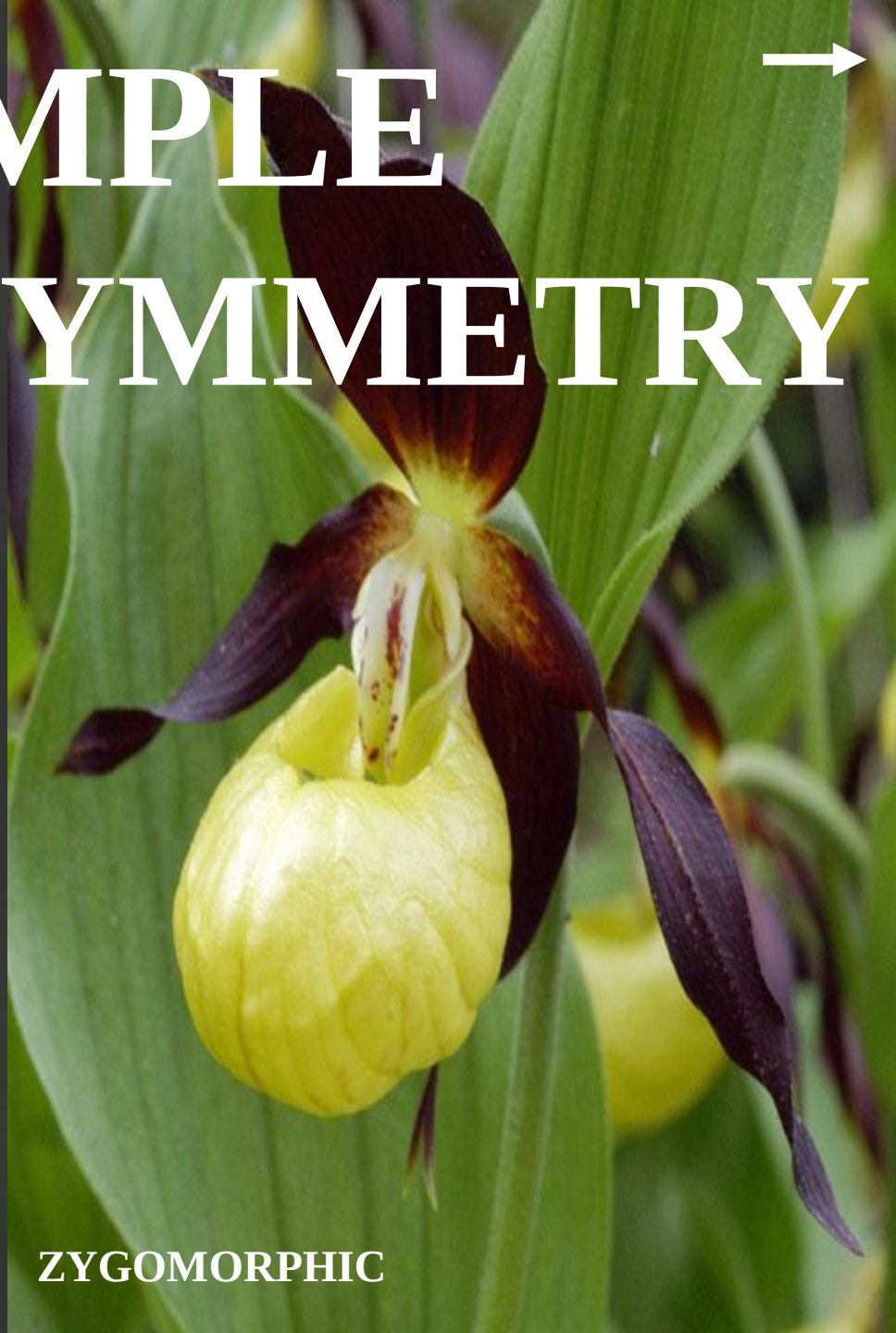


ACTINOMORPHIC

EXAMPLE FLOWER SYMMETRY

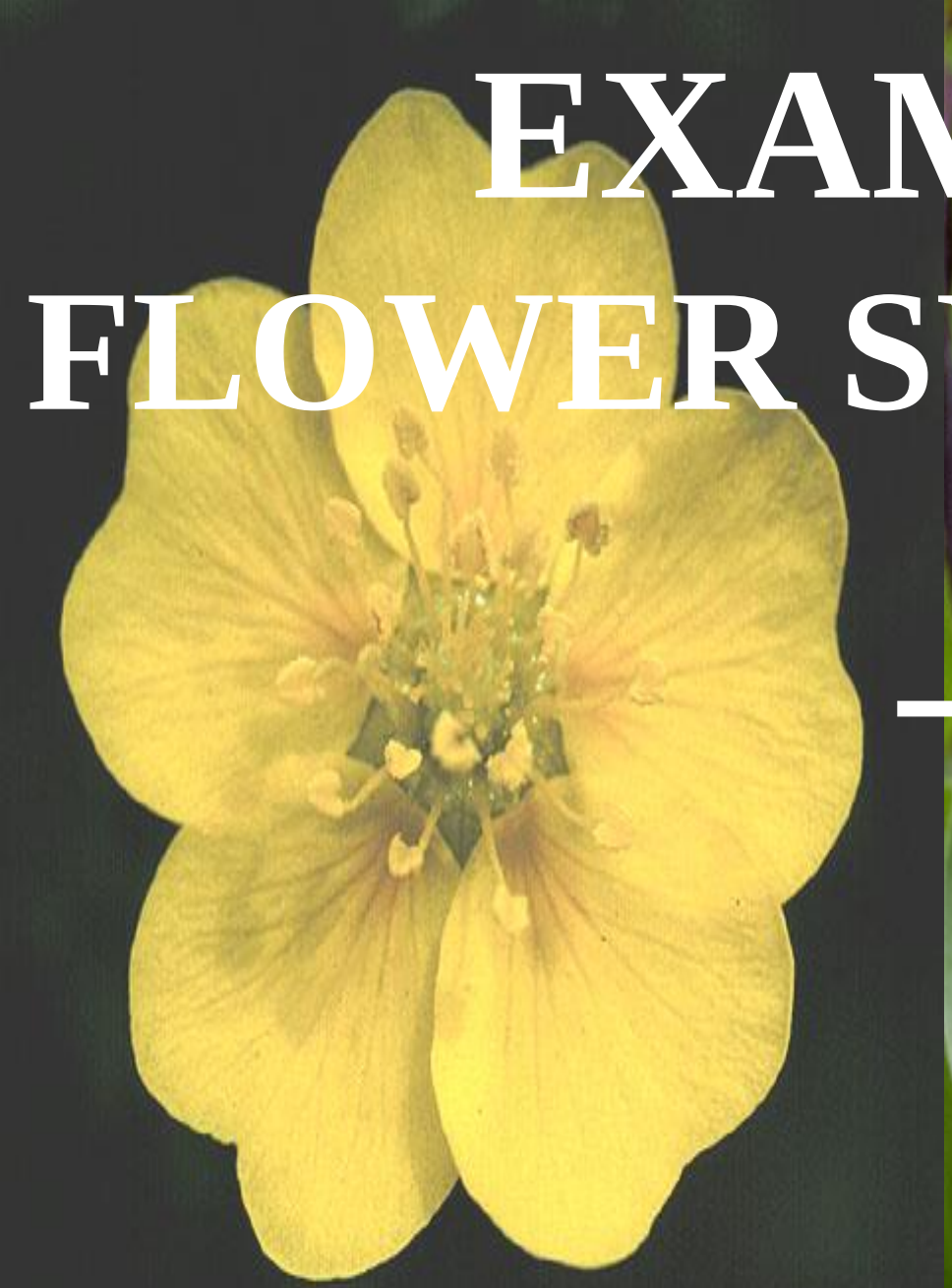


ACTINOMORPHIC



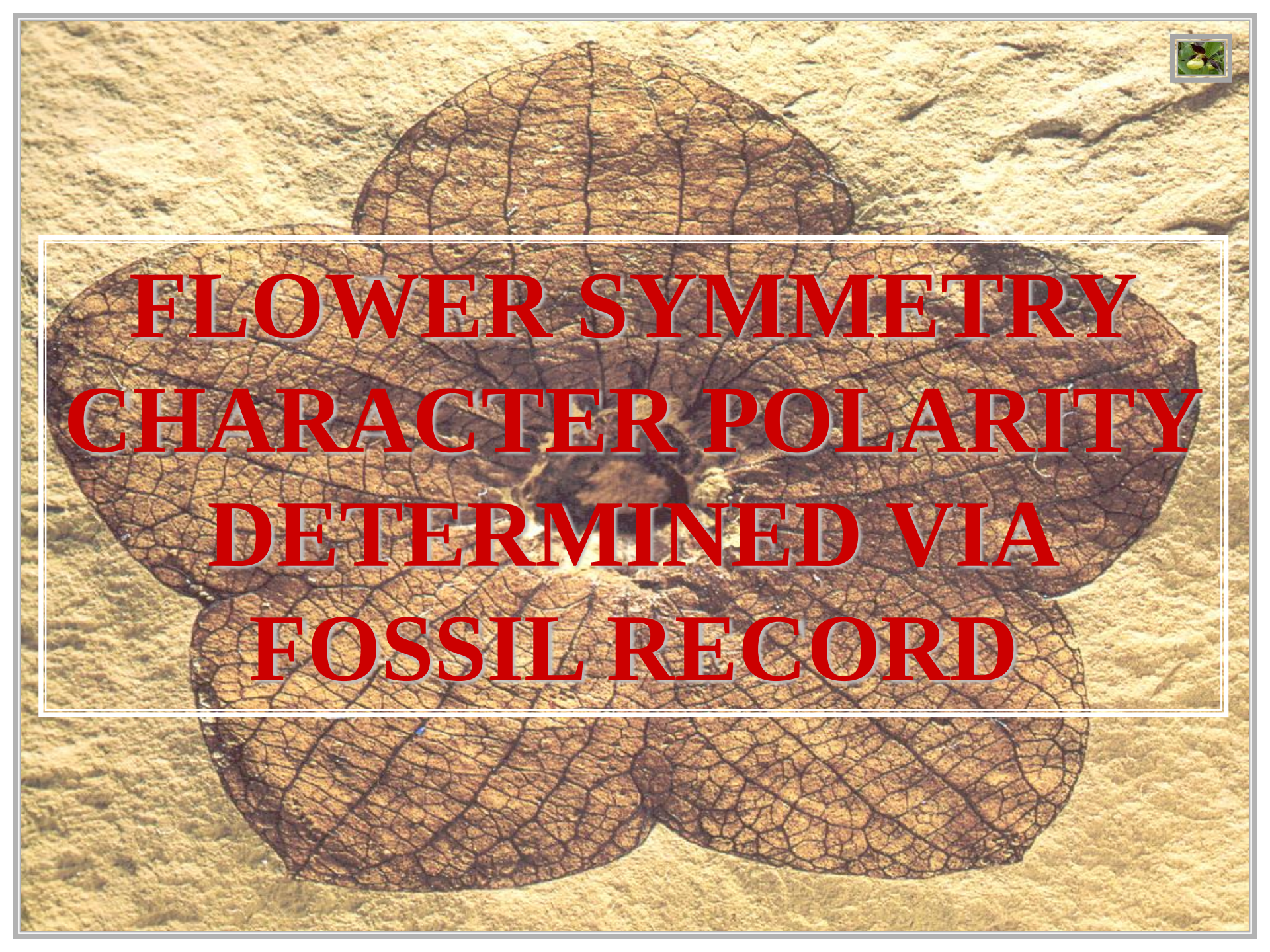
ZYGOMORPHIC

EXAMPLE FLOWER SYMMETRY

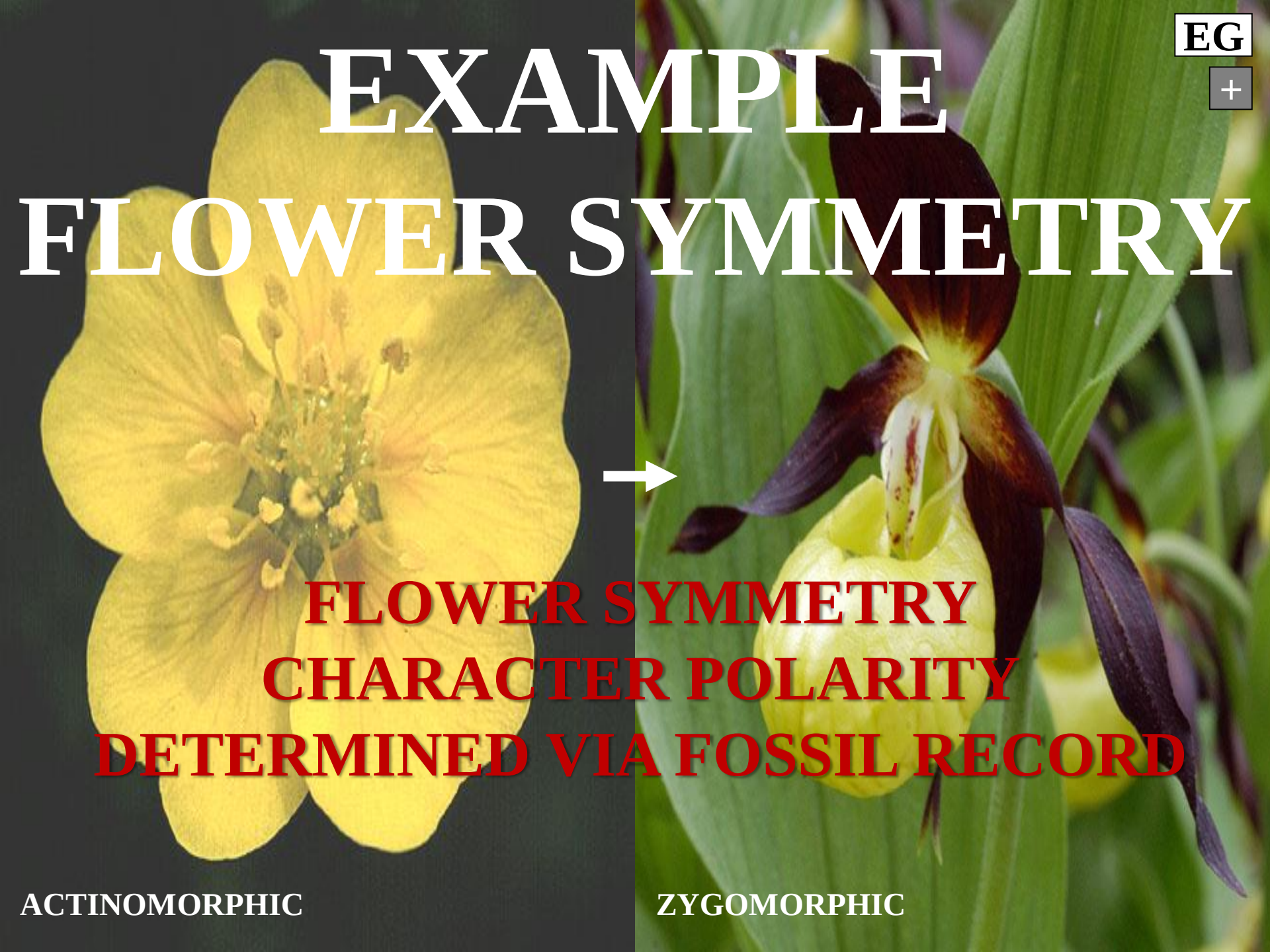


ACTINOMORPHIC

ZYGOMORPHIC



FLOWER SYMMETRY CHARACTER POLARITY DETERMINED VIA FOSSIL RECORD


EG
+
EXAMPLE
FLOWER SYMMETRY
FLOWER SYMMETRY
CHARACTER POLARITY
DETERMINED VIA FOSSIL RECORD
ACTINOMORPHIC
ZYGOMORPHIC

DM

DATA MATRIX CHARACTER POLARITIES

WOODY	→	HERBACEOUS
SIMPLE LEAF	→	COMPOUND LEAF
STIPULES PRESENT	→	STIPULES ABSENT
ALTERNATE PHYLLOTAXY	→	OPPOSITE PHYLLOTAXY
ACTINOMORPHIC	→	ZYGOMORPHIC
PRIMITIVE PLT	→	**ADVANCED PLT**

DATA MATRIX

PLT-TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
PLT-TAXON-E	+	+	+	+	+
PLT-TAXON-D	+	+	+	+	-
PLT-TAXON-C	+	+	+	-	-
PLT-TAXON-B	+	+	-	-	-
PLT-TAXON-A	+	-	-	-	-

+ = CHARACTER PRESENT

MUST DETERMINE CHARACTER POLARITY OF ALL CHARACTERS

P

CLASSICAL PHYLOGENTIC DENDROGRAM

PHYLOGRAM

PHYLOGRAM
DENDROGRAM

GENERATED FREE-STYLE VIA:

PHYLOGRAM
DENDROGRAM

PHYLOGRAM
DENDROGRAM

DM

GENERATED FREE-STYLE VIA:
DATA MATRIX
&
CHARACTER POLARITIES

PHYLOGRAM
DENDROGRAM

PHYLOGRAM

GENERATED FREE-STYLE

DATA MATRIX

TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
TAXON-E	+	+	+	+	+
TAXON-D	+	+	+	+	
TAXON-C	+	+	+		
TAXON-B	+	+			
TAXON-A	+				

