

MODELING MARVELS

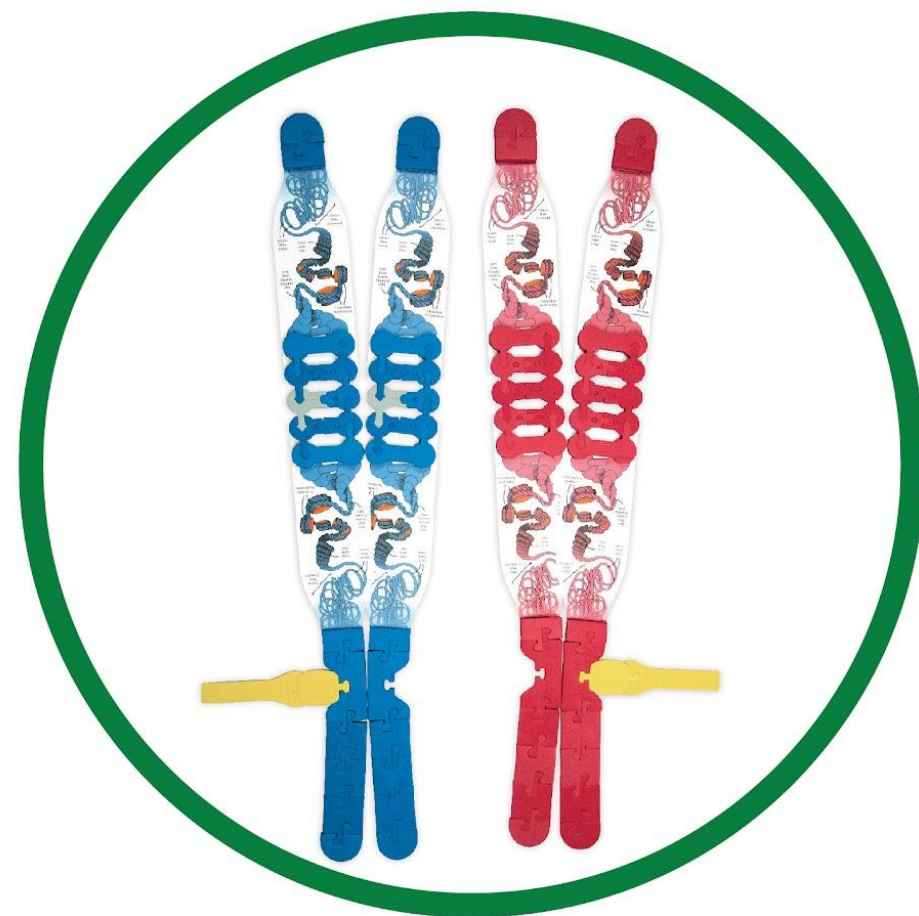
2022 EDUCATORS WEBINARS

- **SANDRA CRUSA**

Chromosome Connections for
your Classroom

- **TIM HERMAN, PhD**

Modeling Methylation in Epigenetics



CHROMOSOME WEBINAR

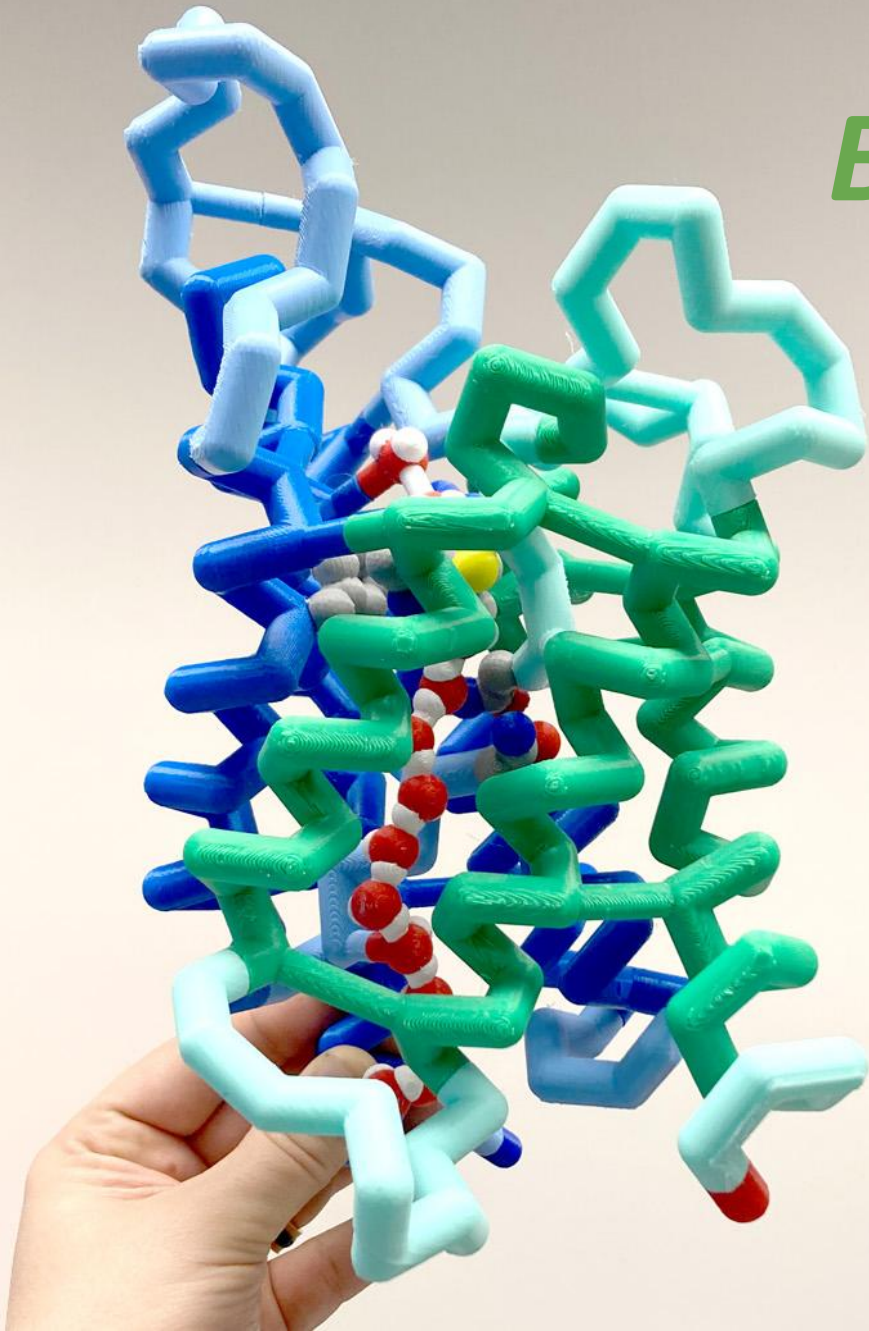
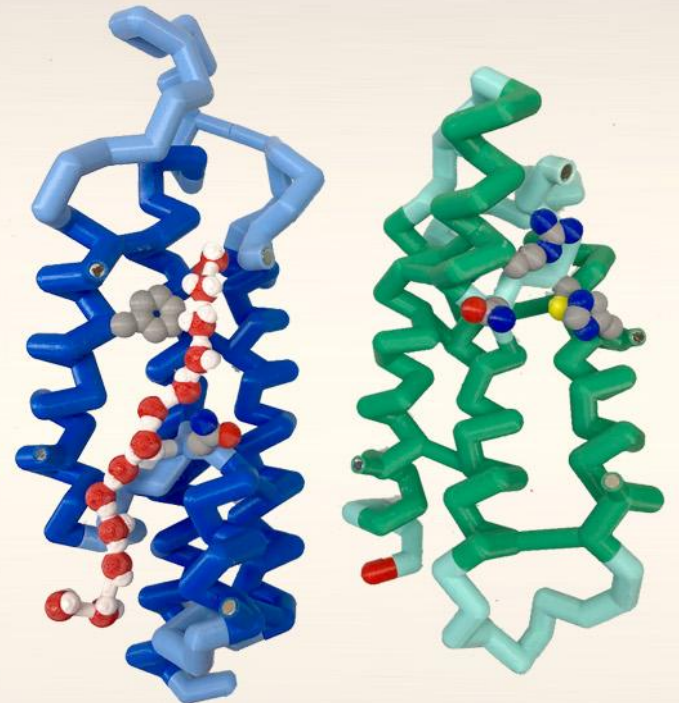
TUESDAY | MARCH 22 6:30 - 8 PM CST

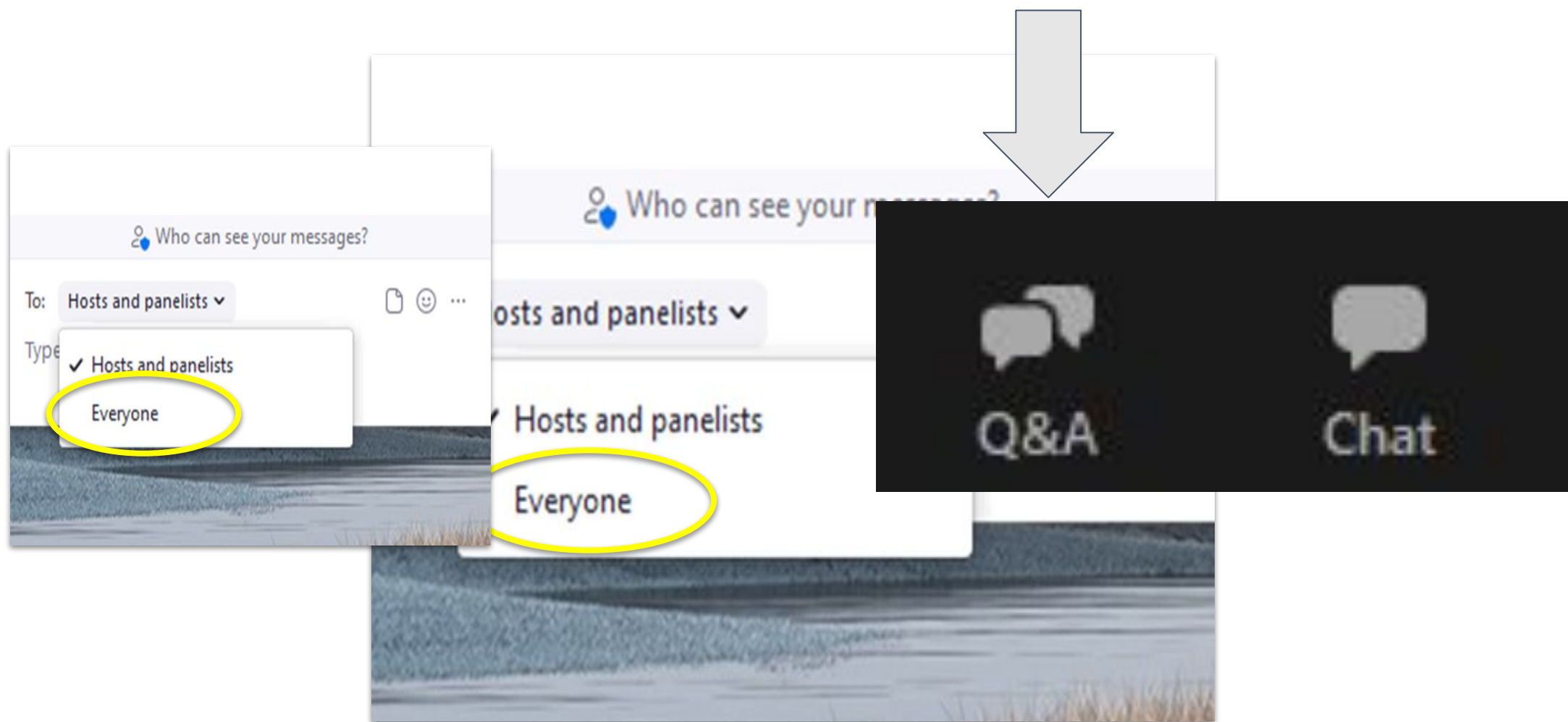
~ Coming Soon ~

Bigger! Stronger!! Better!!!

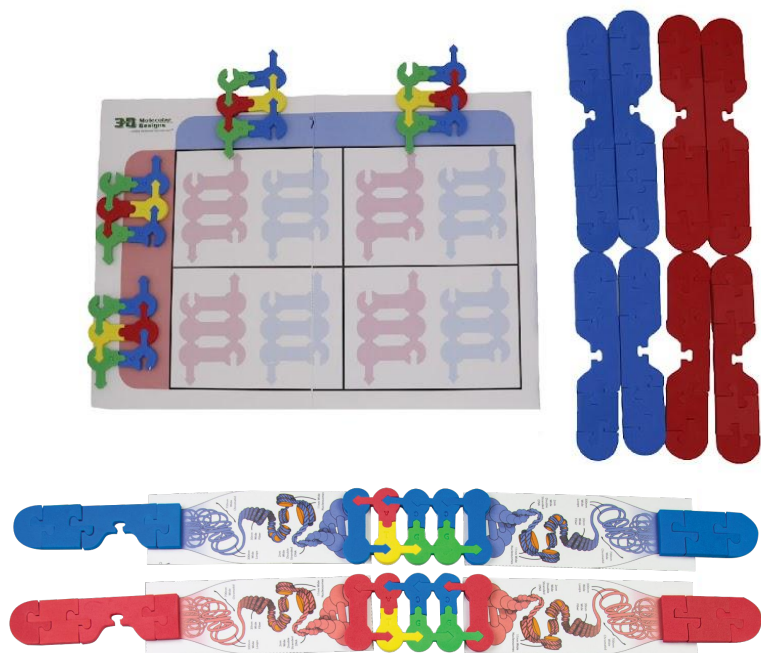
We are excited to be upgrading our 3D printed model products.
Keep an eye out for fall of 2022 to see the initial collection!

- New lessons
- Digital complements
- Sturdy plastic material
- Bright colors
- Lower cost
- Augmented Reality overlays
- And more!

