$C^IC\,Susu$ x $C^IC\,Susu$

	C^ISu	C^Isu	CSu	Csu
C^ISu	C^IC^ISuSu	C^IC^ISusu	C^ICSuSu	C^ICSusu
C^Isu	C^IC^ISusu	C^IC^Isusu	C^ICSusu	C^ICsusu
CSu	C^ICSuSu	C^ICSusu	$CCSuSu$	$CCSusu$
Csu	C^ICSusu	C^ICsusu	$CCSusu$	$CCsusu$

yellow (C^IC or C^IC^I)
purple (CC)
smooth ($SuSu$ or $Susu$)
wrinkle ($susu$)

=> yellow smooth = 9/16
yellow wrinkle = 3/16
purple smooth = 3/16
purple wrinkle = 1/4

To be used for question ①

GENE INTERACTION IN CORN

Purpose:

1. To illustrate gene interaction and genetic variation.

2. To drill on the basic methology of genetic investigations.

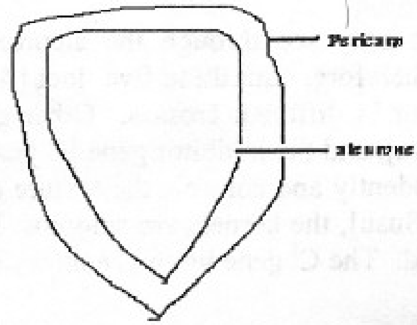
Materials:

F_2 corn ears of the various genetic constitutions such as:

Phenotypic Description on F_2 Kernels	F_1 genotype	Expected F_2 Ratio
Purple-yellow; starchy-sweet	R/r: Su/su	9:3:3:1
Purple; yellow-white	R/r:Y/y	12:3:1
Purple-red; yellow	R/r; Pr/pr	9:3:4
Purple-yellow	R/r; C/c	9:7
Yellow-purple	C^I/C; R/r	13:3
Starchy-sweet; yellow	Su/su	3:1

Background:

Corn [Zea mays] is a monoecious plant. It has both male [tassels] and female [ear shoot] reporductive organs on the same plant. They are naturally cross pollinated: pollen of one plant drops on silks of the other plant to achieve pollination. A kernel is then developed after fertilization through each silk of ear shoot. The cross section of a natured kernel is diagrammed :



The aleurone is a single layer of cells just beneath the pericarp of the corn kernel. Cells in this layer are filled with aleurone grains which could be either pigmented or clear. Three independent loci are involved in the production of a basic pigment compound called **anthocyanin**. They work in a **dominant complementary** fashion, i.e. all of th ethree dominant genes are necessary for any anthocyanin production. The possible phenotypic effects of these three genes are:

Gene symbol	**Phenotypic expression**
A_C_R_	Colored [with anthocyanin]
aaC_R_ A_ccR_ A_C_rr Aaccrr	Colorless [without anthocyanin]

To be used for question (2)

Either a dominant or recessive gene in the blanks will not change the phenotypic expresstions. Thus, various segregation ratios with regard to colored or colorless aleurone can be obtained from crosses with different genotypes involving these three genes.

Another locus, Pr, modifies the anthocyanin to be either purple or red. When the dominant allele, Pr, is present, the aleurone is purple. When two recessive alleles, prpr, are present, the aleurone is red. So, the genotype of the homozygous red stock would be AACCRRprpr, but a purple stock would be AACCRRPrPr. Thus, various segregations of purple, red and colorless aleurone could be obtained from different crosses. Two points should be kept in mind: (1) the complementary gene action of A, C, R controls the production of anthocyanin, and (2) the Pr locus modifies the anthocyanin to be either purple or red. Without anthocyanin, of course, the modifier genes have no effect and the aleurone is colorless.

In addition, another locus, Y, could make the color of the kernel look different when the aleurone is colorless. This locus controls the color of the endosperm in a kernel:

Y_ = yellow endosperm   yy = white endosperm

Remember, one can only see through the aleurone if it is colorless and detect the endosperm color. Therefore, with these five loci [A, C, R, Pr, Y] various types of genic interactions can occur in different crosses. Other genes, such as those in the starchy-sugary locus [Su or su], and the inhibitor gene [C^I] can also enter into the picture. The Su locus works independently and controls the texture of the endosperm. If the endosperm is starchy [SuSu or Susu], the kernels are smooth. When it is sugary [susu], the kernels appear to be wrinkled. The C^I gene inhibits anthocyanin production.

Note that it is customary to write only the segregating gene pairs or loci in this series of genes controlling color and other characteristics. The other loci are assumed to be in a dominant homozygous condition. In the Materials section, the complete genotypic description for R/r; Su/su would be A/A; C/C; R/r; Su/su; Y/Y. A slant is used to separate genes in corresponding locations in a pair of homologous chromosomes [alleles]. A semicolon is used to separate non-homologous chromosomes. In short-hand notation, this reduces to AACCRrSusuYY. Some examples of crosses and phenotypic results are:

Example A:

F_1	R/r; Su/su	x	R/r; Su/su	
F_2	(AACCPrPrYY) R_Su_		9/16	purple,starchy
	(")R_susu		3/16	purple, sweet
	(")rrSu_		3/16	yellow, starchy
	(")rrsusu		1/16	yellow, sweet

Example B:

F_1	R/r; Y/y	x	R/r; Y/y	
F_2	(AACCPrPrSuSu)R_Y_	}	9/16	purple
	(")R_yy		3/16	
	(")rrY_		3/16	yellow
	(")rryy		1/16	white

Example C:

F_1	C^I/C; R/r	x	C^I/C; R/r	
F_2	(AAYYPrPrSuSu)C^I_R_	}	9/16	
	(")C^I_rr		3/16	yellow
	(")CCrr		1/16	
	(")CCRr		3/16	purple

C^I inhibits anthocyanin production and is dominant over C or c.

Example D:

F_1	R/r; C/c	x	R/r; C/c	
F_2	(SuSuPrPrYYAA)R_C_		9/16	purple
	(")R_cc	}	3/16	
	(")rrC_		3/16	yellow
	(")rrcc		1/16	

Example E:

F_1	R/r; Pr/pr	x	R/r; Pr/pr	
F_2	(AACCYYSuSu)R_Pr_		9/16	purple
	(")R_prpr		3/16	red
	(")rrPr_	}	3/16	yellow
	(")rrprpr		1/16	

1 In the following space, use the branching scheme or forked line system to diagram the genotype and proportions of the entire cross from the parental (P) to the F_2 generation.

2 Summarize the results under the following headings:

Genotype (complete with 6 loci)	Phenotype (color and/or texture of kernel)
Parent 1:______________________	Parent 1:______________________
Parent 2:______________________	Parent 2:______________________
F_1:______________________	F_1:______________________

3 Group the F_2 results for explicit presentation:

F_2 genotypes (complete)	Genotypic Proportions	F_2 phenotypes	Summary of F_2 phenotypes with proportion