+ = CHARACTER PRESENT

PHYLOGRAM

DATA MATRIX

TAXON	CH-1	CH-2	CH-3	CH-4	CH-5

TAXON-A +

+ = CHARACTER PRESENT

EVOLVED CH-1

PLT-TAXON-A

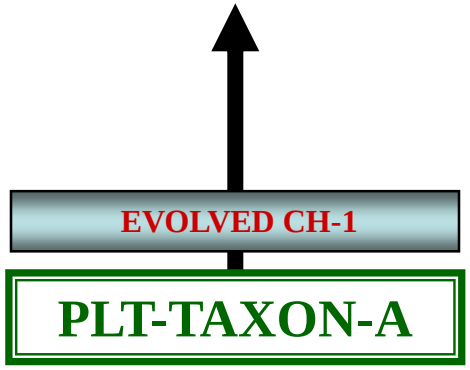
B

PHYLOGRAM

DATA MATRIX

TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
TAXON-A	+				

+ = CHARACTER PRESENT

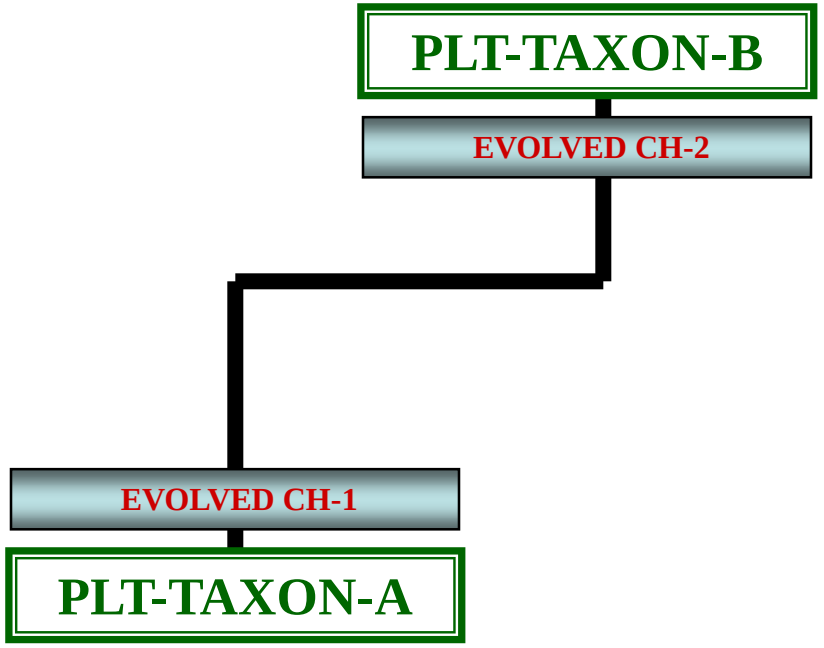


PHYLOGRAM

DATA MATRIX

TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
TAXON-B	+		+		
TAXON-A	+				

+ = CHARACTER PRESENT



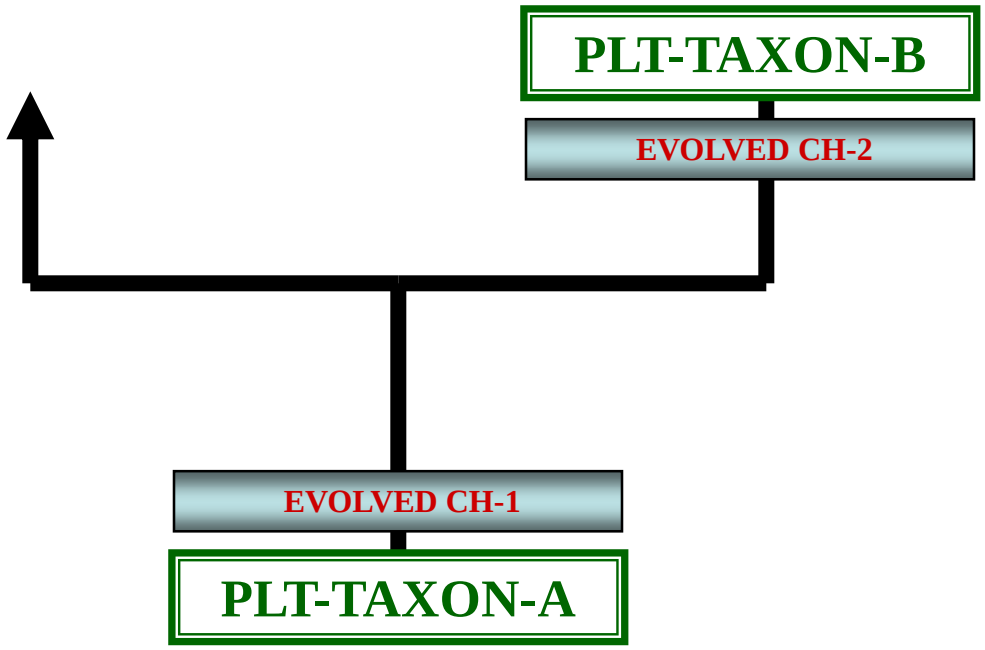
C

PHYLOGRAM

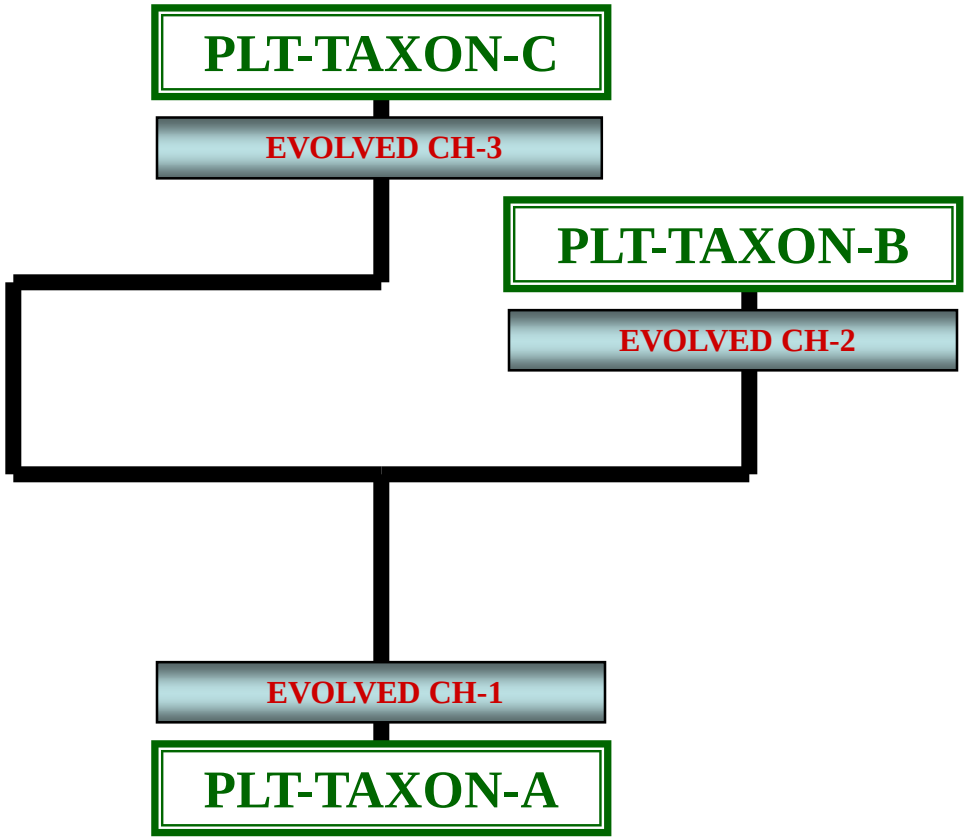
DATA MATRIX

TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