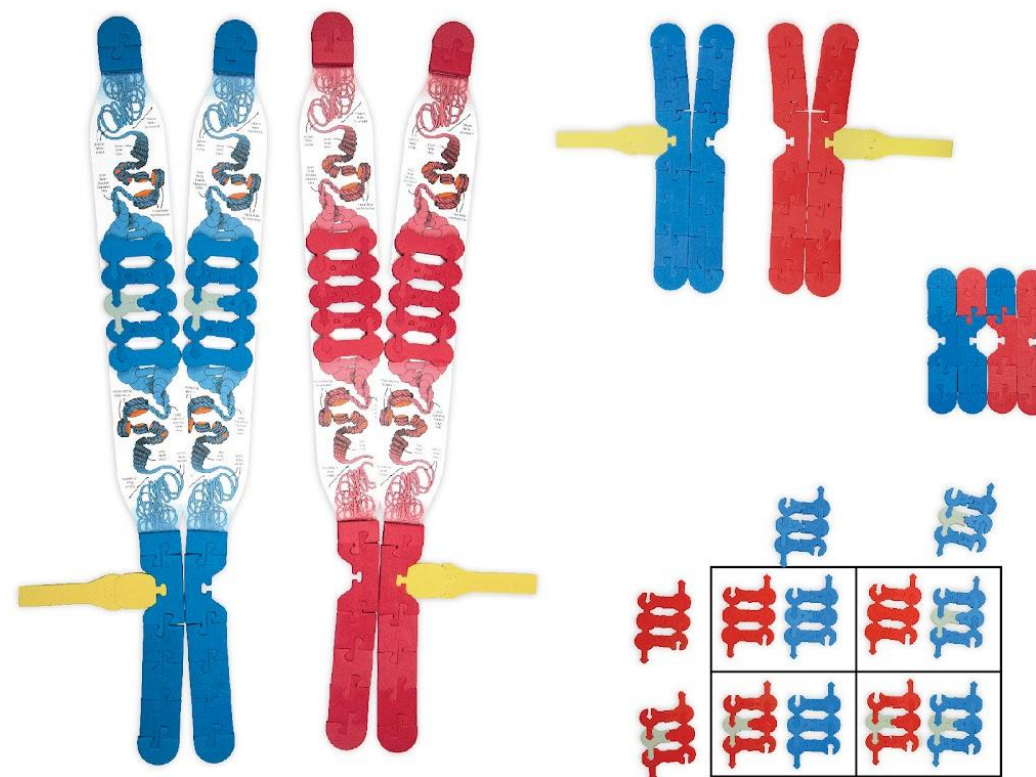




Chromosome Student Modeling Pack



Chromosome Connections Kit®



CHROMOSOME WEBINAR
TUESDAY | MARCH 22 6:30 - 8 PM CST

PRESENTER:

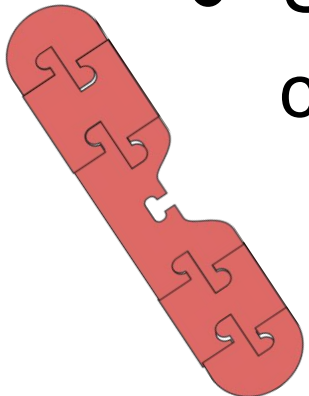
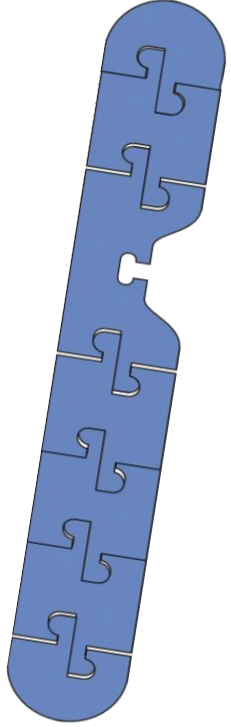
SANDRA CRUSA

NBCT, Mica Mountain High School

**Chromosome Connections for
your Classroom**



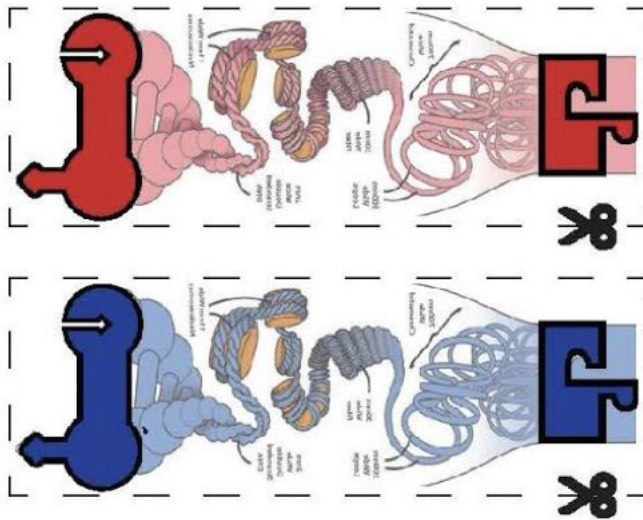
**MODELING
MARVELS**
2022 EDUCATORS WEBINARS



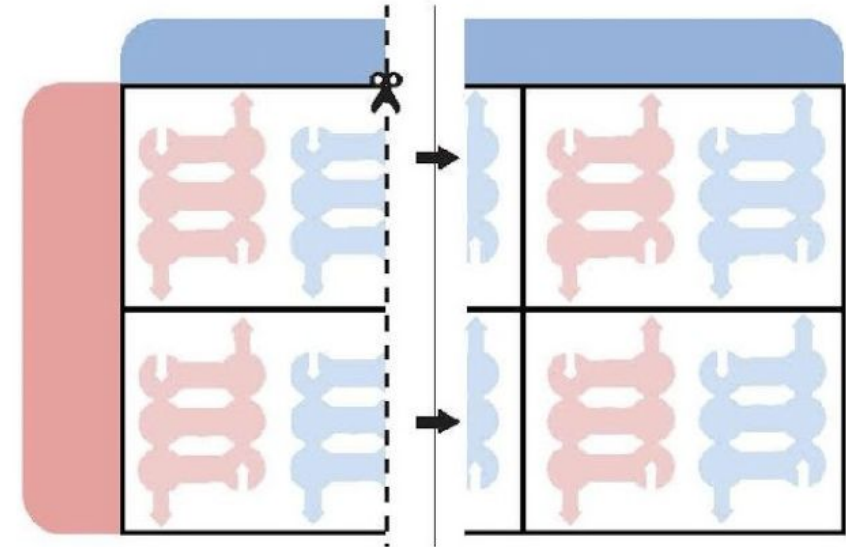
Workshop Learning Goals

- Model Chromosome structure and anatomy
- Compare/contrast mitosis and meiosis
- Model mechanisms that contribute to genetic variation
- Use models to connect inheritance of traits to chromosomes at the molecular level
 - Punnett Squares

Student Modeling Kit Assembly

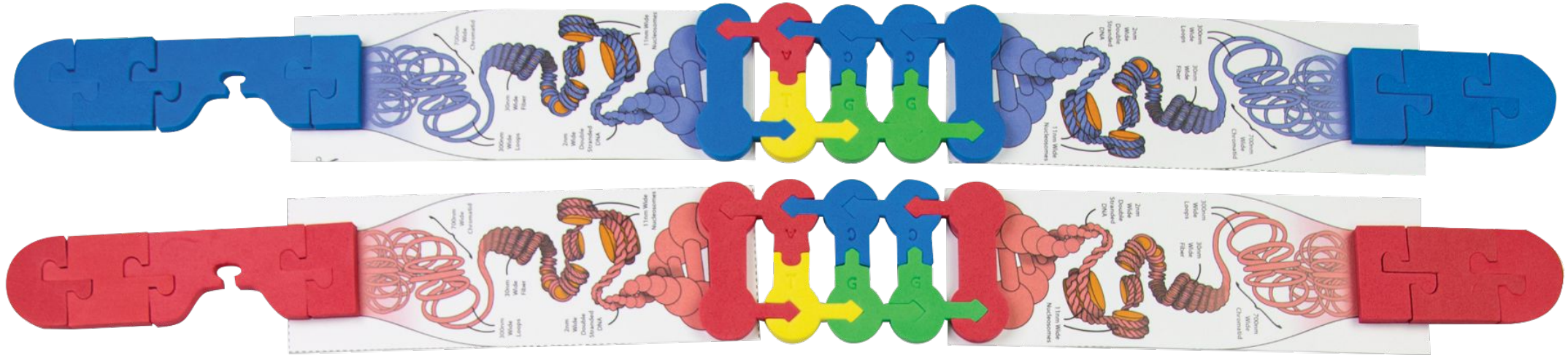


Cut apart the Chromosome Scaling Graphics and attach the corresponding foam parts with glue (recommended) or tape.



Cut edge off Punnett Square graphic and attach to second page with glue or tape.

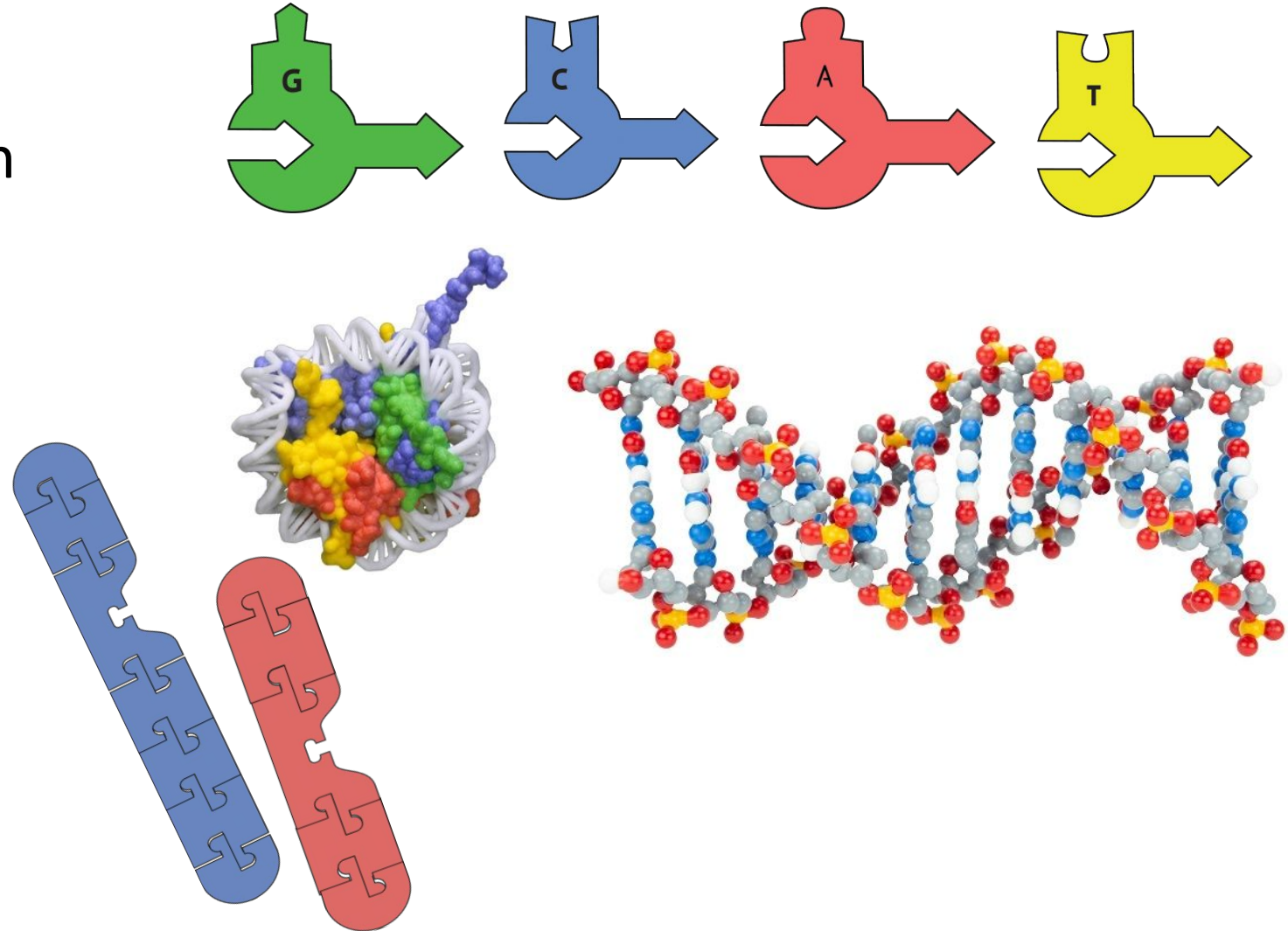
Assemble Your chromosomes like below....



Organization of DNA

Using Models to help students visualize the DNA is organized in Eukaryotic chromosomes

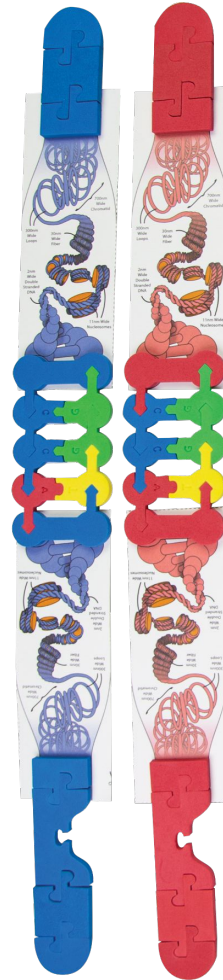
What similarities and differences do you see in these models?

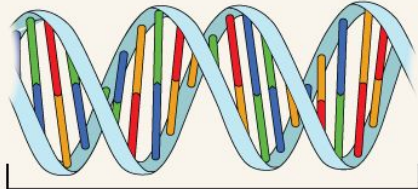
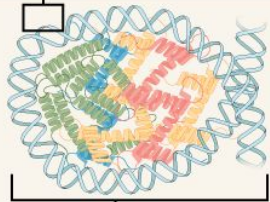
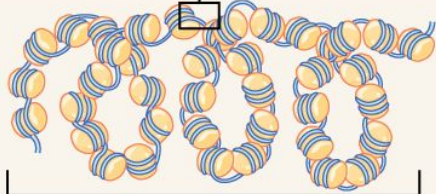
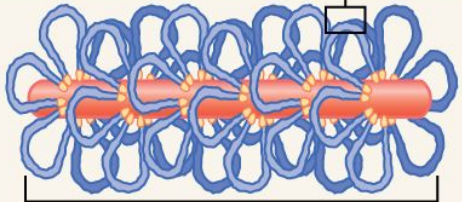
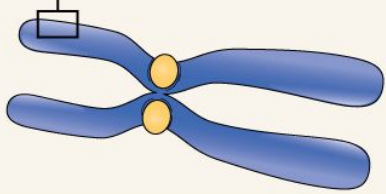


Organization of DNA

Science and Engineering Practice: Develop and Use Models

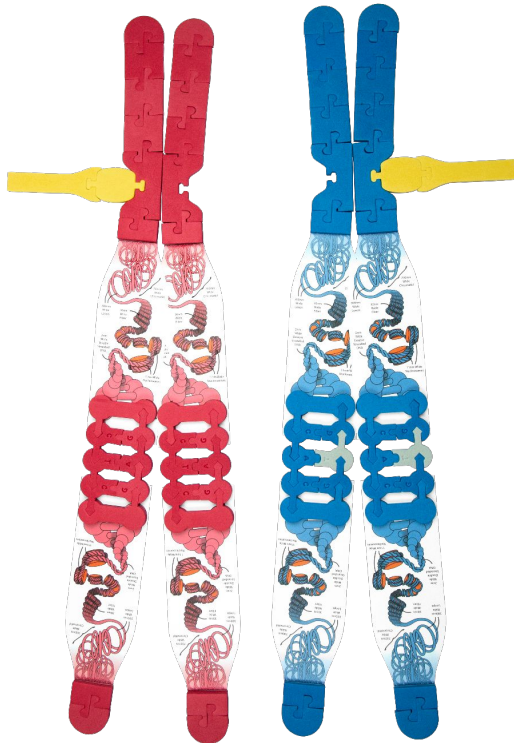
Have students create chart in
their notebook to evaluate
models as you are using them



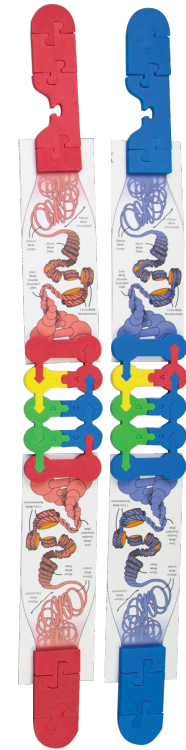
Organization of Eukaryotic Chromosomes	
DNA double helix	
DNA wrapped around histone	
Nucleosomes coiled into a chromatin fiber	
Further condensation of chromatin	
Duplicated chromosome	

Classroom Kit vs Student Modeling Kit

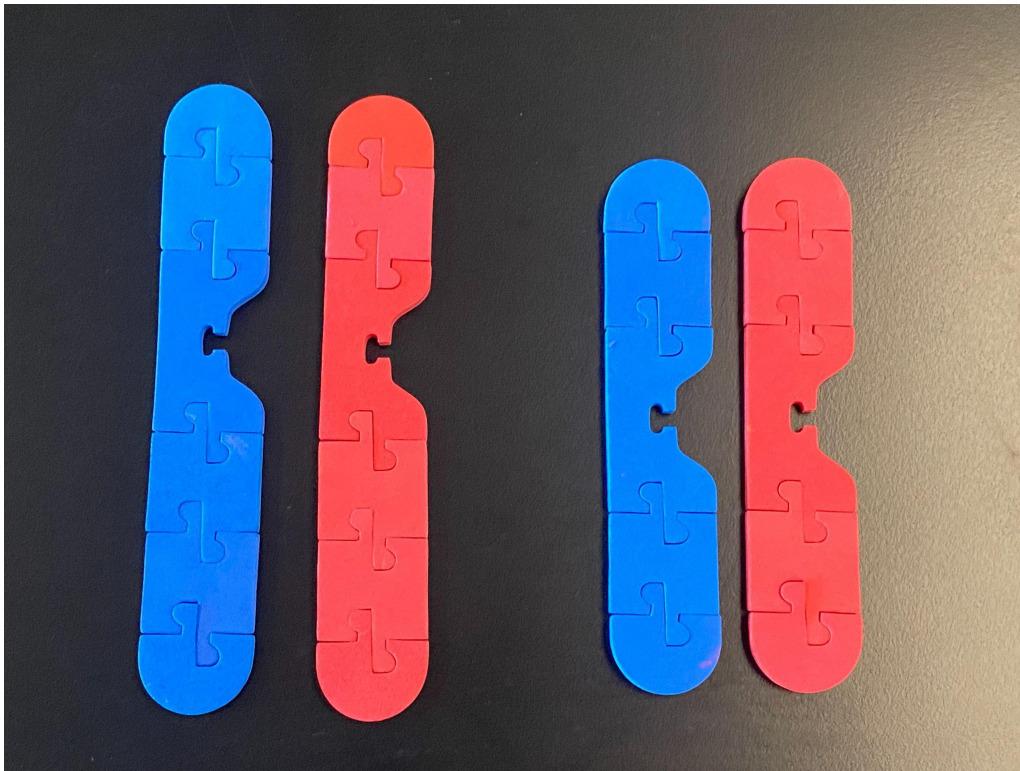
Classroom Kit:



Student Kit:



Assemble Your chromosomes like below....



Kit Management:

Store pieces in ziploc bags

Only have out the pieces you want your students to use.

Cafeteria Trays work well for organizing pieces for groups

Modeling Chromosome Structure

Vocabulary

Homologous Chromosomes

Maternal chromosome

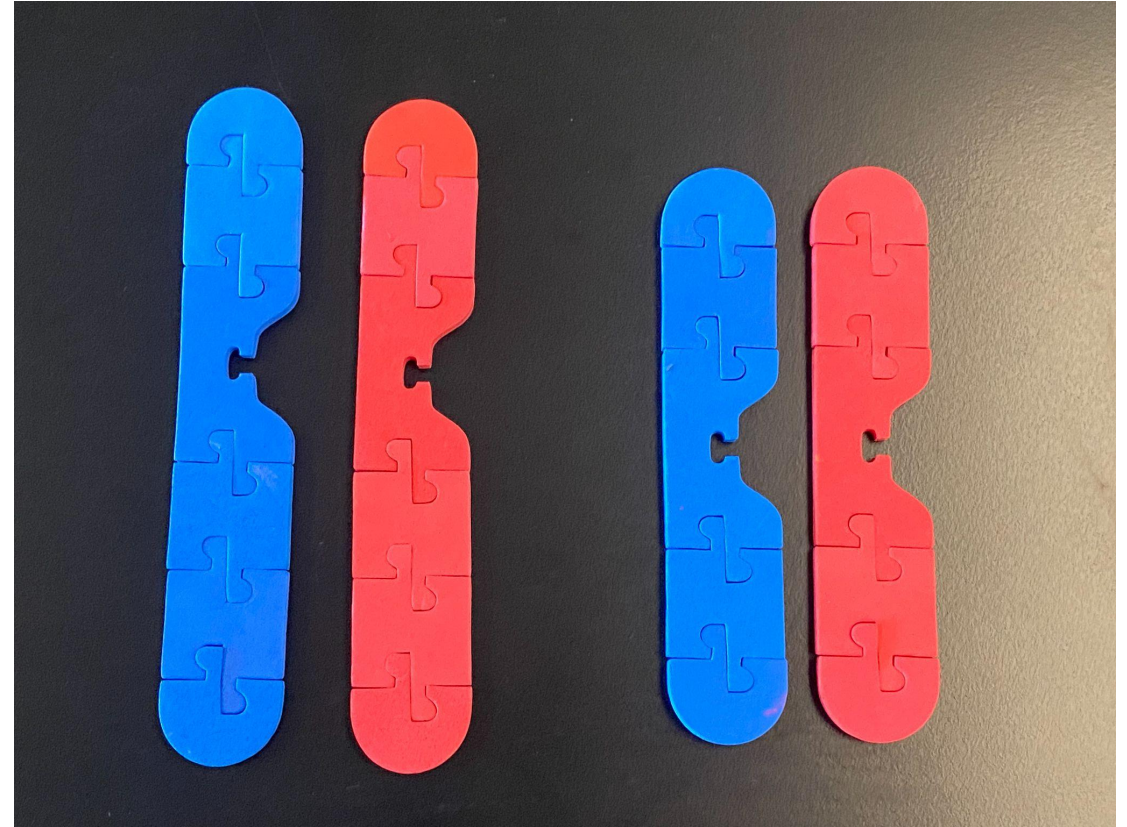
Paternal Chromosome

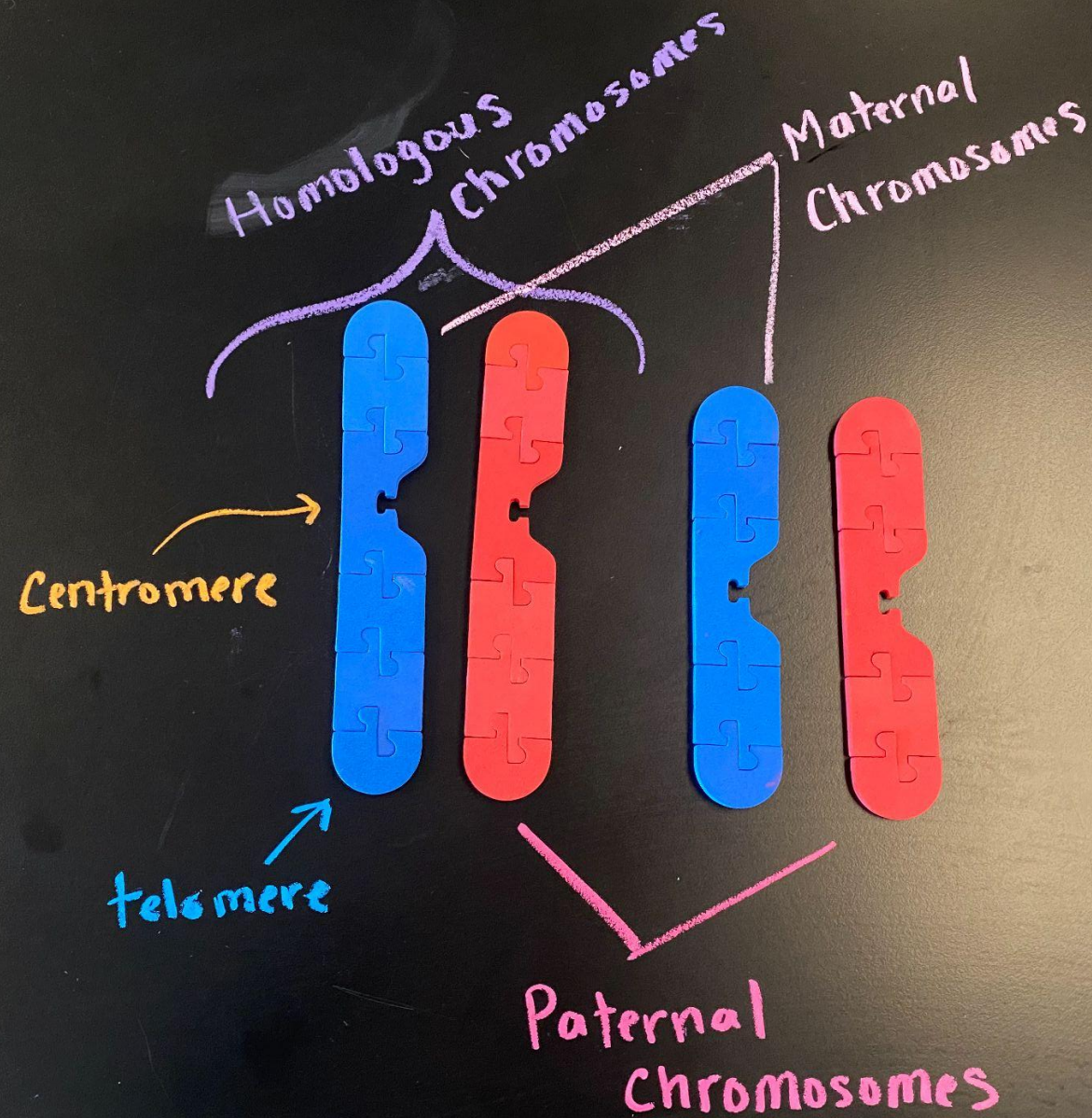
Centromere

Telomeres



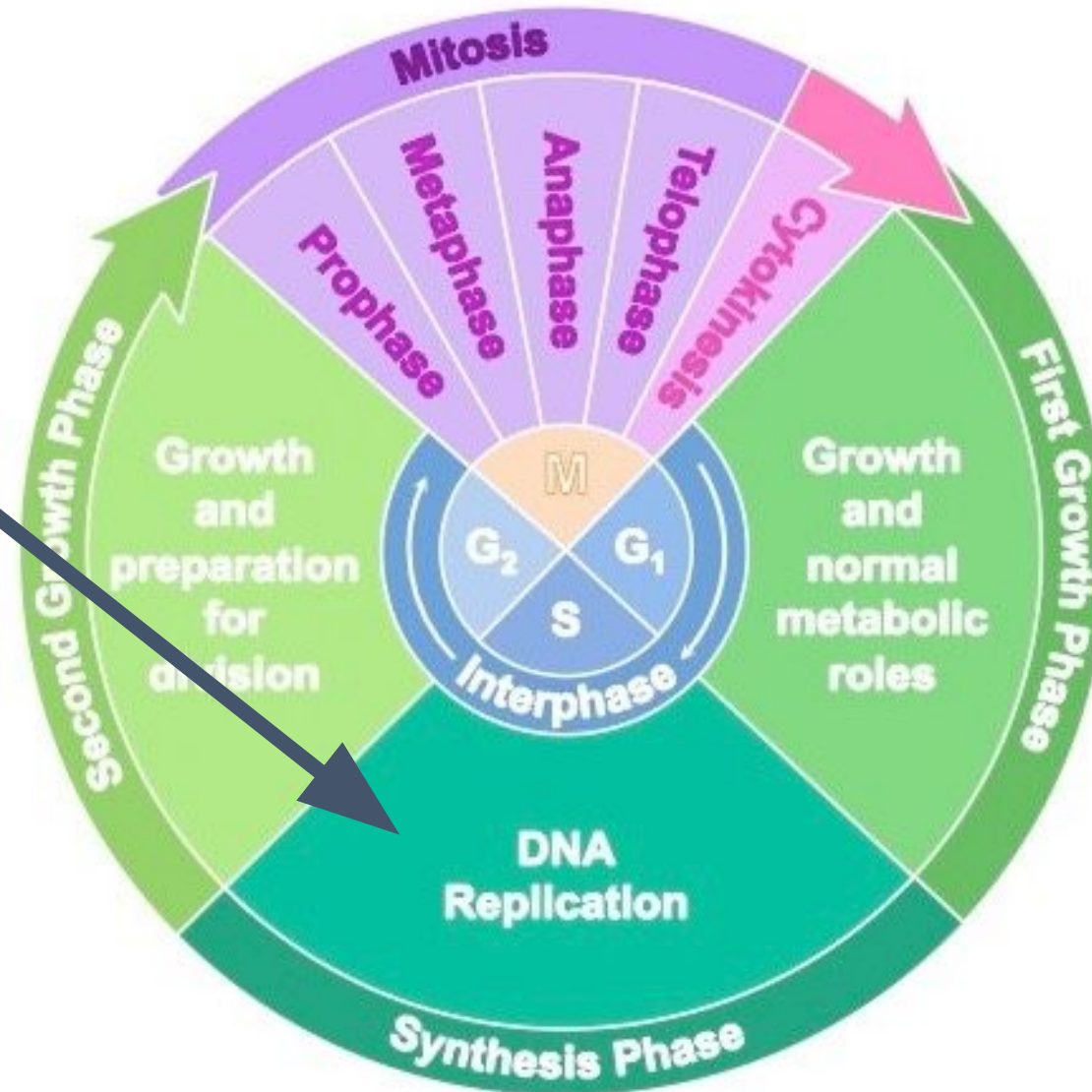
Have students use chalk markers to write on desks or print out terms for them to label