TAXON-B	+		+		
TAXON-A	+				

+ = CHARACTER PRESENT



PHYLOGRAM

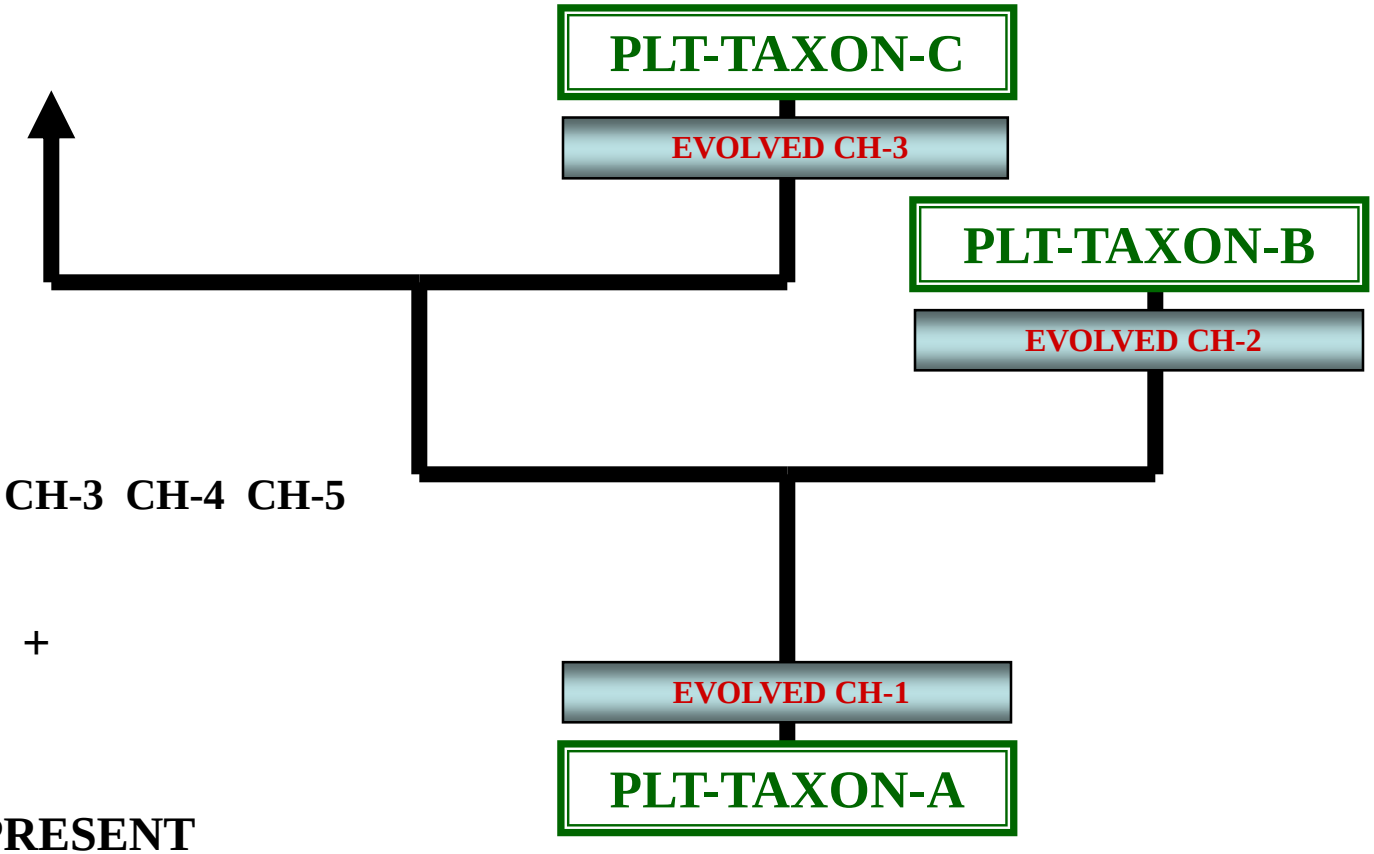


DATA MATRIX

TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
TAXON-C	+	+	+		
TAXON-B	+	+			
TAXON-A	+				

+ = CHARACTER PRESENT

PHYLOGRAM

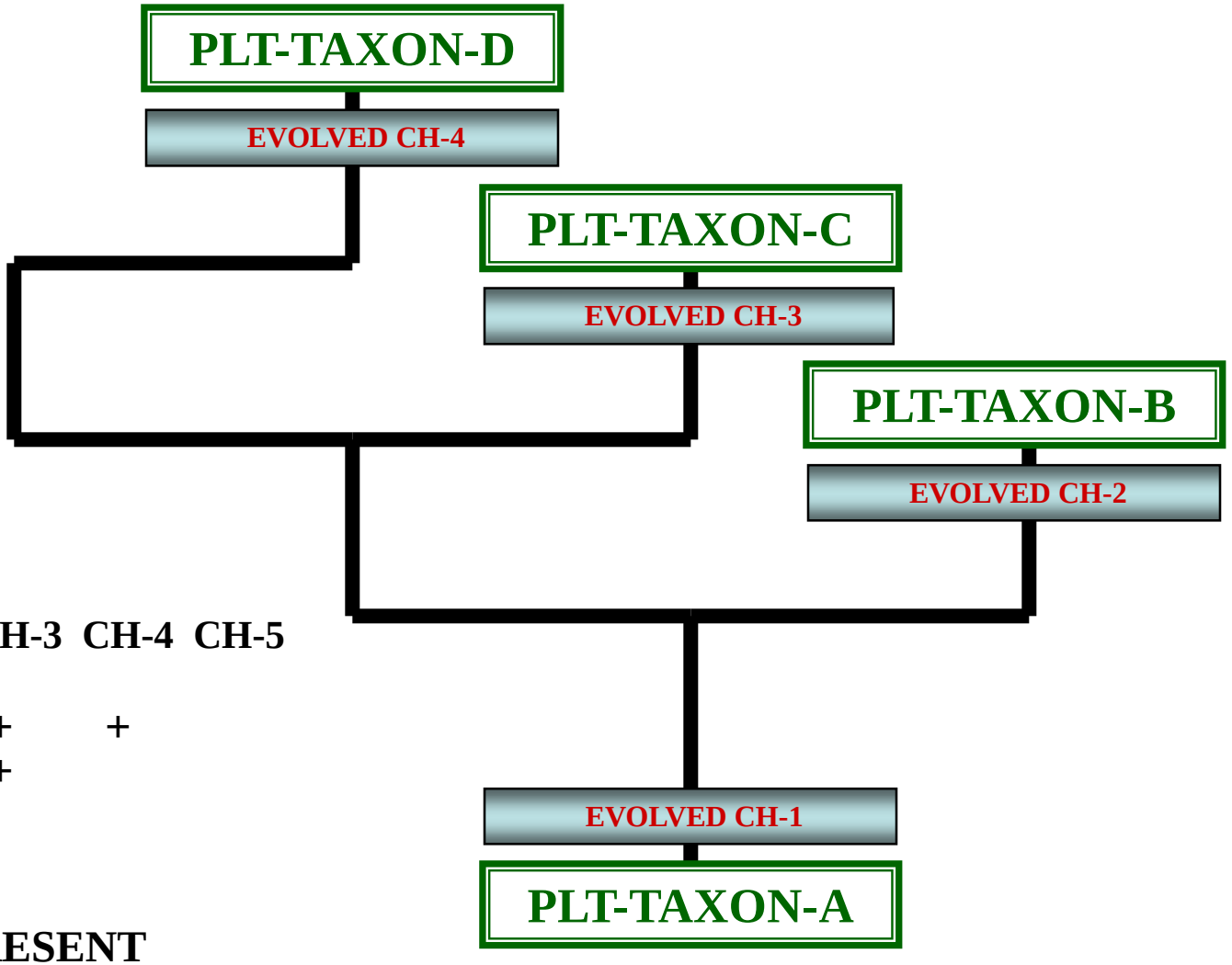


DATA MATRIX

TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
TAXON-C	+	+	+		
TAXON-B	+	+			
TAXON-A	+				

+ = CHARACTER PRESENT

PHYLOGRAM

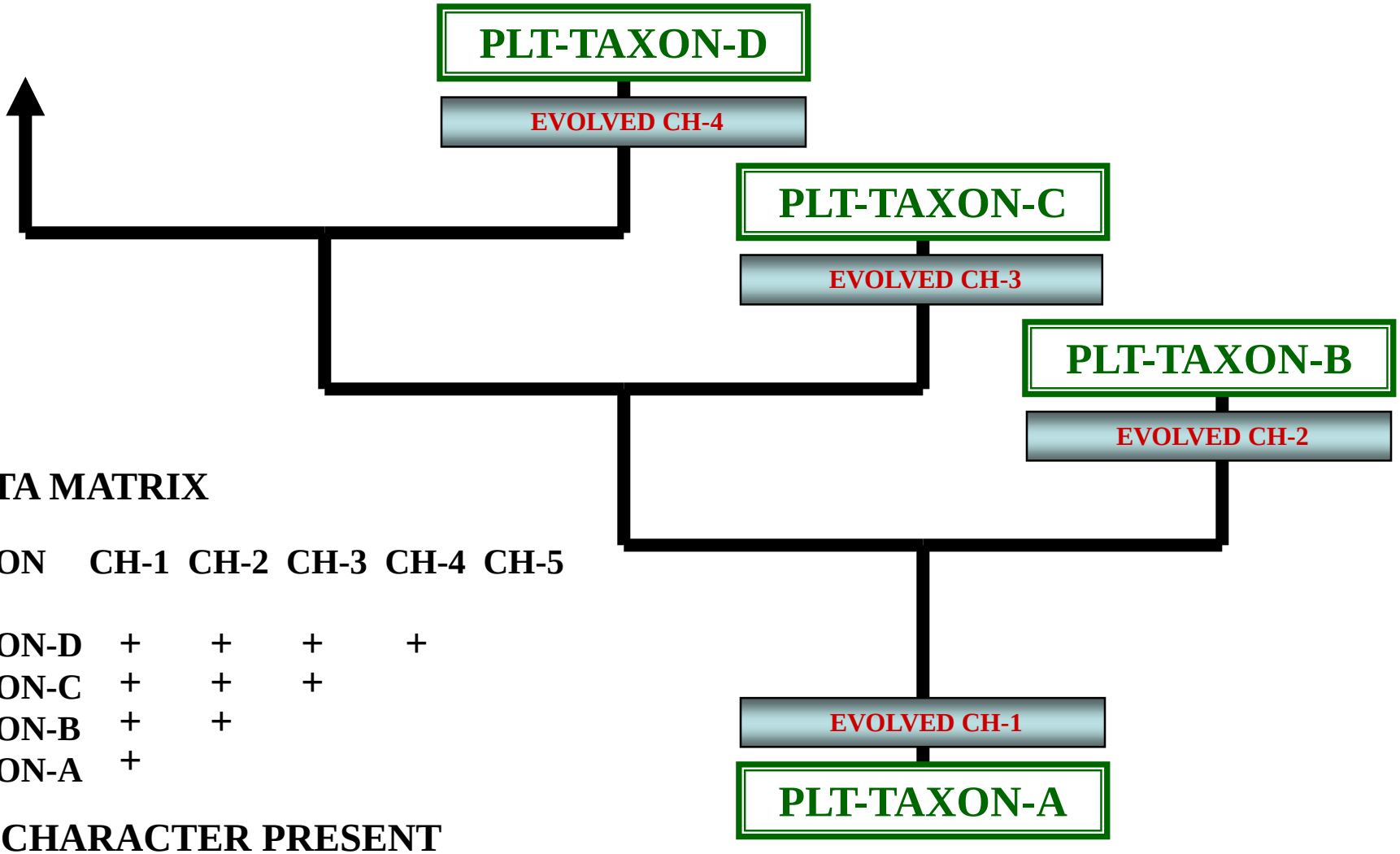


DATA MATRIX

TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
TAXON-D	+	+	+	+	
TAXON-C	+	+	+		
TAXON-B	+	+			
TAXON-A	+				