Modeling Mitosis

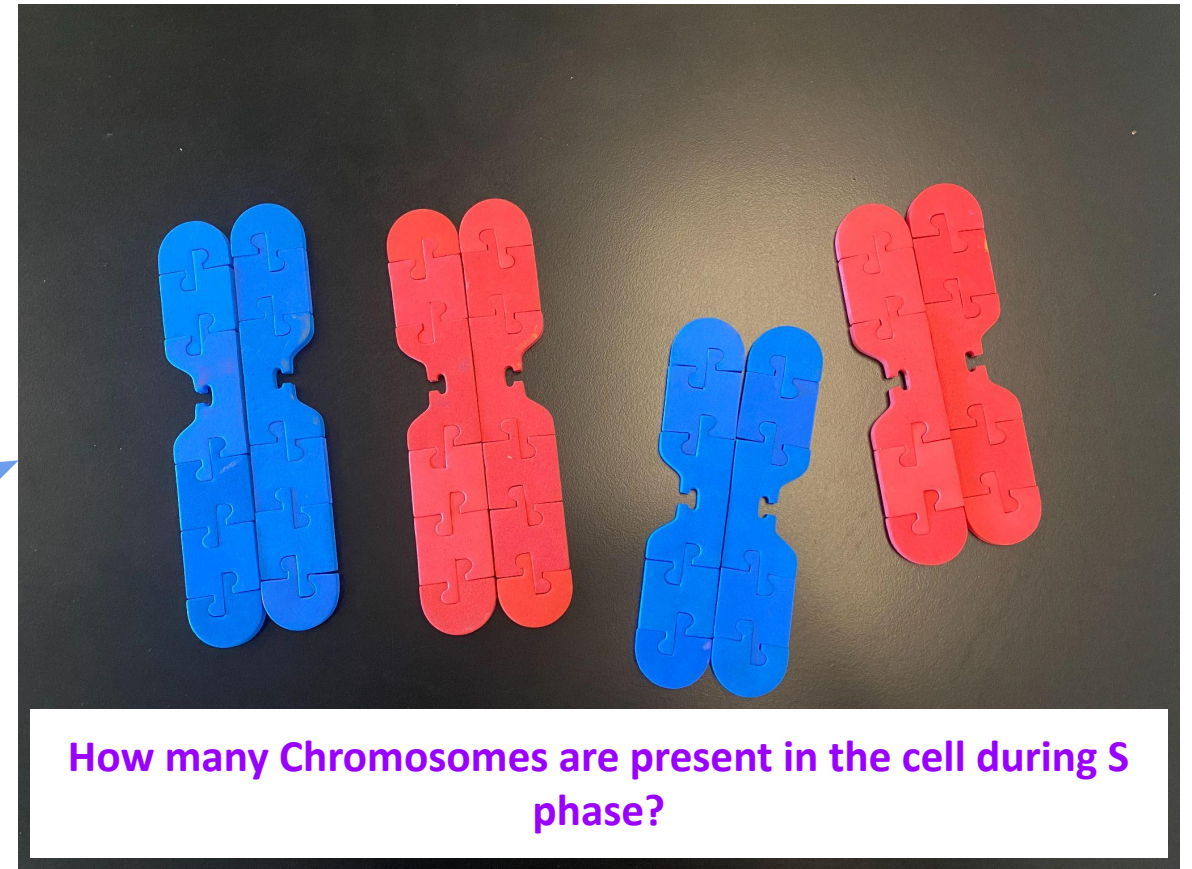
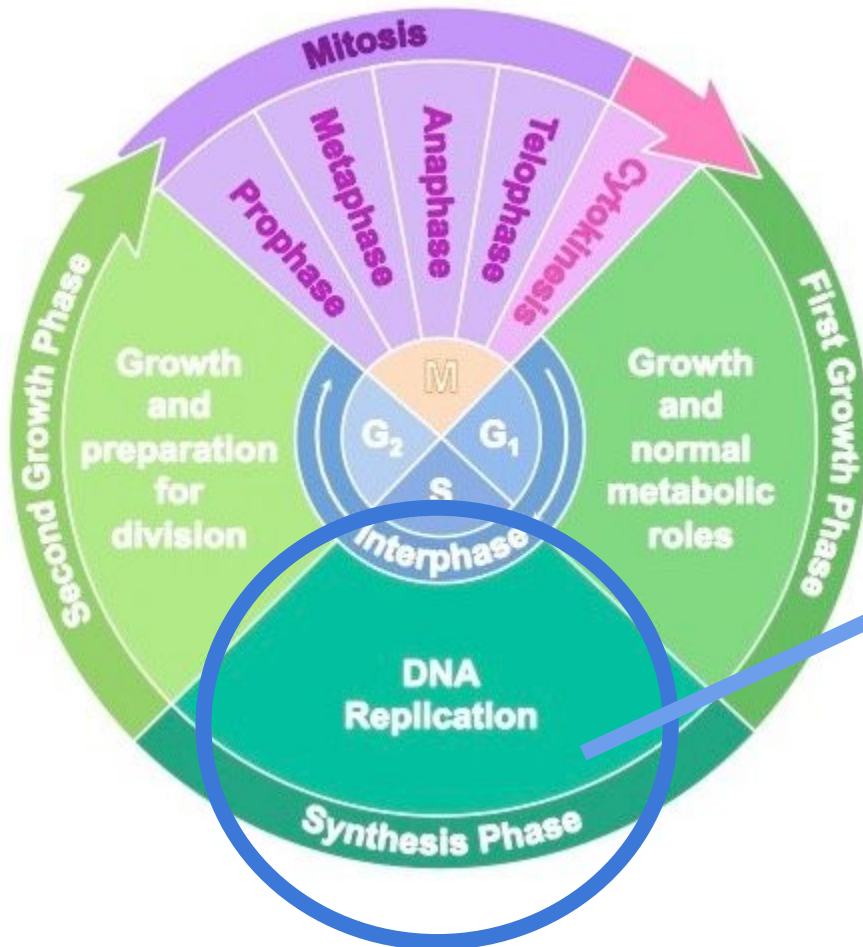
DNA Replication



Modeling Mitosis

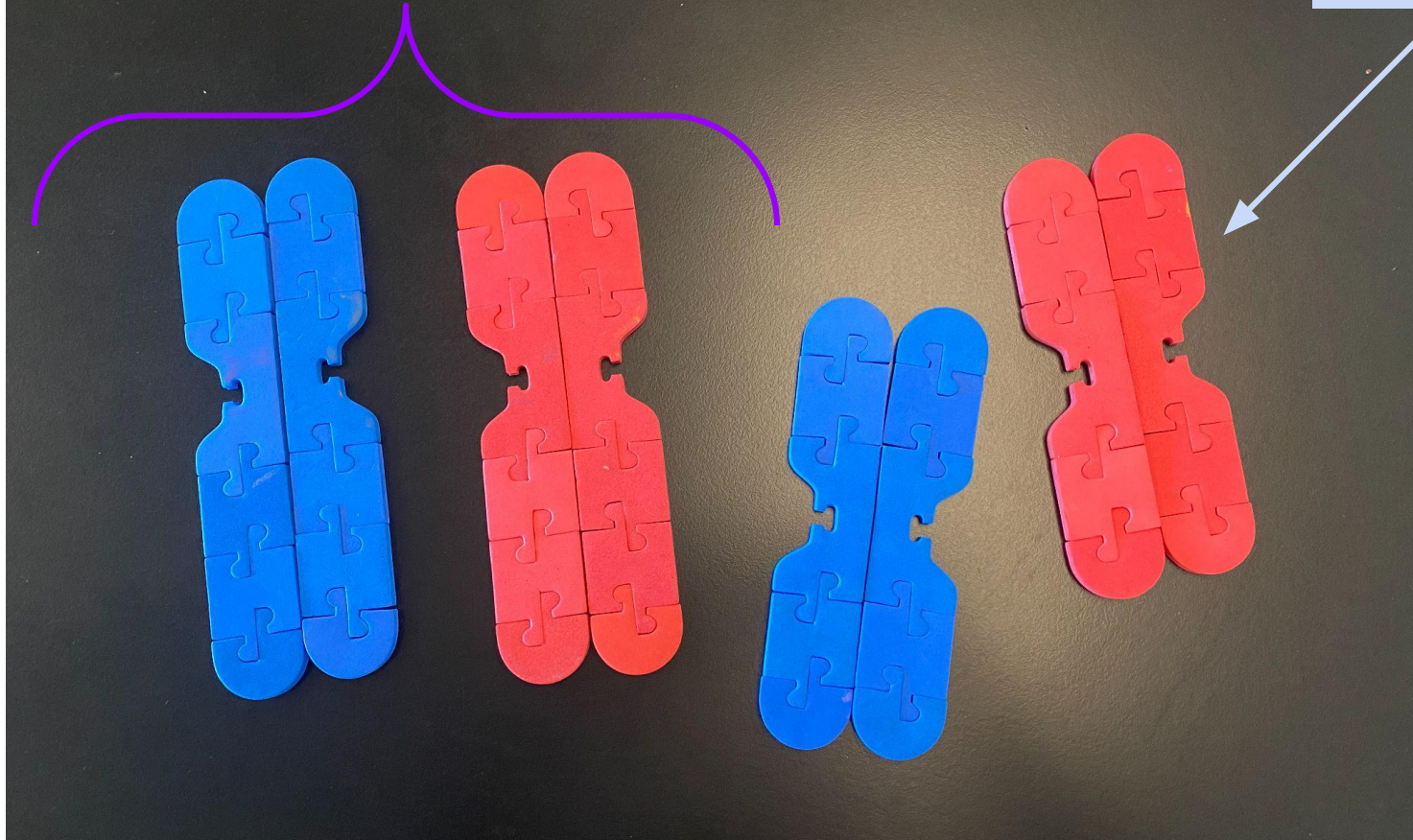
THE CELL CYCLE

With your Kits, replicate your Chromosomes:



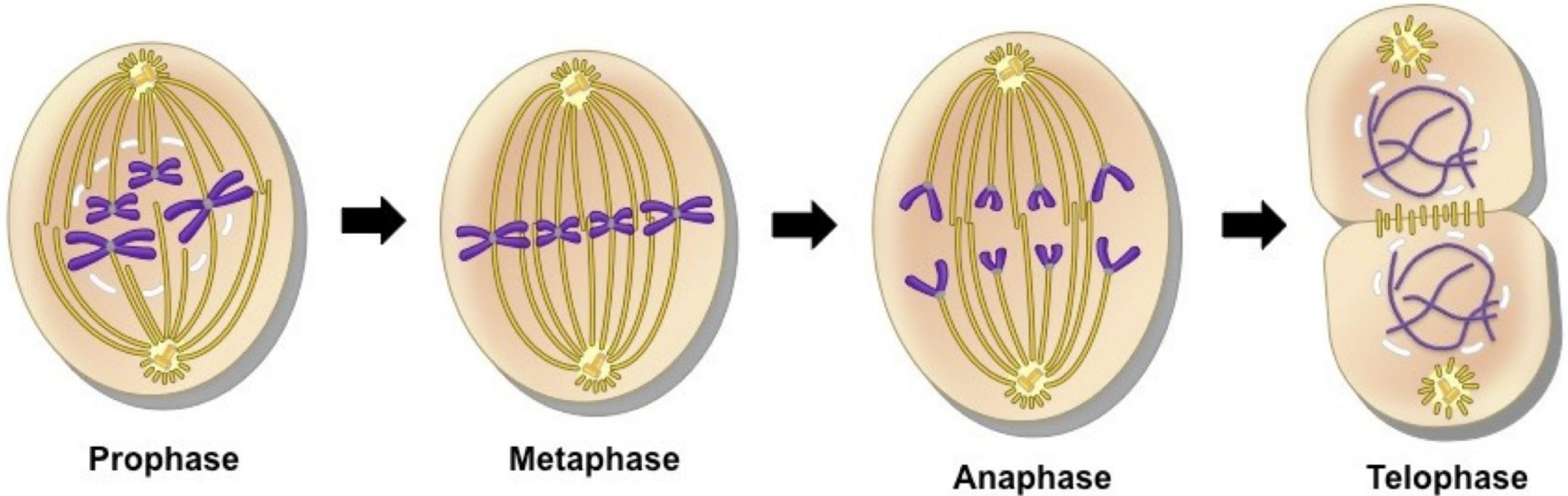
HOMOLOGOUS CHROMOSOMES

**SISTER
CHROMATID**



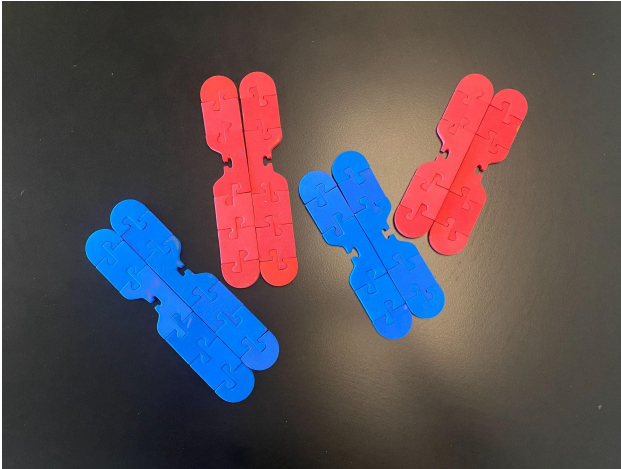
Each chromosome = 2 identical sister chromatids

Modeling Mitosis

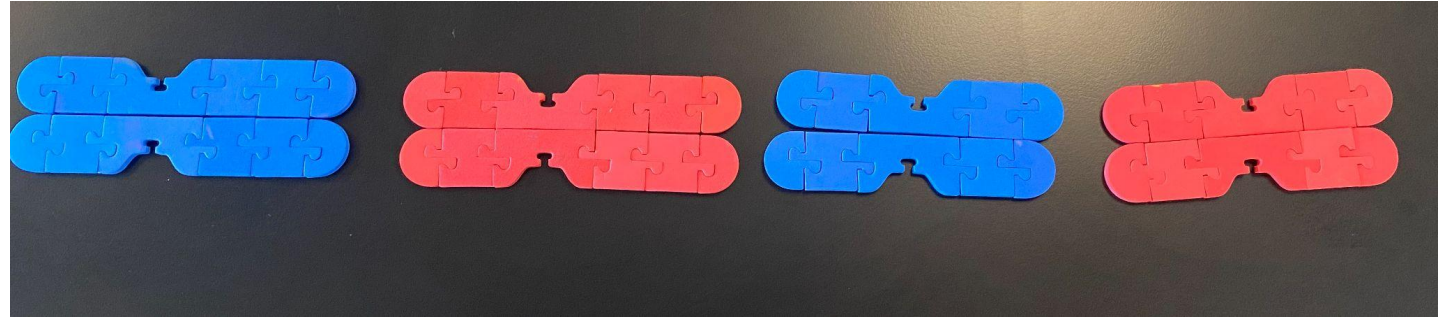


Modeling Mitosis

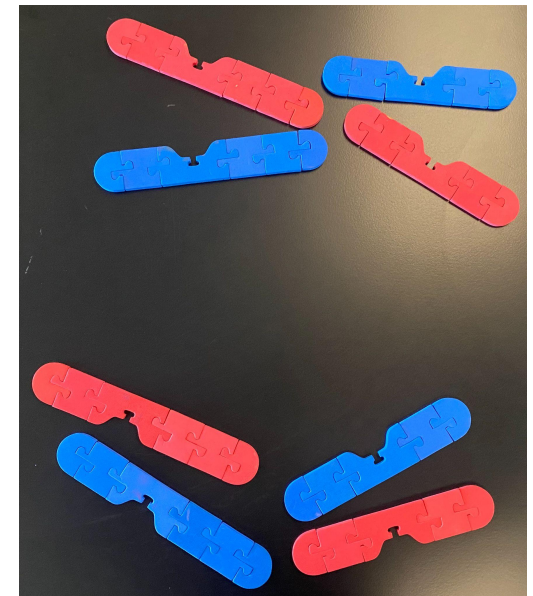
PROPHASE



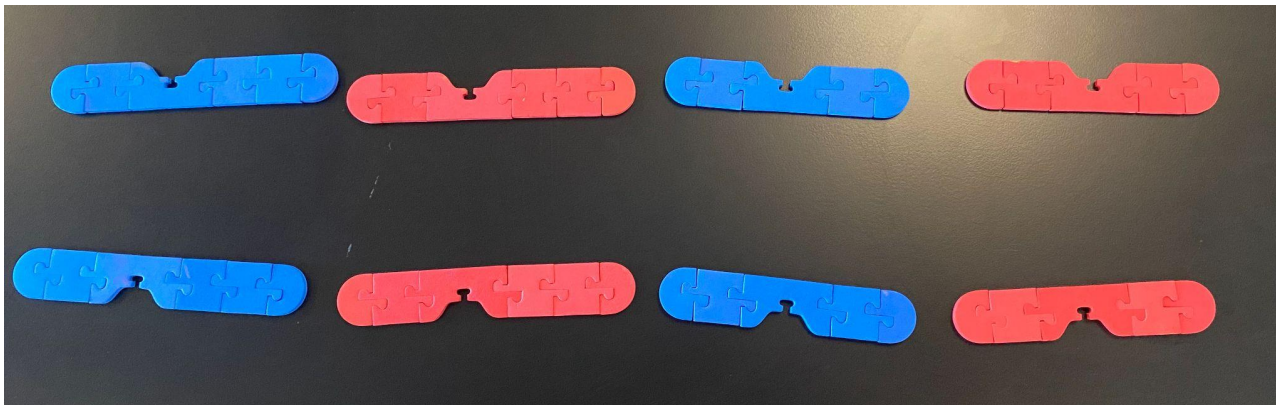
METAPHASE



TELOPHASE



ANAPHASE



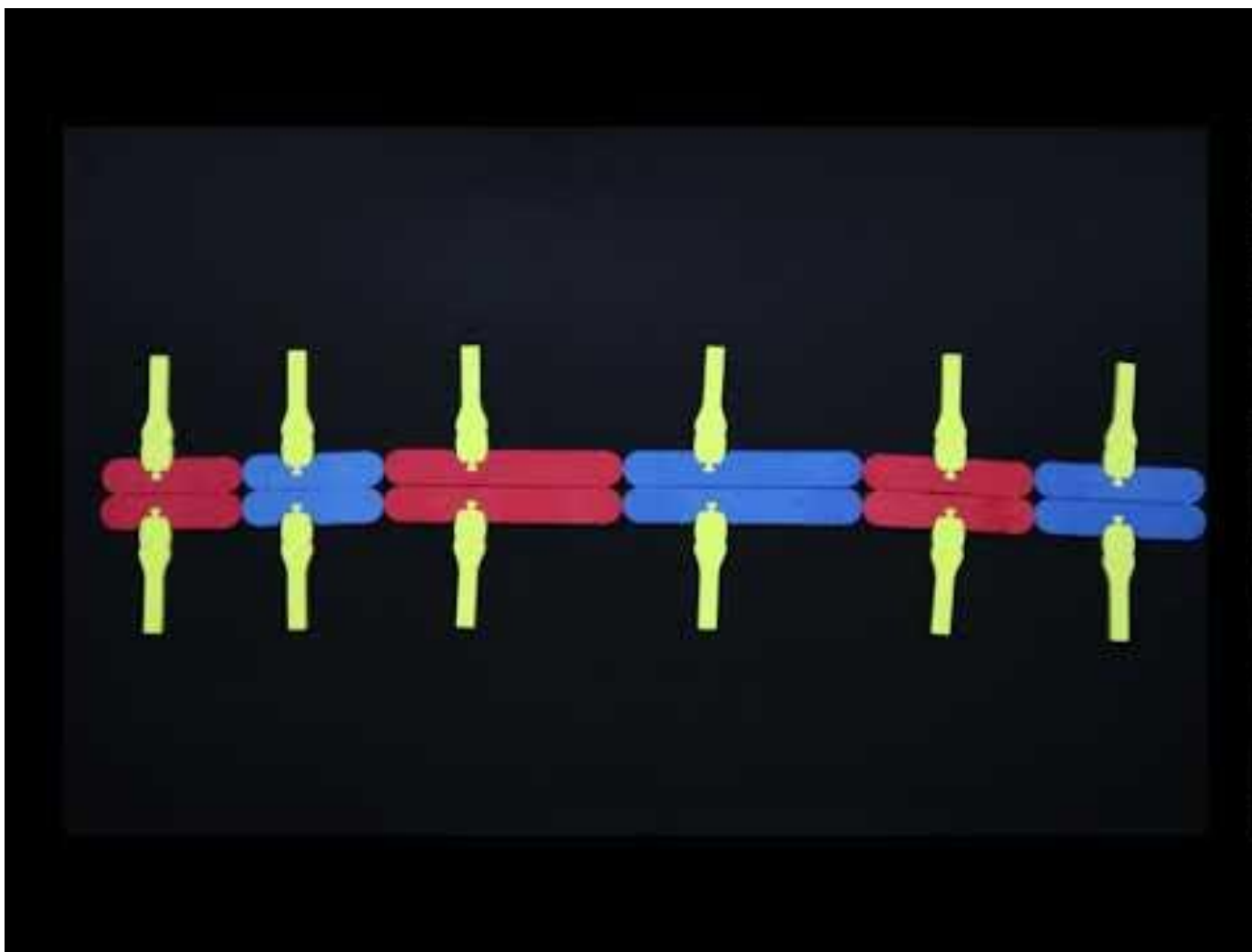
Student Reflection

Students discuss with partner:

- How do the daughter cells compare to the parent cell?
- How many chromosomes were in the parent cell?
- How many chromosomes are in each daughter cell?

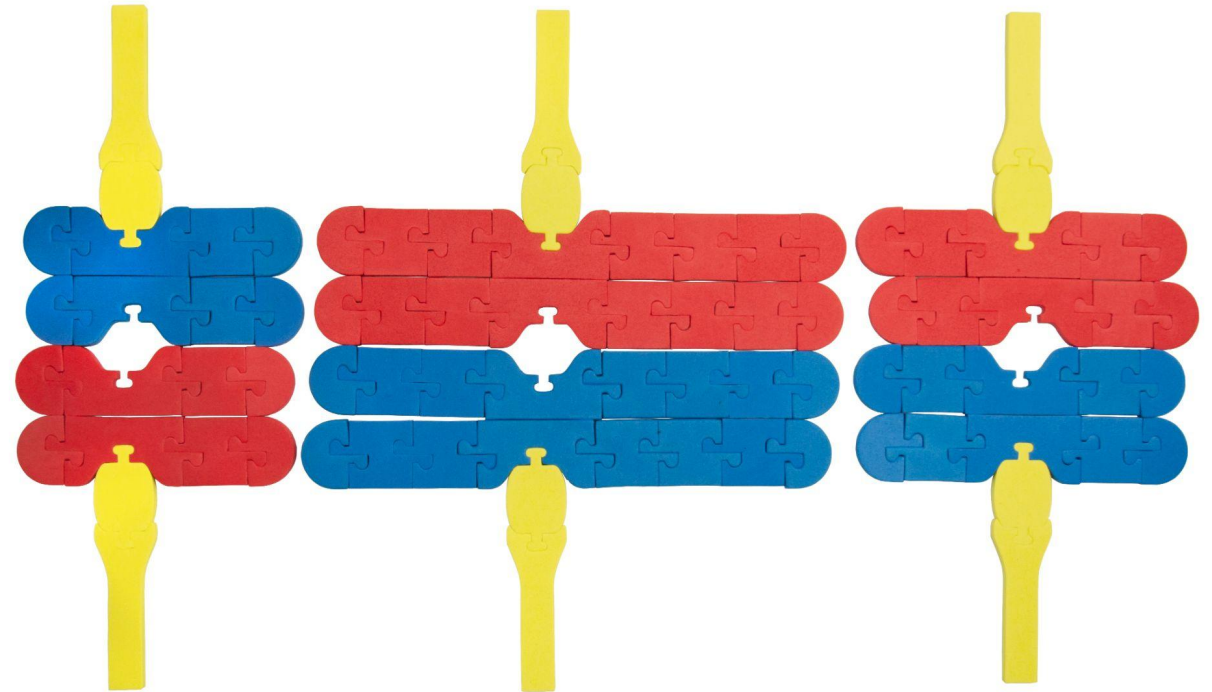
Students Assessing Students

- One Student explains the events of each phase, while the other student models



Classroom Kit vs Student Kit

Classroom Kit comes with
Spindle fibers to attach to
the centromere



Digital Resource

LINK
IN THE
CHAT!

Chromosome Activity_STUDENT ☆ ⬆ ⬇

File Edit View Poll Everywhere Help

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Mitosis

Mitosis is a type of cell division that results in two daughter cells, each having the same number and kind of chromosomes as the parent cell.

- Grab the chromosomes from the **parent cell** to fill in the other steps in mitosis, including **DNA replication**, **cell division** and the resulting two **daughter cells**.
- Answer the question below and move to the next slide.

Parent Cell DNA Replication Cell Division Two Daughter Cells

How many chromosomes are in the parent cell?