+ = CHARACTER PRESENT

PHYLOGRAM

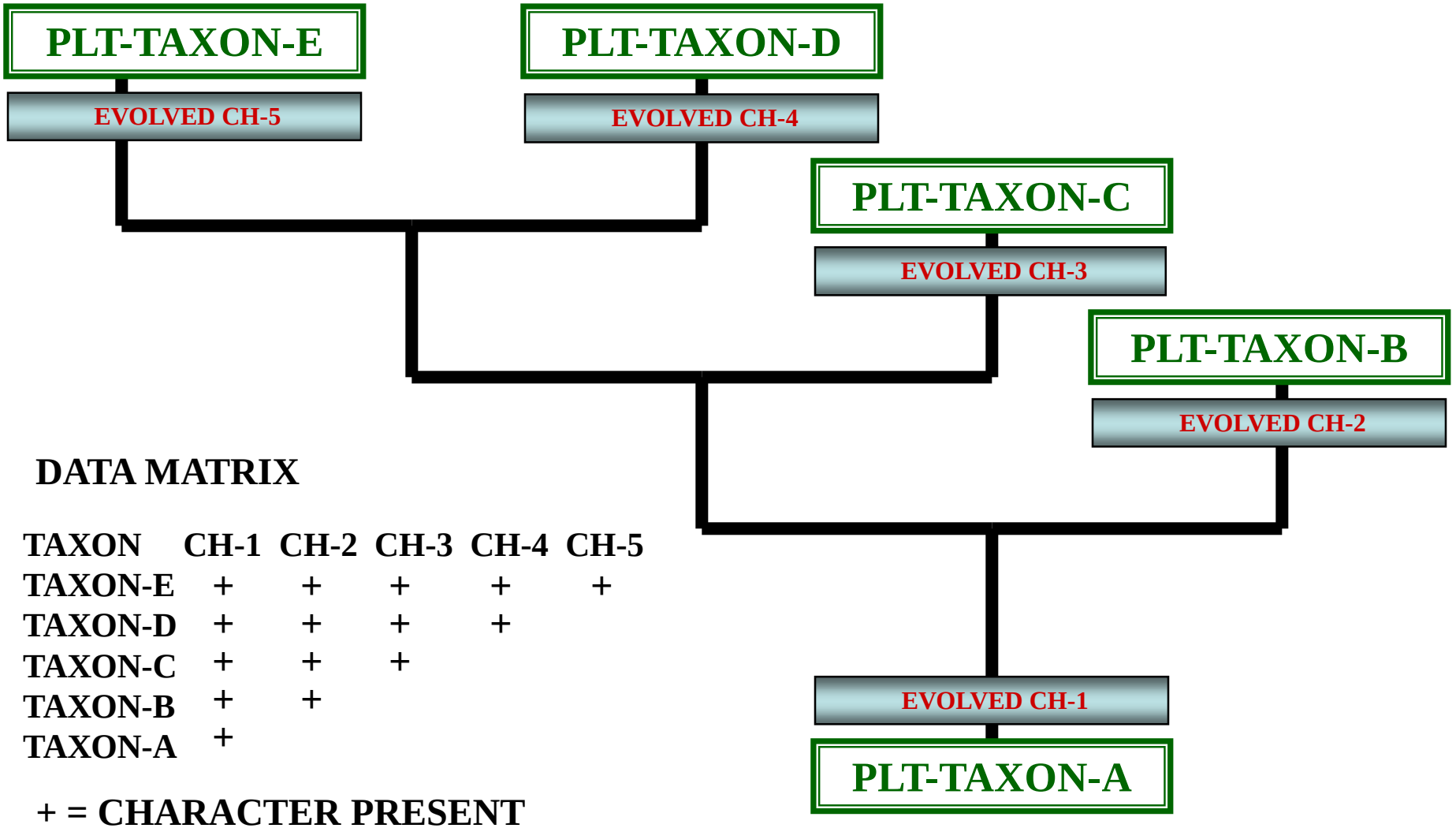


DATA MATRIX

TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
TAXON-D	+	+	+	+	
TAXON-C	+	+	+		
TAXON-B	+	+			
TAXON-A	+				

+ = CHARACTER PRESENT

PHYLOGRAM



DATA MATRIX

TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
TAXON-E	+	+	+	+	+
TAXON-D	+	+	+	+	
TAXON-C	+	+	+		
TAXON-B	+	+			
TAXON-A	+				

+ = CHARACTER PRESENT

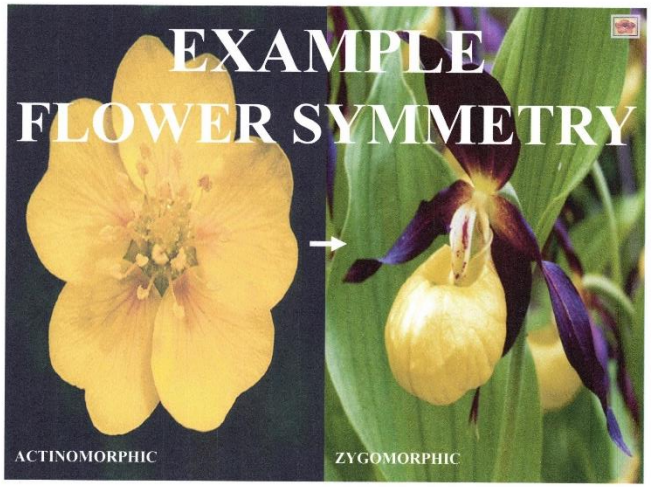
PHYLOGRAM

GENERATED FREE-STYLE

DATA MATRIX

TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
TAXON-E					+
TAXON-D				+	+
TAXON-C			+	+	+
TAXON-B		+	+	+	+
TAXON-A	+	+	+	+	+

+ = CHARACTER PRESENT



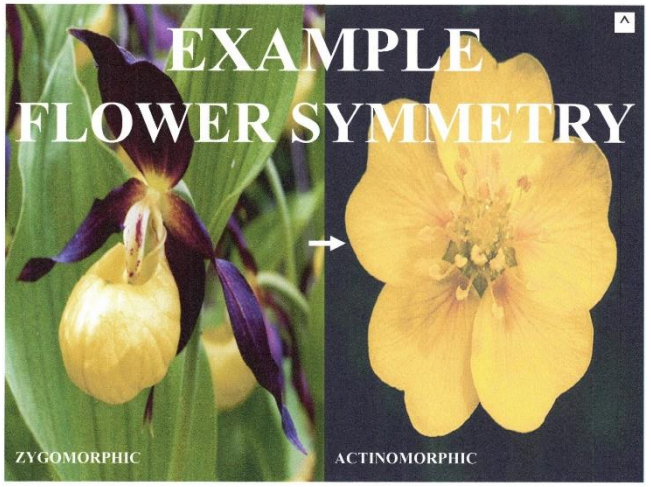
PHYLOGRAM

GENERATED FREE-STYLE

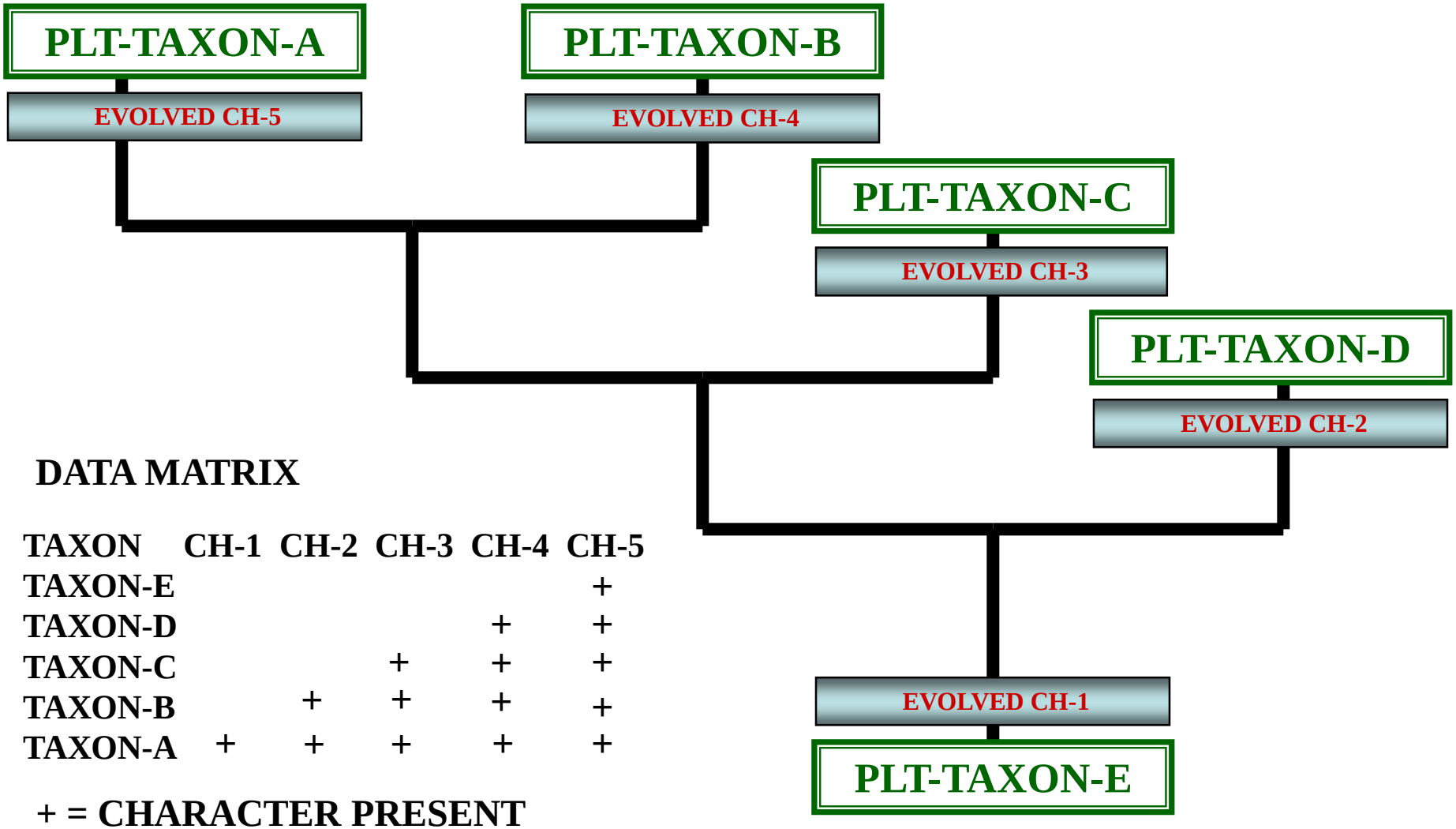
DATA MATRIX

TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
TAXON-E					+
TAXON-D				+	+
TAXON-C			+	+	+
TAXON-B		+	+	+	+
TAXON-A	+	+	+	+	+

+ = CHARACTER PRESENT



PHYLOGRAM



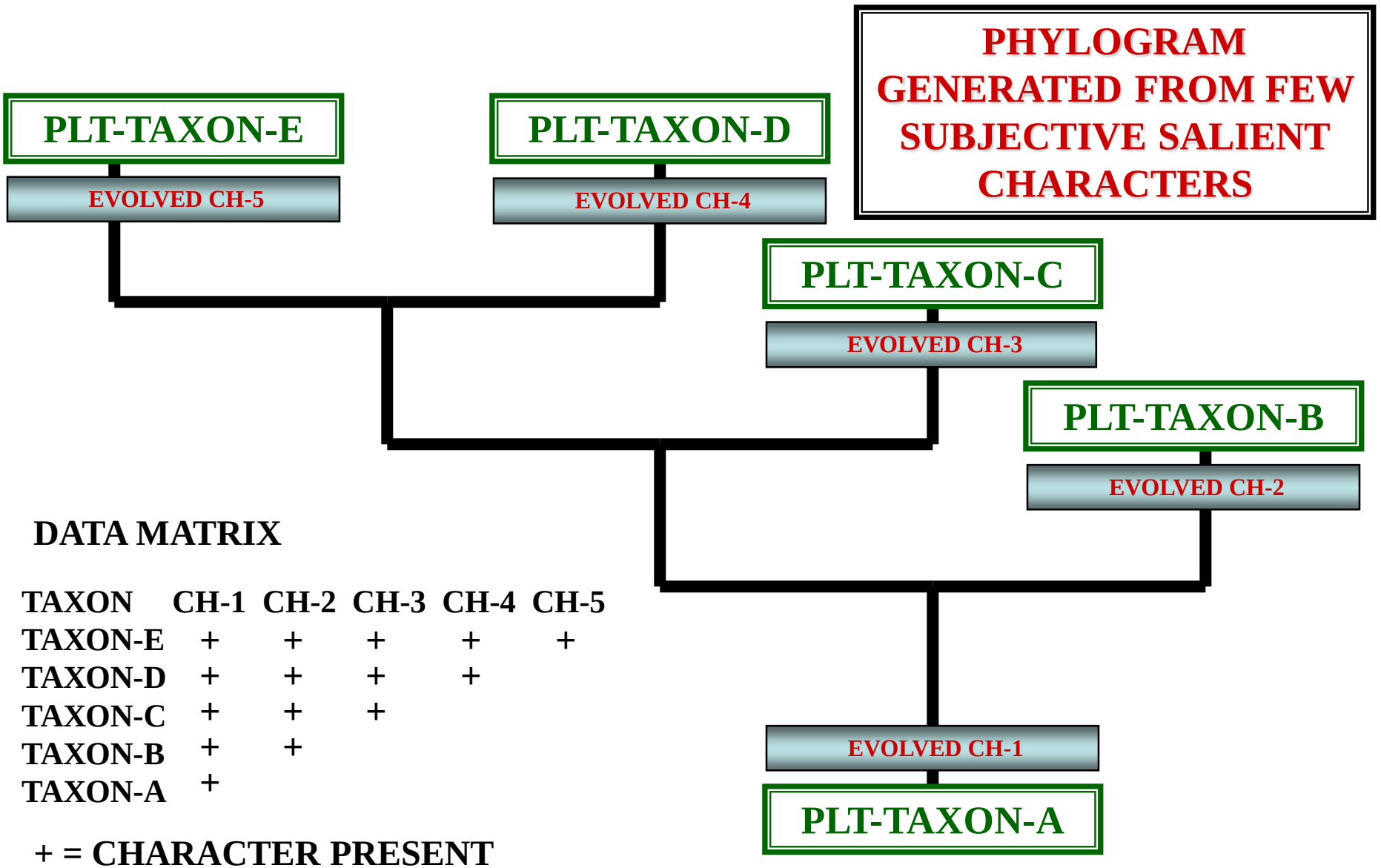
DATA MATRIX

TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
TAXON-E					+
TAXON-D				+	+
TAXON-C			+	+	+
TAXON-B		+	+	+	+
TAXON-A	+	+	+	+	+

+ = CHARACTER PRESENT

CLASSICAL PHYLOGENETIC CLASSIFICATION DISADVANTAGES

PHYLOGRAM

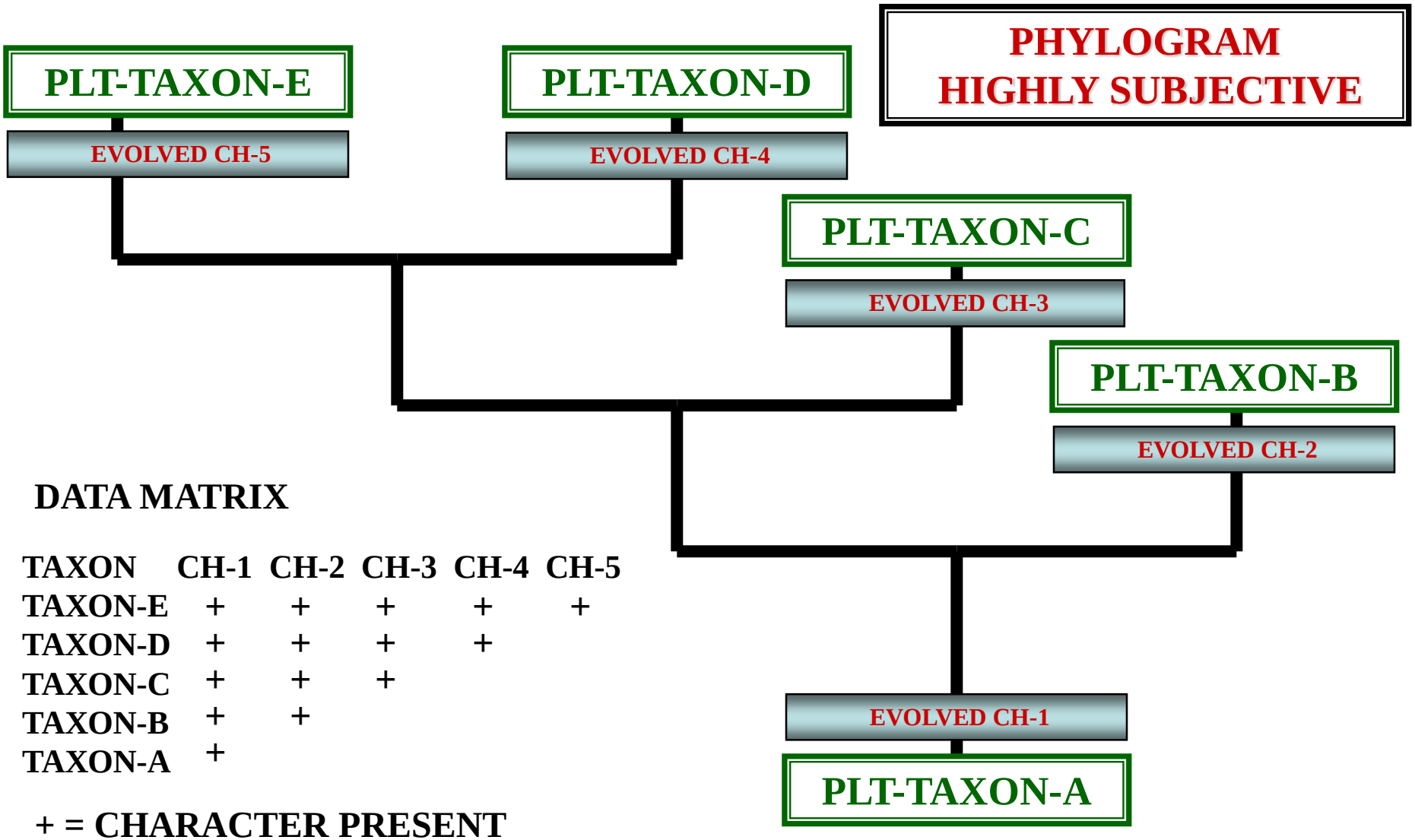


DATA MATRIX

TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
TAXON-E	+	+	+	+	+
TAXON-D	+	+	+	+	
TAXON-C	+	+	+		
TAXON-B	+	+			
TAXON-A	+				

+ = CHARACTER PRESENT

PHYLOGRAM



DATA MATRIX

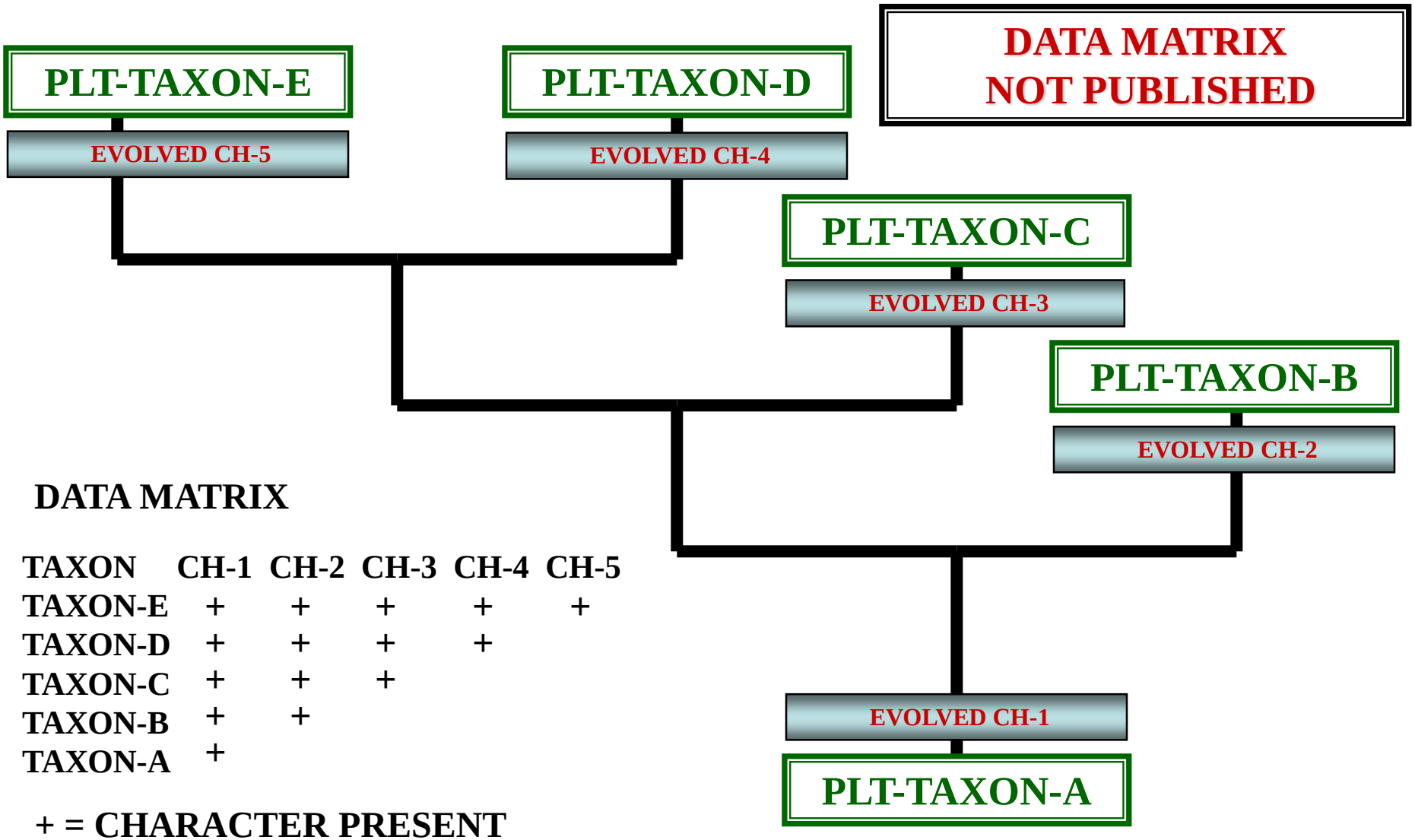
TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
TAXON-E	+	+	+	+	+
TAXON-D	+	+	+	+	
TAXON-C	+	+	+		
TAXON-B	+	+			
TAXON-A	+				

+ = CHARACTER PRESENT

PHYLOGRAM

DM

+



DATA MATRIX

TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
TAXON-E	+	+	+	+	+
TAXON-D	+	+	+	+	
TAXON-C	+	+	+		
TAXON-B	+	+			
TAXON-A	+				

+ = CHARACTER PRESENT

DATA MATRIX

PLT-TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
PLT-TAXON-E	+	+	+	+	+
PLT-TAXON-D	+	+	+	+	-
PLT-TAXON-C	+	+	+	-	-
PLT-TAXON-B	+	+	-	-	-
PLT-TAXON-A	+	-	-	-	-