Modeling Meiosis

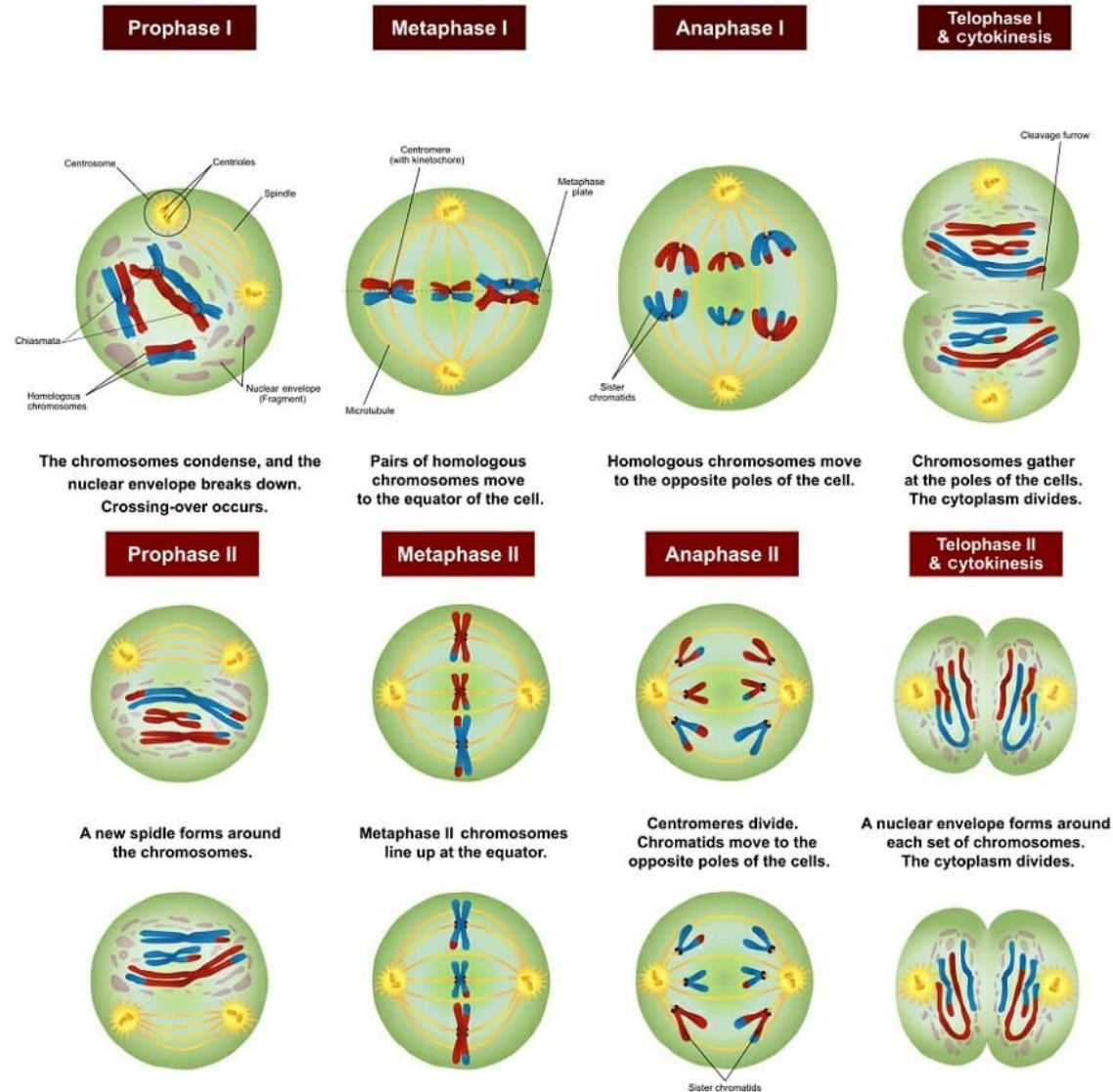
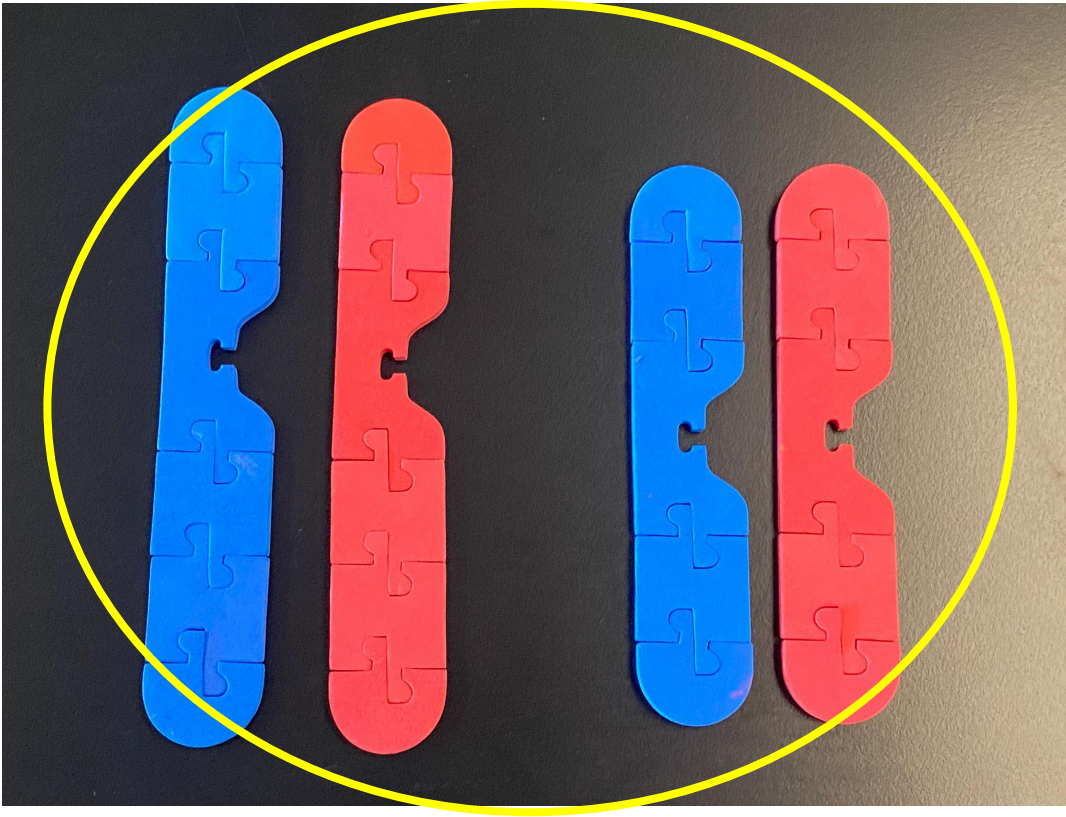


Image source:
<https://biologydictionary.net/meiosis/>

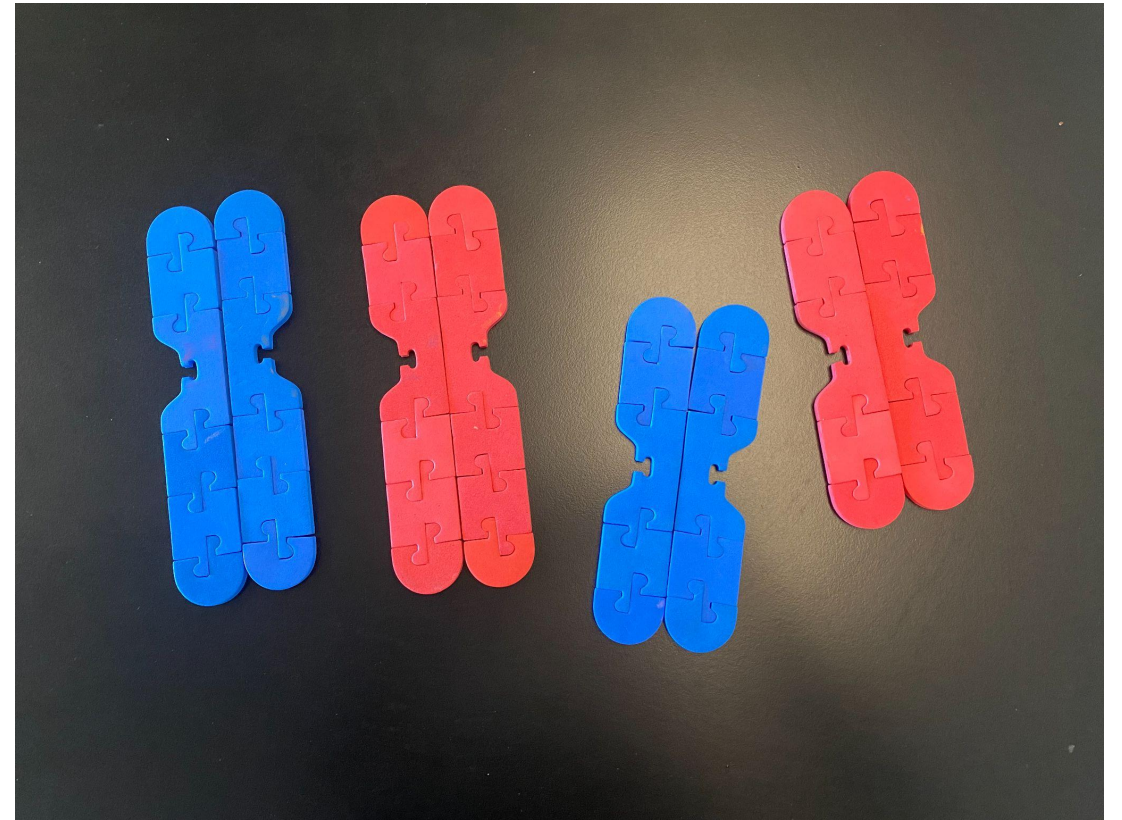
Interphase

G1 Phase



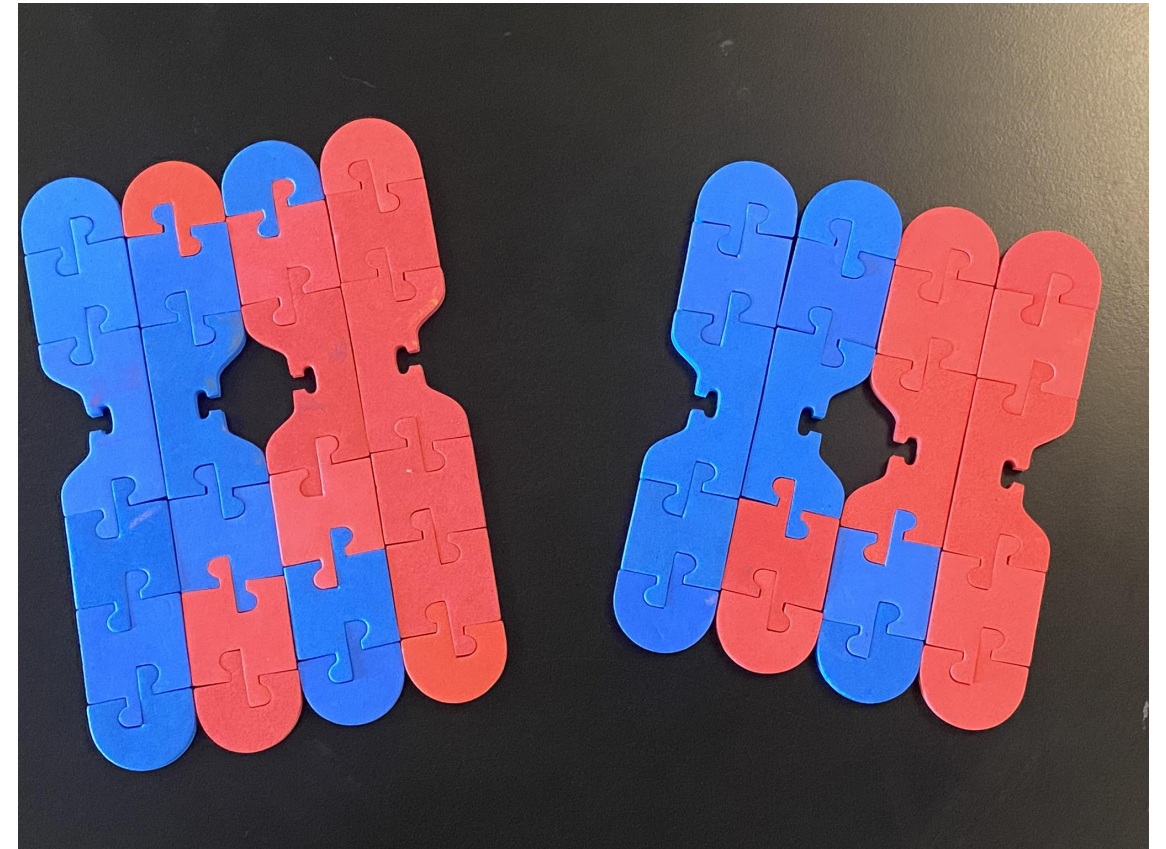
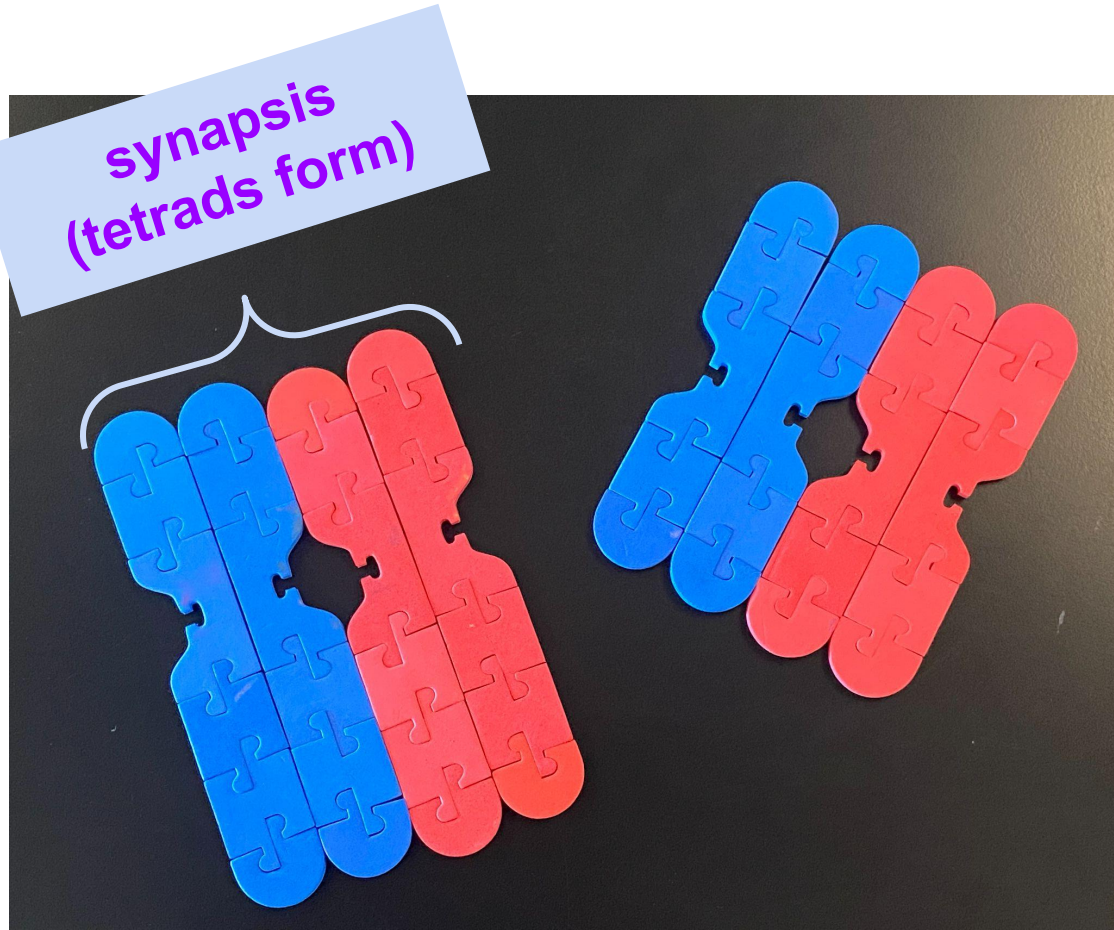
Parent Cell: Diploid $2N$