+ = CHARACTER PRESENT

DATA MATRIX

PLT-TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
PLT-TAXON-A	+	-	-	-	-

DATA MATRIX NOT PUBLISHED WITH PHYLOGRAM

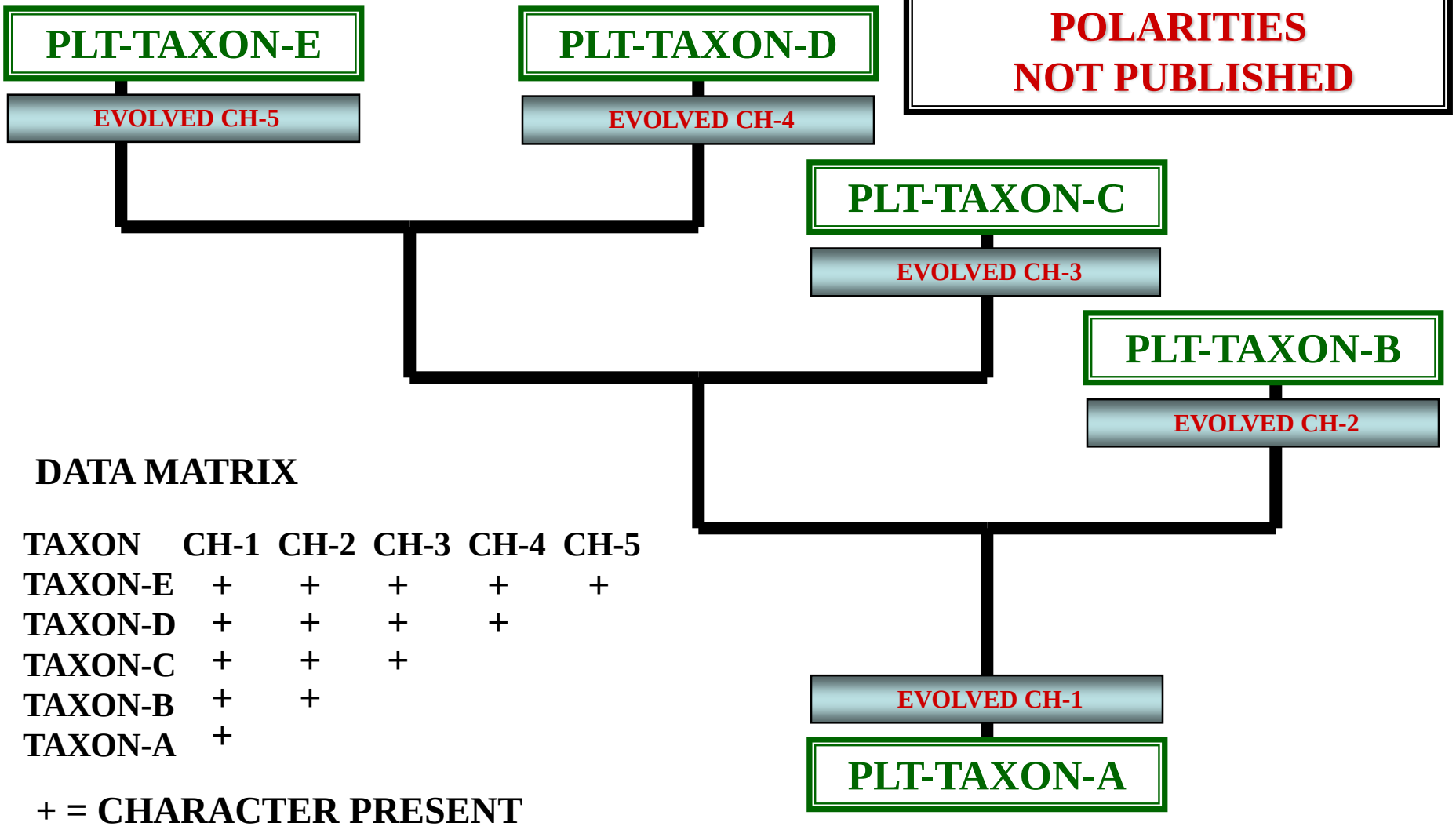
+ = CHARACTER PRESENT

PHYLOGRAM

M

+

CHARACTER POLARITIES NOT PUBLISHED



DATA MATRIX

TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
TAXON-E	+	+	+	+	+
TAXON-D	+	+	+	+	
TAXON-C	+	+	+		
TAXON-B	+	+			
TAXON-A	+				

+ = CHARACTER PRESENT

DATA MATRIX CHARACTER

CHARACTER POLARITIES NOT PUBLISHED WITH PHYLOGRAM

ACTINOMORPHIC → ZYGOMORPHIC

PRIMITIVE PLT → ADVANCED PLT

PHYLOGRAM

>

PHYLOGRAM
NOT
DEBATE CONDUSIVE

PLT-TAXON-E

EVOLVED CH-5

PLT-TAXON-D

EVOLVED CH-4

PLT-TAXON-C

EVOLVED CH-3

PLT-TAXON-B

EVOLVED CH-2

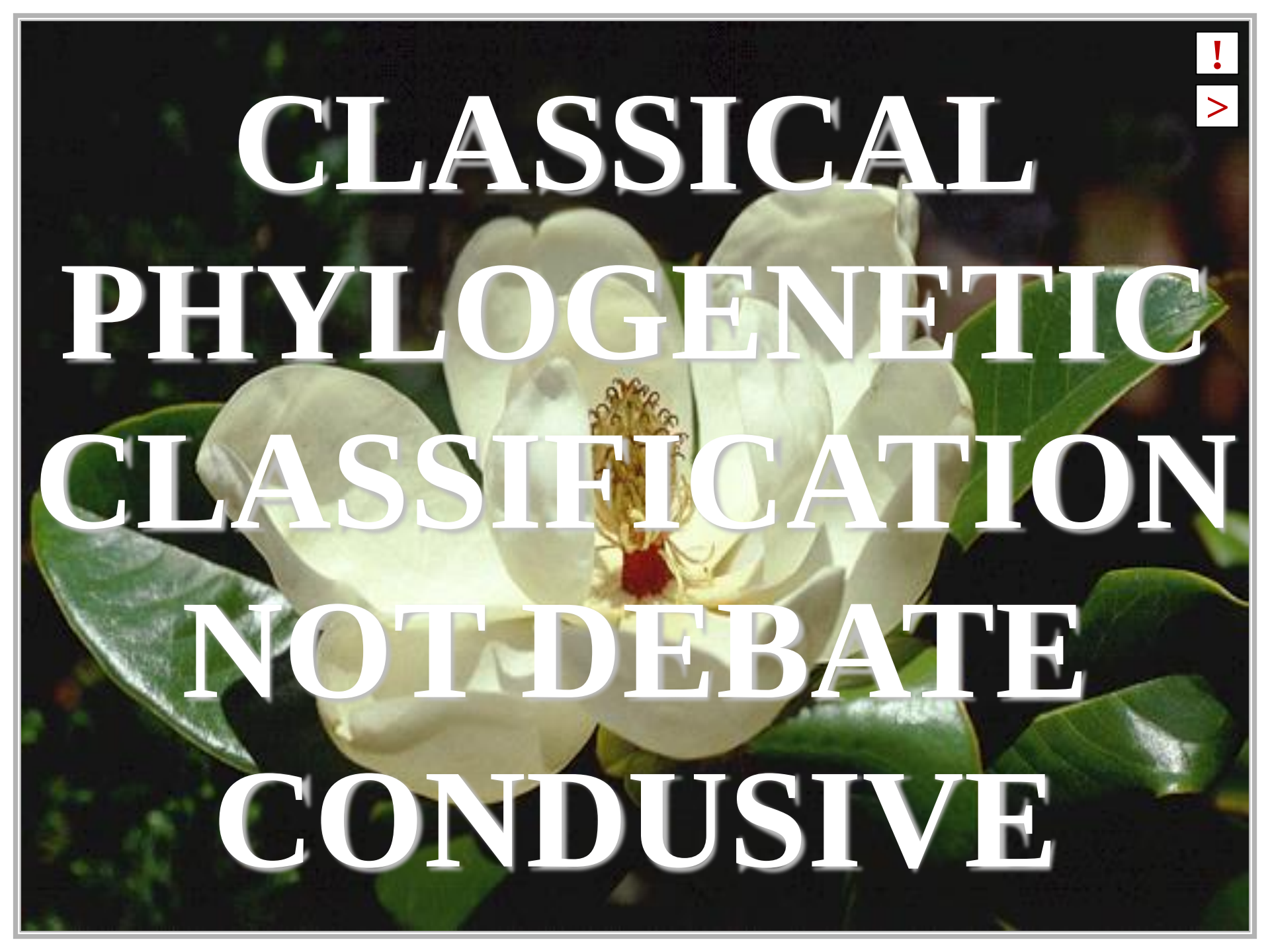
EVOLVED CH-1

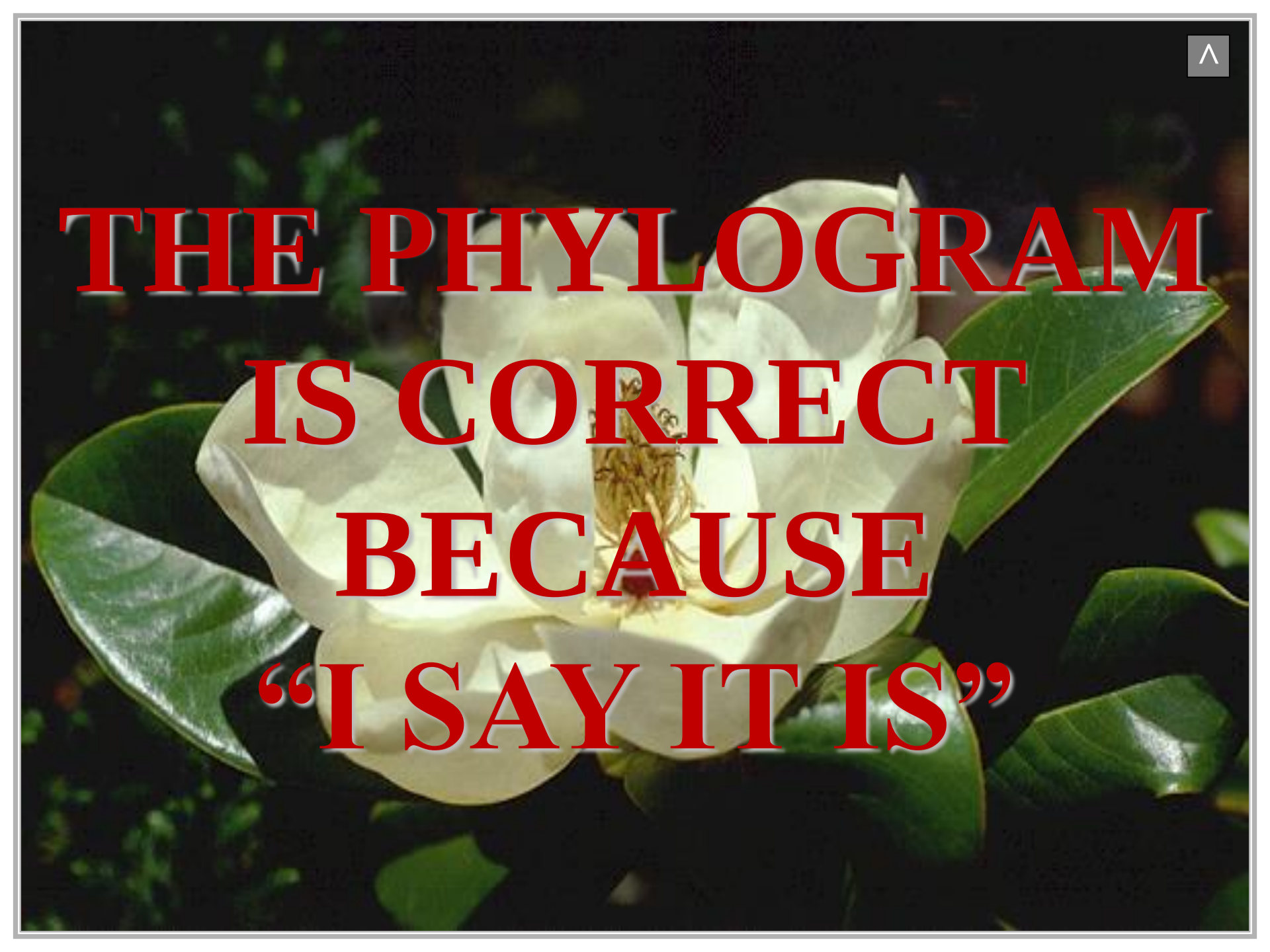
PLT-TAXON-A

DATA MATRIX

TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
TAXON-E	+	+	+	+	+
TAXON-D	+	+	+	+	
TAXON-C	+	+	+		
TAXON-B	+	+			
TAXON-A	+				

+ = CHARACTER PRESENT


CLASSICAL
PHYLOGENETIC
CLASSIFICATION
NOT DEBATE
CONDUSIVE


THE PHYLOGRAM
IS CORRECT
BECAUSE
“I SAY IT IS”