S Phase



Prophase 1

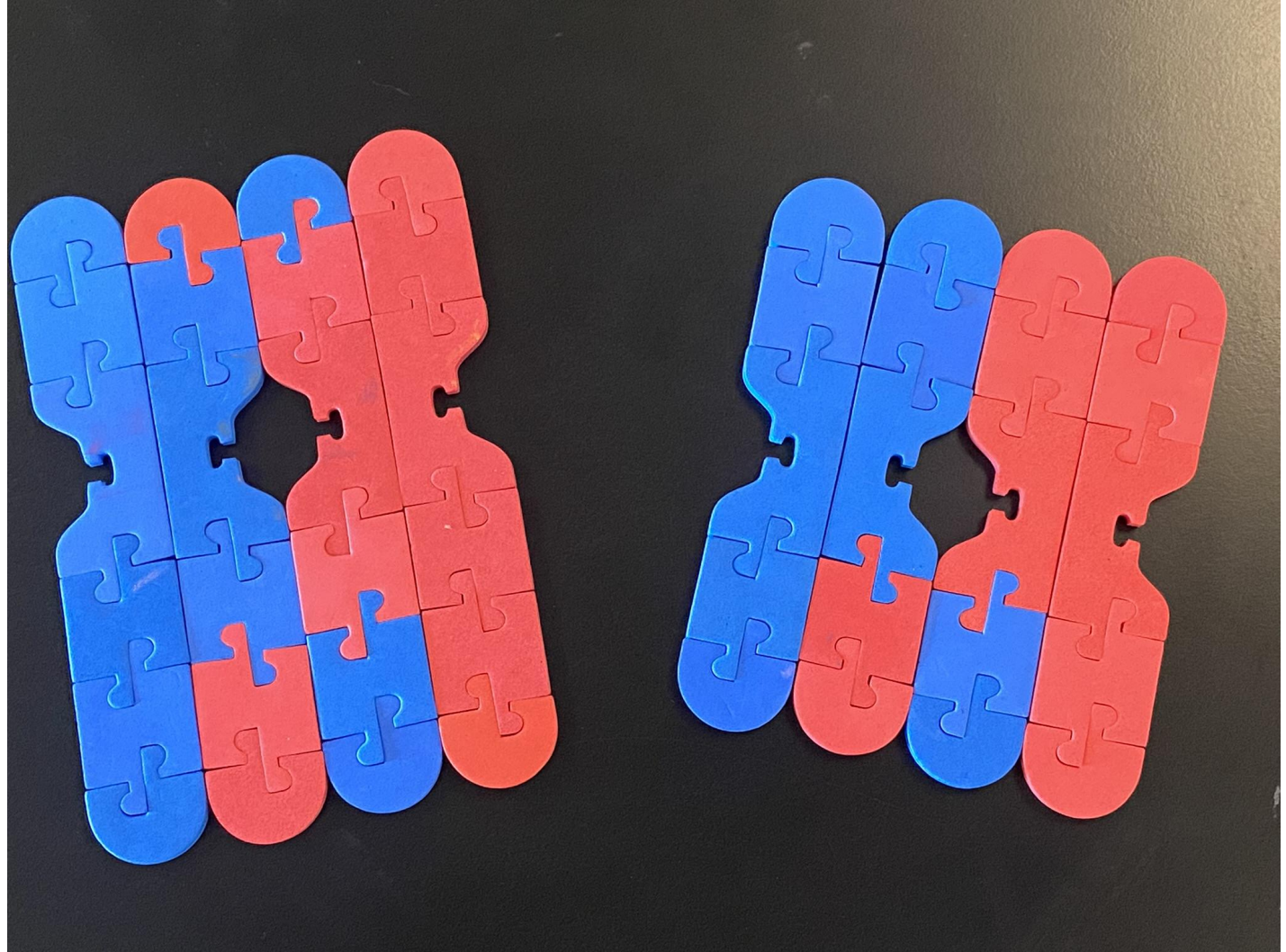
Modeling Crossing over



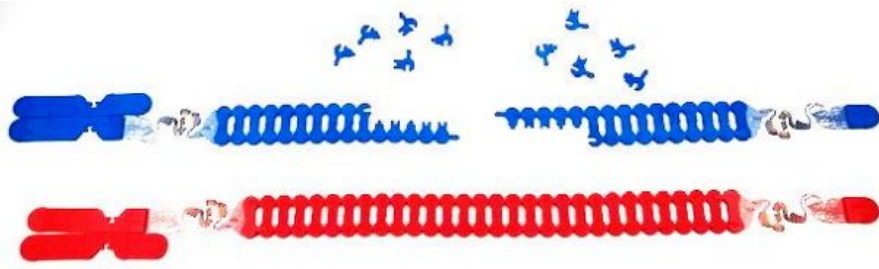
Modeling Crossing over

**Question for students
to ponder....**

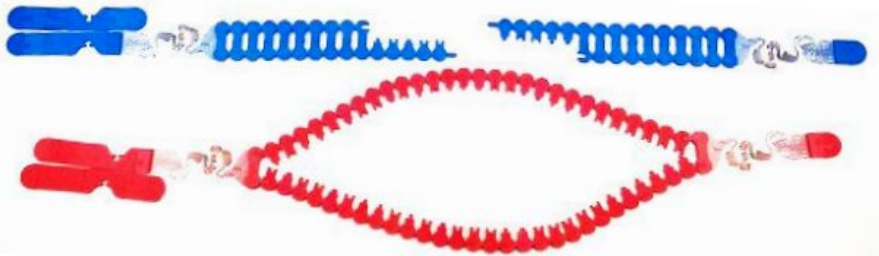
**How many times can
crossing over take
place?**



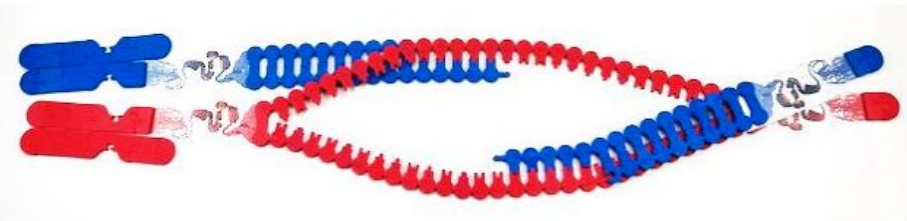
Crossing over is not that simple



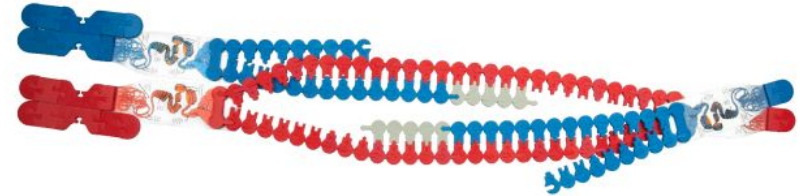
4. At the same time, the homologous DNA sequence on the maternal chromosome is denatured...in preparation for strand invasion.



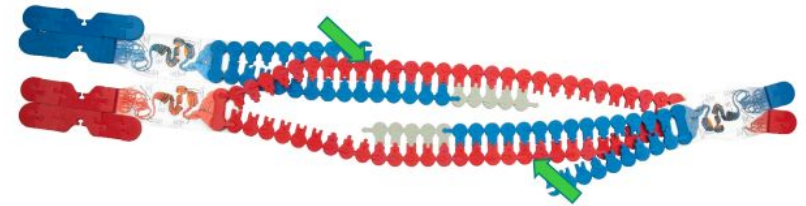
5. During strand invasion, the protruding 3' ends of the paternal DNA form Watson/Crick base pairs with their homologous sequences on the maternal chromosome.



6. DNA polymerase then extends the 3'-OH primer of the paternal chromosomes synthesizing new DNA (grey nucleotides in this model) in the 5' to 3' direction.



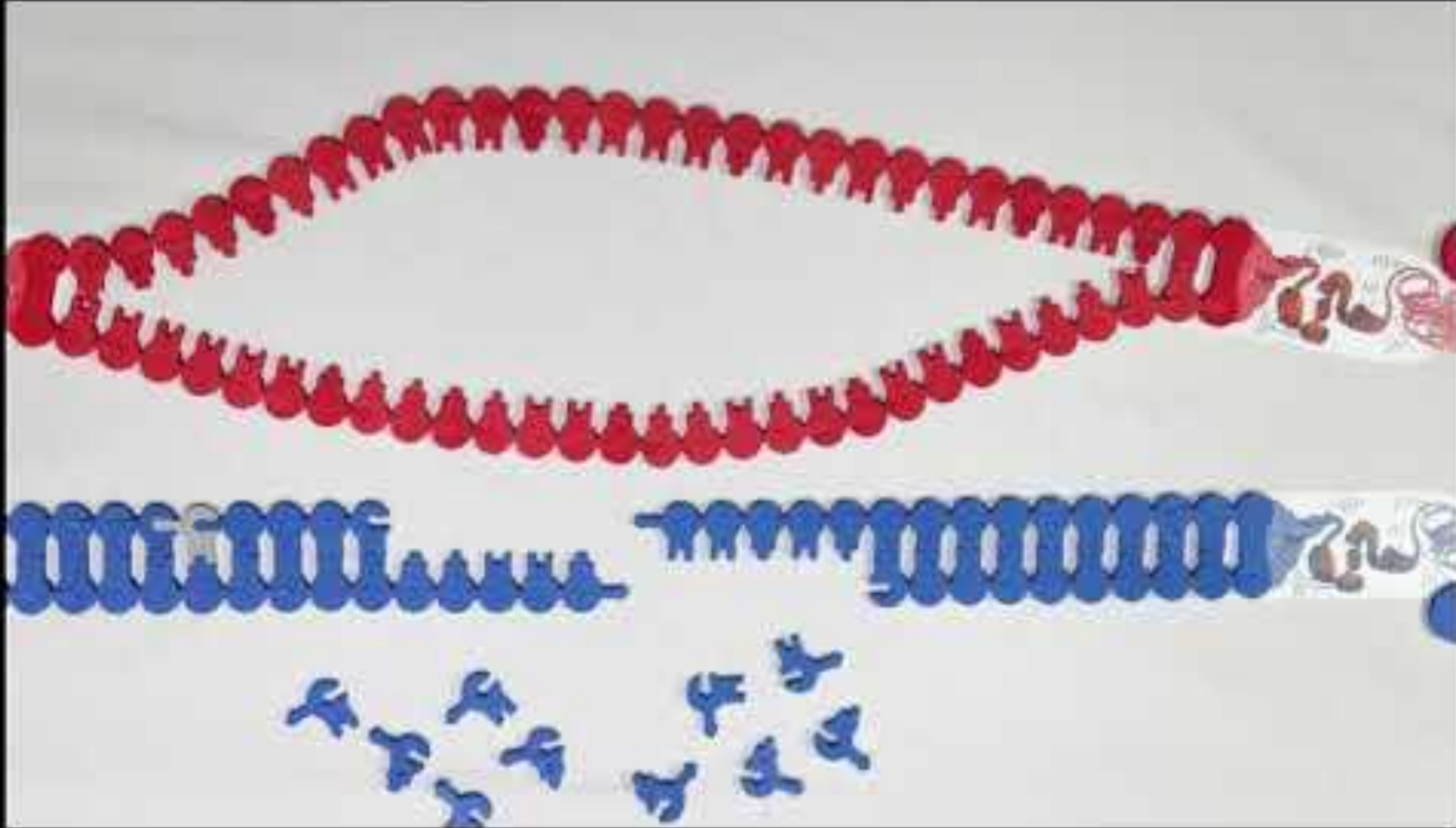
7. To resolve these intertwined chromosomes, single-stranded cuts are introduced into the maternal DNA at the sites of the green arrows.



8. Ligation reactions then form the final phosphodiester bonds that seal up the single-stranded nicks in the chromosomes generating the chromosomes shown below.

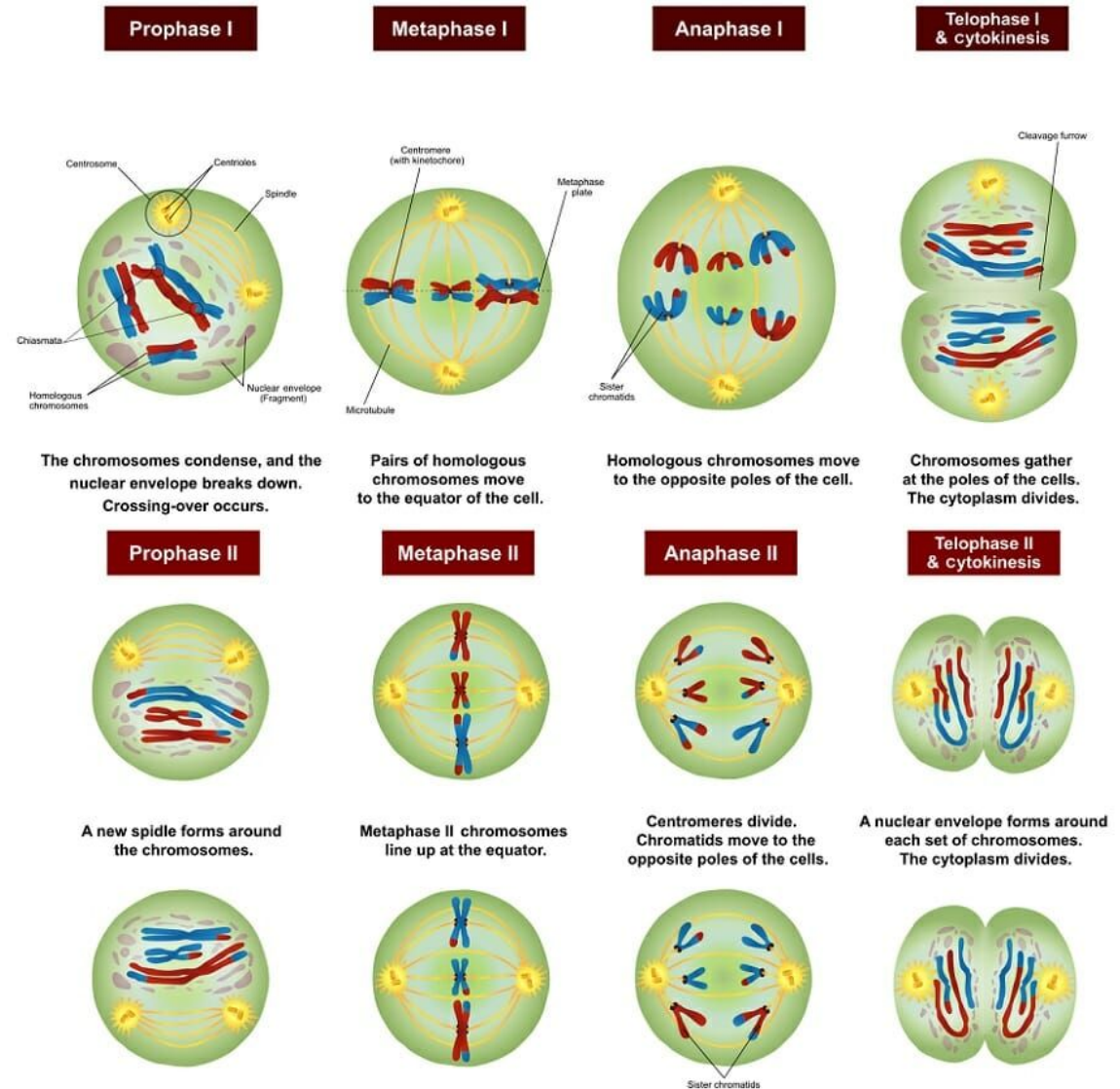


Crossing over is not that simple



Modeling Meiosis

Use your kits
to now model
Meiosis 1 and
Meiosis 2



Modeling Meiosis

****** Add in images of each stage of Meiosis*****- Complete by Thursday for 3DMD**

Student Reflection

Students discuss with partner:

- In meiosis, how do the daughter cells compare to the original parent cell?
- How many chromosomes were in the parent cell?
- How many chromosomes are in each daughter cell?