C

CLADISTIC PHYLOGENETIC CLASSIFICATION

CLADISTIC PHYLOGENETIC CLASSIFICATION

CLADISTIC PHYLOGENETIC CLASSIFICATION

CONTEMPORARY PHYLOGENETIC METHOD

CLADISTIC PHYLOGENETIC CLASSIFICATION

CLADISTIC PHYLOGENETIC CLASSIFICATION

CONTEMPORARY PHYLOGENETIC METHOD

PRACTICED SINCE COMPUTERS

CLADISTIC PHYLOGENETIC CLASSIFICATION

CLADISTIC PHYLOGENETIC CLASSIFICATION

CONTEMPORARY PHYLOGENETIC METHOD

PRACTICED SINCE COMPUTERS

MORE OBJECTIVE THAN CLASSICAL

CLADISTIC PHYLOGENETIC CLASSIFICATION

C

CLADISTIC TERMS

CLADE

P

CLADE

PHYLOGENETICALLY RELATED TAXA

CLADE

PLESIOMORPHIC CHARACTER STATE

PLESIOMORPHIC CHARACTER STATE

NON-DERIVED CHARACTER STATE

PLESIOMORPHIC CHARACTER STATE

A

PLESIOMORPHIC CHARACTER STATE

NON-DERIVED CHARACTER STATE

PRIMITIVE CHARACTER STATE

PLESIOMORPHIC CHARACTER STATE

APOMORPHIC CHARACTER STATE

APOMORPHIC CHARACTER STATE

DERIVED CHARACTER STATE

APOMORPHIC CHARACTER STATE

S

APOMORPHIC CHARACTER STATE

DERIVED CHARACTER STATE

ADVANCED CHARACTER STATE

APOMORPHIC CHARACTER STATE

SYMPLESIOMORPHIC CHARACTER STATE

S

SYMPLESIOMORPHIC CHARACTER STATE

SHARED PLESIOMORPHIC CHARACTER STATE

SYMPLESIOMORPHIC CHARACTER STATE

SYNAPOMORPHIC CHARACTER STATE

A

SYMPLESIOMORPHIC CHARACTER STATE

SHARED SYNAPOMORPHIC CHARACTER STATE

SYMPLESIOMORPHIC CHARACTER STATE

AUTAPOMORPHIC CHARACTER STATE

AUTAPOMORPHIC CHARACTER STATE

DIAGNOSTIC APOMORPHIC CHARACTER STATE

AUTAPOMORPHIC CHARACTER STATE

IN-GROUP

CLADISTIC IN-GROUP

PRIMARY STUDY GROUP

CLADISTIC IN-GROUP

CLADISTIC IN-GROUP

PRIMARY STUDY GROUP
CONSIDERED DESCENDANT TO OUT-GROUP

CLADISTIC IN-GROUP

CLADISTIC IN-GROUP

PRIMARY STUDY GROUP
CONSIDERED DESCENDANT TO OUT-GROUP
SUGGESTED VIA FOSSIL RECORD

CLADISTIC IN-GROUP

CLADISTIC IN-GROUP

PRIMARY STUDY GROUP
CONSIDERED DESCENDANT TO OUT-GROUP
SUGGESTED VIA FOSSIL RECORD
BEARS APOMORPHIC CHARACTER STATES

CLADISTIC IN-GROUP

O

CLADISTIC IN-GROUP

PRIMARY STUDY GROUP
CONSIDERED DESCENDANT TO OUT-GROUP
SUGGESTED VIA FOSSIL RECORD
BEARS APOMORPHIC CHARACTER STATES
COMPARED WITH OUT-GROUP

CLADISTIC IN-GROUP

OUT-GROUP

CLADISTIC OUT-GROUP

SECONDARY STUDY GROUP

CLADISTIC OUT-GROUP

CLADISTIC OUT-GROUP

SECONDARY STUDY GROUP
CONSIDERED ANCESTRAL TO IN-GROUP

CLADISTIC OUT-GROUP

CLADISTIC OUT-GROUP

SECONDARY STUDY GROUP
CONSIDERED ANCESTRAL TO IN-GROUP
SUGGESTED VIA FOSSIL RECORD

CLADISTIC OUT-GROUP

CLADISTIC OUT-GROUP

SECONDARY STUDY GROUP
CONSIDERED ANCESTRAL TO IN-GROUP
SUGGESTED VIA FOSSIL RECORD
BEARS PLEISIOMORPHIC CHARACTER STATES

CLADISTIC OUT-GROUP

CLADISTIC OUT-GROUP

SECONDARY STUDY GROUP
CONSIDERED ANCESTRAL TO IN-GROUP
SUGGESTED VIA FOSSIL RECORD
BEARS PLEISIOMORPHIC CHARACTER STATES
COMPARED WITH IN-GROUP

CLADISTIC OUT-GROUP

DM

S

DATA MATRIX

DATA MATRIX

PLT-TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
PLT-TAXON-E	+	+	+	+	+
PLT-TAXON-D	+	+	+	+	-
PLT-TAXON-C	+	+	+	-	-
PLT-TAXON-B	+	+	-	-	-
PLT-TAXON-A	+	-	-	-	-

+ = CHARACTER PRESENT

SELECT MANY SALIENT PHYLOGENTIC CHARACTERS

DATA MATRIX

PLT-TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
PLT-TAXON-E	+	+	+	+	+
PLT-TAXON-D	+	+	+	+	-
PLT-TAXON-C	+	+	+	-	-
PLT-TAXON-B	+	+	-	-	-
PLT-TAXON-A	+	-	-	-	-

+ = CHARACTER PRESENT

LESS SUBJECTIVE CHARACTER BIAS

DATA MATRIX

PLT-TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
PLT-TAXON-E	+	+	+	+	+
PLT-TAXON-D	+	+	+	+	-
PLT-TAXON-C	+	+	+	-	-
PLT-TAXON-B	+	+	-	-	-
PLT-TAXON-A	+	-	-	-	-

+ = CHARACTER PRESENT

BECAUSE MANY SALIENT CHARACTERS ARE USED

DATA MATRIX

PLT-TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
PLT-TAXON-E	+	+	+	+	+
PLT-TAXON-D	+	+	+	+	-
PLT-TAXON-C	+	+	+	-	-
PLT-TAXON-B	+	+	-	-	-
PLT-TAXON-A	+	-	-	-	-

+ = CHARACTER PRESENT

MUST DETERMINE CORRECT CHARACTER POLARITY

C

EG

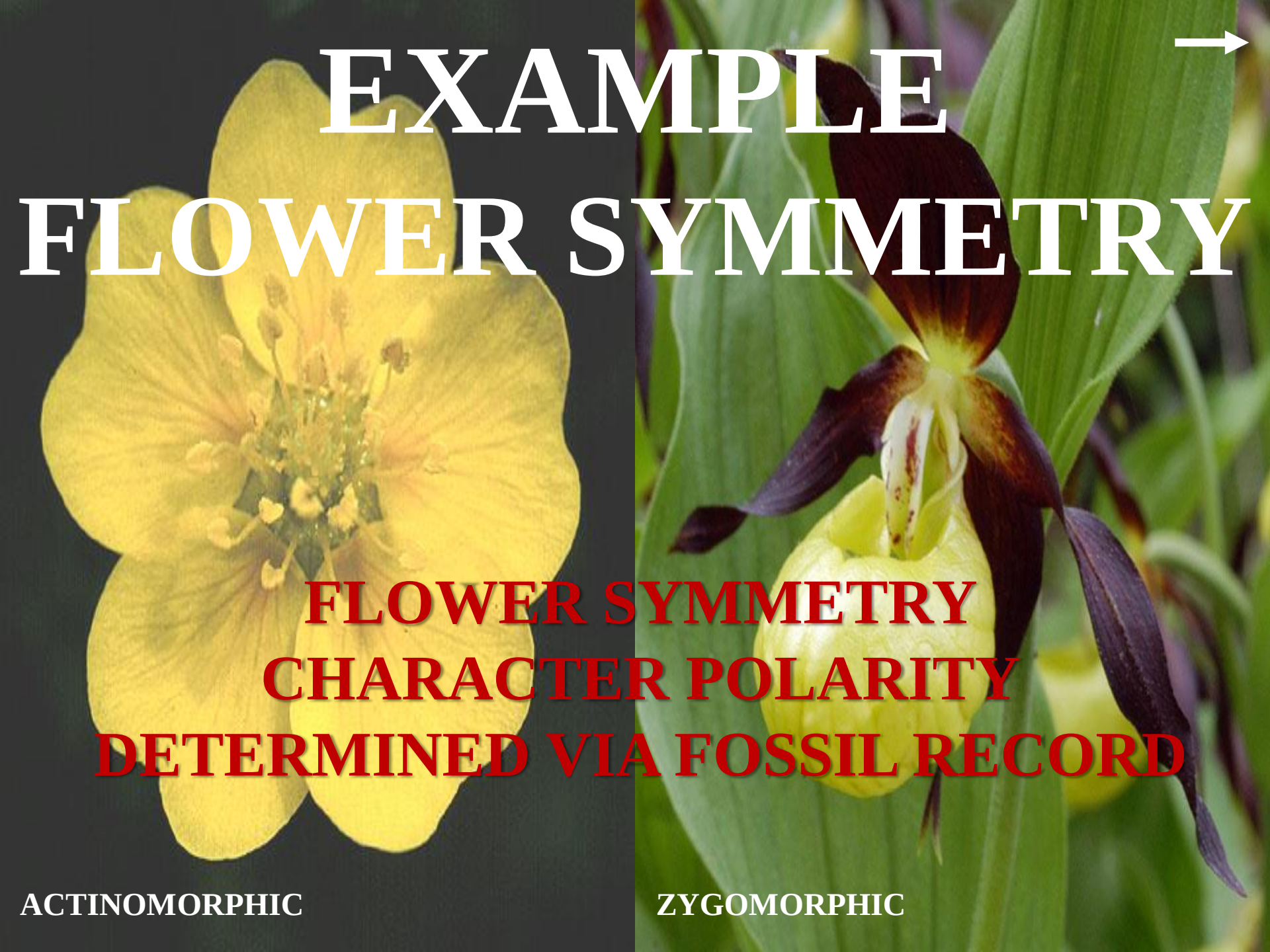
CHARACTER POLARITY

CHARACTER POLARITY

!!!DO NOT COPY!!!

EXAMPLE FLOWER SYMMETRY

EXAMPLE FLOWER SYMMETRY

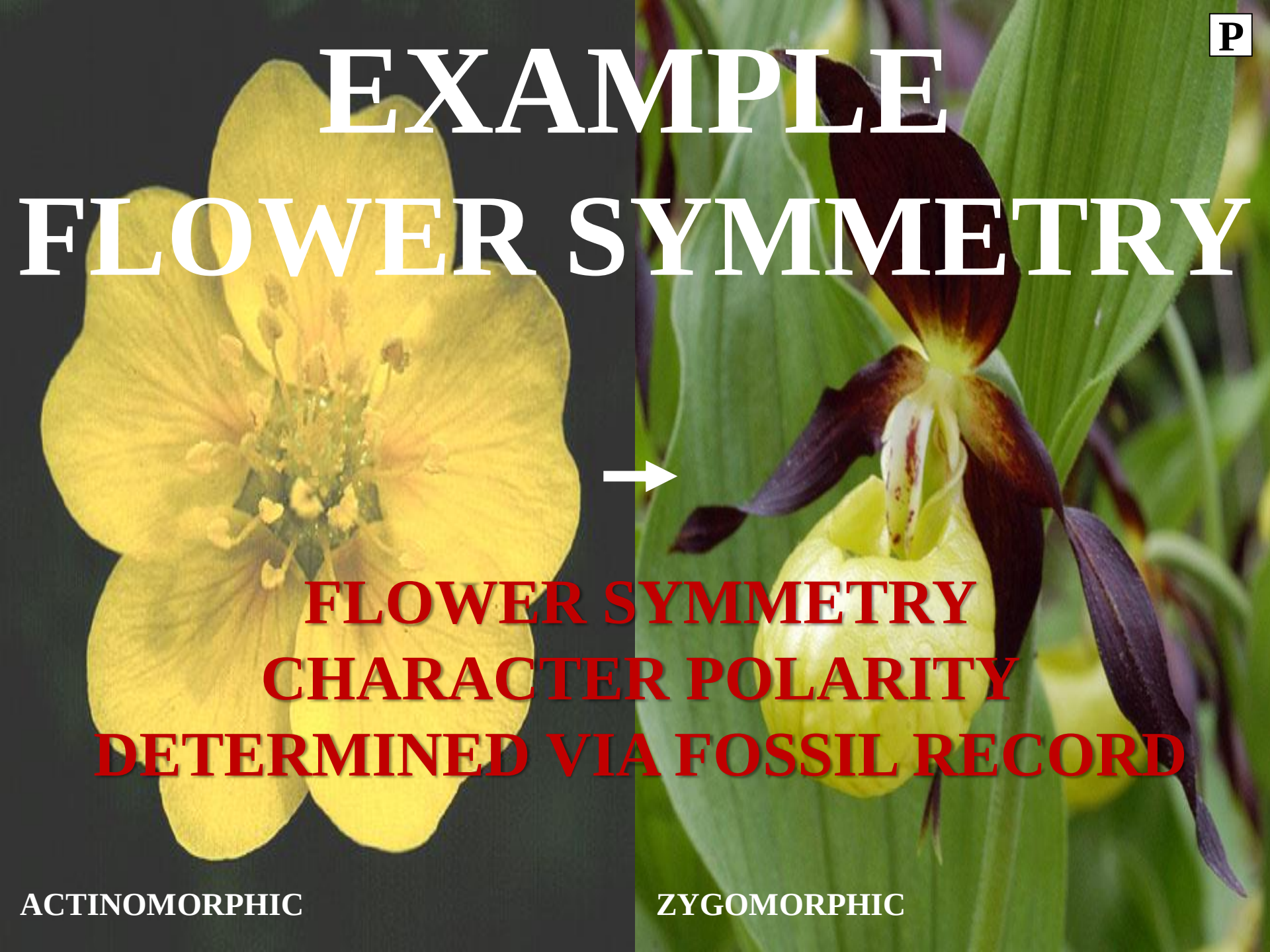


FLOWER SYMMETRY CHARACTER POLARITY DETERMINED VIA FOSSIL RECORD

ACTINOMORPHIC

ZYGOMORPHIC

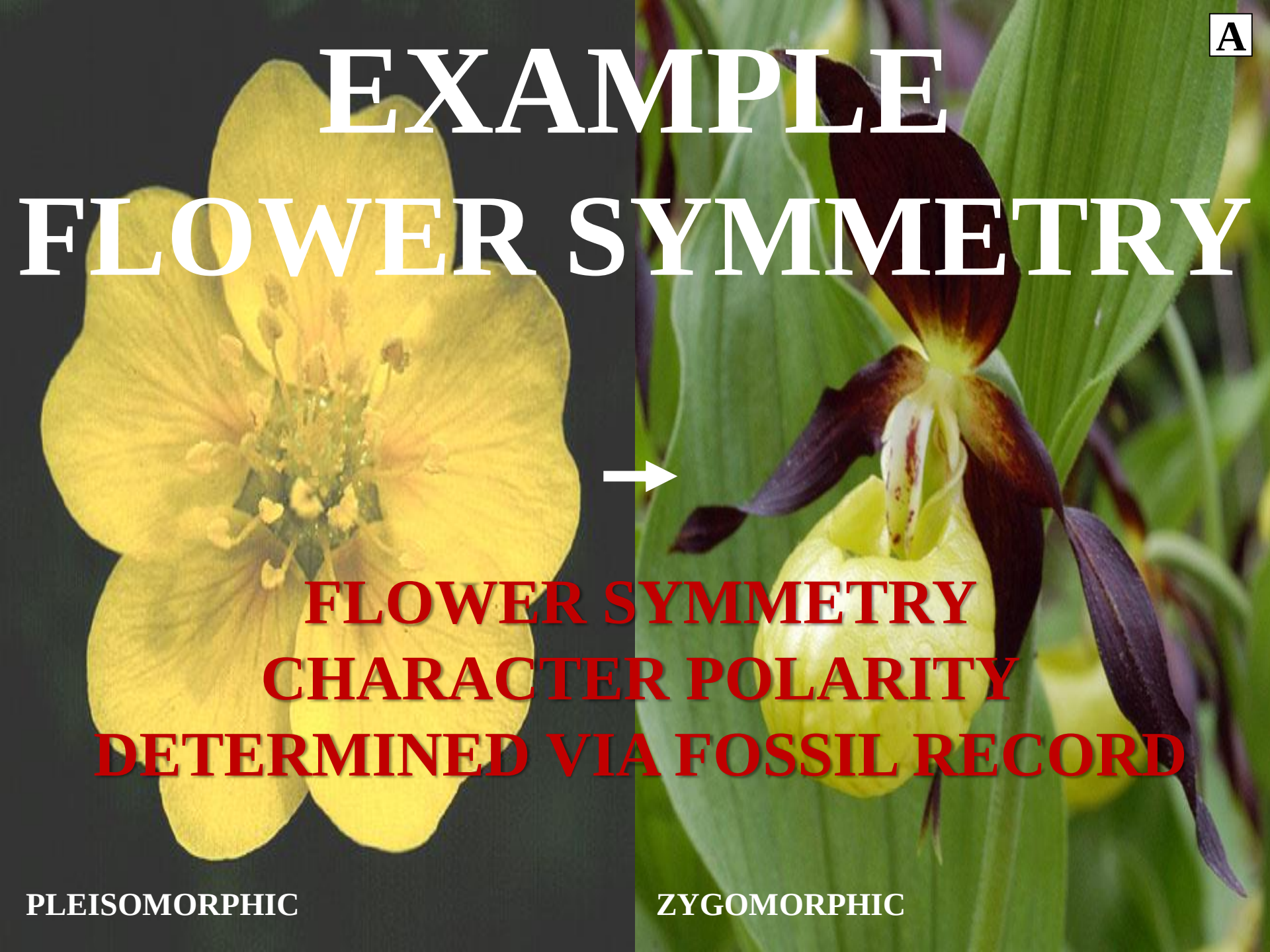
EXAMPLE
FLOWER SYMMETRY



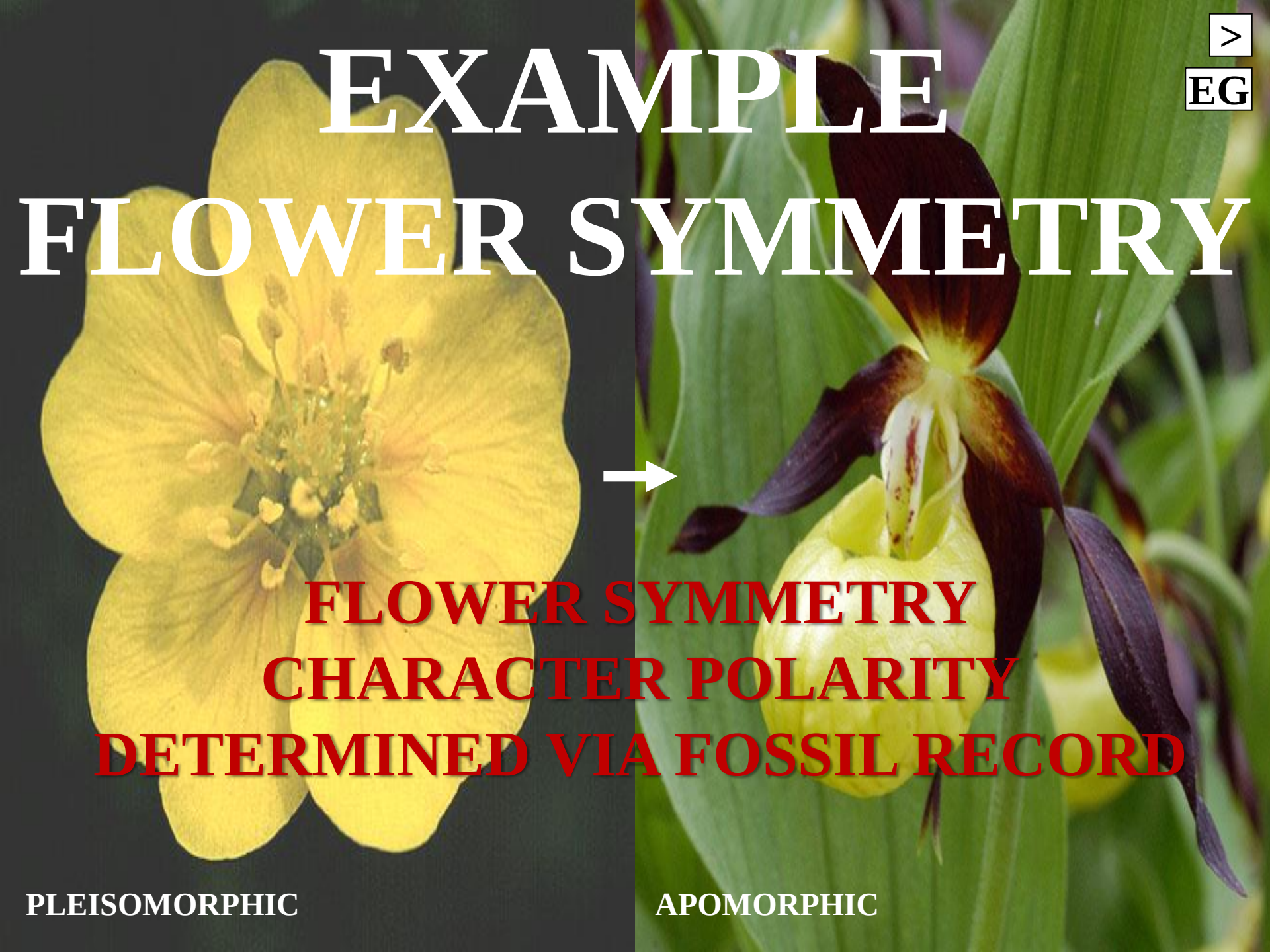
FLOWER SYMMETRY
CHARACTER POLARITY
DETERMINED VIA FOSSIL RECORD

ACTINOMORPHIC

ZYGOMORPHIC


A
EXAMPLE
FLOWER SYMMETRY
FLOWER SYMMETRY
CHARACTER POLARITY
DETERMINED VIA FOSSIL RECORD
PLEISOMORPHIC
ZYGOMORPHIC

EXAMPLE
FLOWER SYMMETRY



FLOWER SYMMETRY
CHARACTER POLARITY
DETERMINED VIA FOSSIL RECORD

PLEISOMORPHIC

APOMORPHIC

>
EG

DATA MATRIX CHARACTER POLARITIES

WOODY → **HERBACEOUS**

DATA MATRIX CHARACTER POLARITIES

WOODY → **HERBACEOUS**

SIMPLE LEAF → **COMPOUND LEAF**

DATA MATRIX CHARACTER POLARITIES

WOODY	→	**HERBACEOUS**
SIMPLE LEAF	→	**COMPOUND LEAF**
STIPULES PRESENT	→	**STIPULES ABSENT**

DATA MATRIX CHARACTER POLARITIES

WOODY	→	**HERBACEOUS**
SIMPLE LEAF	→	**COMPOUND LEAF**
STIPULES PRESENT	→	**STIPULES ABSENT**
ALTERNATE PHYLLOTAXY	→	**OPPOSITE PHYLLOTAXY**

DATA MATRIX CHARACTER POLARITIES

WOODY	→	**HERBACEOUS**
SIMPLE LEAF	→	**COMPOUND LEAF**
STIPULES PRESENT	→	**STIPULES ABSENT**
ALTERNATE PHYLLOTAXY	→	**OPPOSITE PHYLLOTAXY**
ACTINOMORPHIC	→	**ZYGOMORPHIC**

DATA MATRIX CHARACTER POLARITIES

WOODY	→	HERBACEOUS
SIMPLE LEAF	→	COMPOUND LEAF
STIPULES PRESENT	→	STIPULES ABSENT
ALTERNATE PHYLLOTAXY	→	OPPOSITE PHYLLOTAXY
ACTINOMORPHIC	→	ZYGOMORPHIC
PRIMITIVE	→	**ADVANCED**

DATA MATRIX CHARACTER POLARITIES

WOODY	→	HERBACEOUS
SIMPLE LEAF	→	COMPOUND LEAF
STIPULES PRESENT	→	STIPULES ABSENT
ALTERNATE PHYLLOTAXY	→	OPPOSITE PHYLLOTAXY
ACTINOMORPHIC	→	ZYGOMORPHIC
NON-DERIVED	→	**ADVANCED**

D

DATA MATRIX CHARACTER POLARITIES

WOODY	→	HERBACEOUS
SIMPLE LEAF	→	COMPOUND LEAF
STIPULES PRESENT	→	STIPULES ABSENT
ALTERNATE PHYLLOTAXY	→	OPPOSITE PHYLLOTAXY
ACTINOMORPHIC	→	ZYGOMORPHIC
PLESIOMORPHIC	→	**ADVANCED**

A

DATA MATRIX CHARACTER POLARITIES

WOODY	→	HERBACEOUS
SIMPLE LEAF	→	COMPOUND LEAF
STIPULES PRESENT	→	STIPULES ABSENT
ALTERNATE PHYLLOTAXY	→	OPPOSITE PHYLLOTAXY
ACTINOMORPHIC	→	ZYGOMORPHIC
PLESIOMORPHIC	→	DERIVED

DATA MATRIX CHARACTER POLARITIES

DM

+

WOODY	→	HERBACEOUS
SIMPLE LEAF	→	COMPOUND LEAF
STIPULES PRESENT	→	STIPULES ABSENT
ALTERNATE PHYLLOTAXY	→	OPPOSITE PHYLLOTAXY
ACTINOMORPHIC	→	ZYGOMORPHIC
PLESIOMORPHIC	→	APOMORPHIC

DATA MATRIX

PLT-TAXON	CH-1	CH-2	CH-3	CH-4	CH-5
PLT-TAXON-E	+	+	+	+	+
PLT-TAXON-D	+	+	+	+	-
PLT-TAXON-C	+	+	+	-	-
PLT-TAXON-B	+	+	-	-	-
PLT-TAXON-A	+	-	-	-	-

+ = CHARACTER PRESENT

MUST DETERMINE CHARACTER POLARITY OF ALL CHARACTERS

C

CLADISTIC PHYLOGENTIC DENDROGRAM

CLADOGRAM