Compare and Contrast

- In what ways are Mitosis and Meiosis similar?
- In what ways are Mitosis and Meiosis different.

So much more modeling can be done with this kit....

- Independent Assortment
- Chromosome Aberrations (nondisjunction)
- Translocation

Digital Resource

LINK
IN THE
CHAT!

Chromosome Activity_STUDENT ☆ 📁 🌐

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Independent Assortment in Meiosis

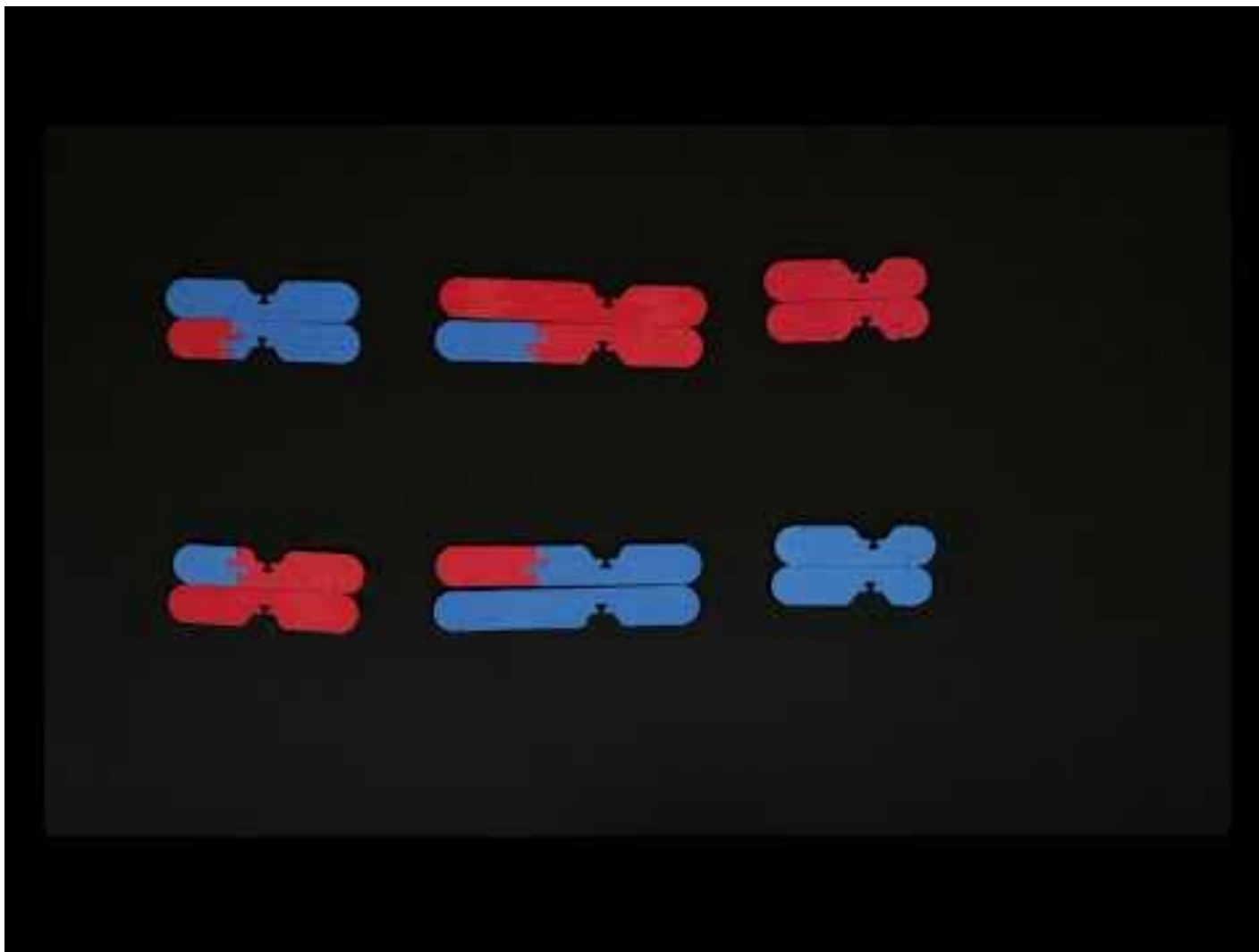
Meiosis results in **gametes**, cells that only carry one copy of each chromosome. Pairs of homologous chromosomes get sorted into gametes **independently** of one another.

1. Grab and place pieces from the magenta circle to show all possible combinations that could result from meiosis in a species with four chromosomes (two pairs of homologous chromosomes).

2. Move to the next slide and answer the activity questions.

Dividing Cell in Metaphase I

Possible Combinations of Chromosomes in Gametes



Inheritance of Traits

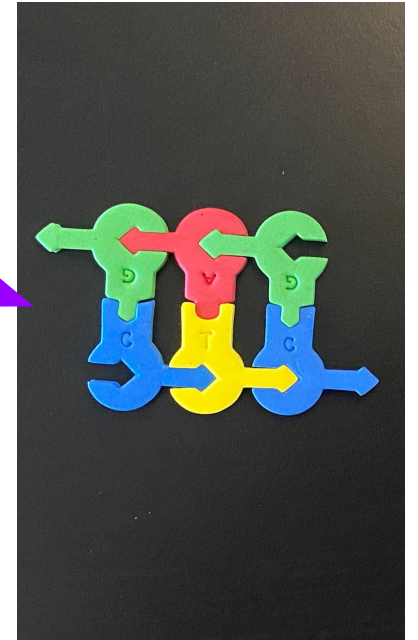
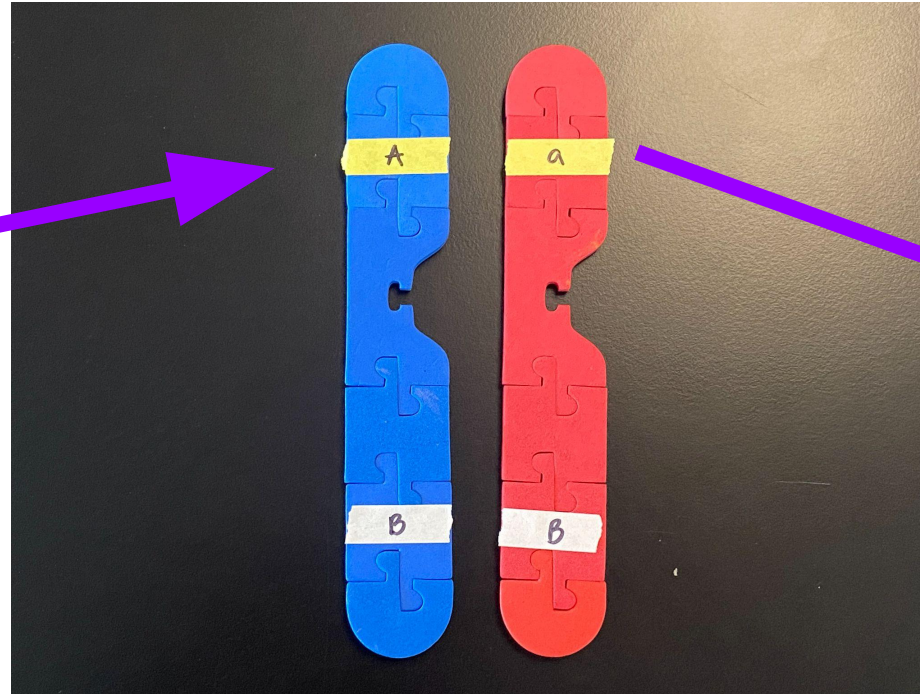
Going from Microscopic Perspective of Chromosomes to Molecular Perspective with Punnett Squares

	S	s
S	SS	Ss
s	Ss	ss

What struggles/misconceptions do students come with to your class about punnett squares?

Inheritance of Traits

	S	s
S	SS	Ss
s	Ss	ss



Inheritance of Traits

Using phenomenon to connect microscopic to molecular.

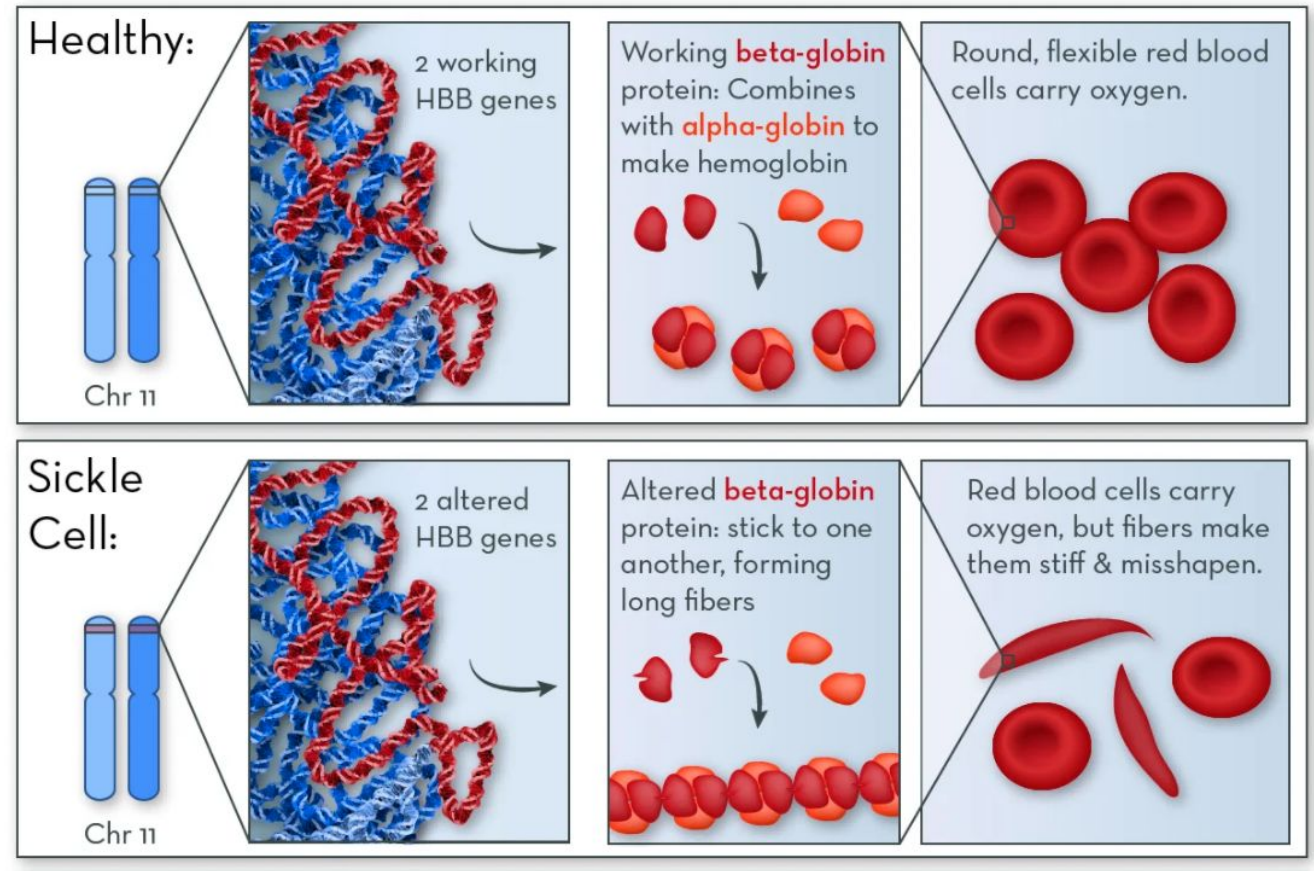
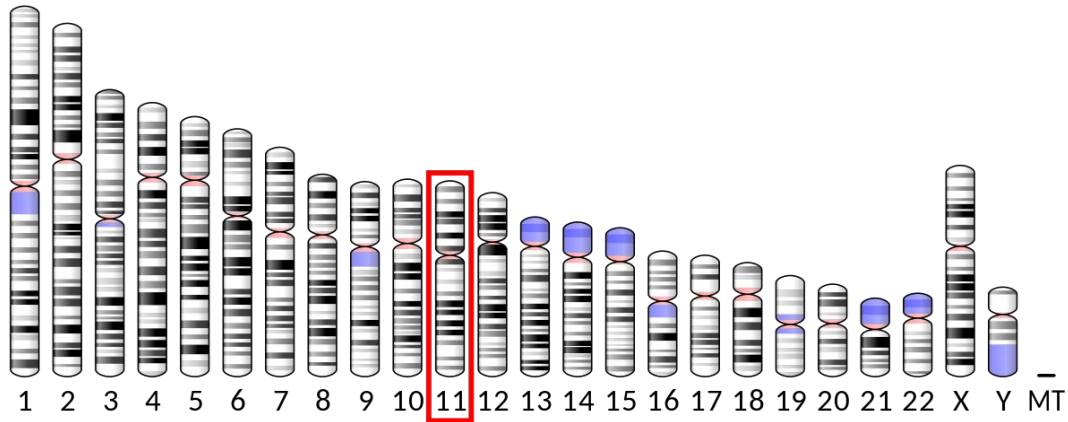
Examples:

- HBB Gene (Sickle Cell) (Autosomal Recessive)
- Huntington's Disease (Autosomal Dominant)
- Hemophilia (Sex-Linked)
- Wisconsin Fast Plants- Stem color, height, etc....

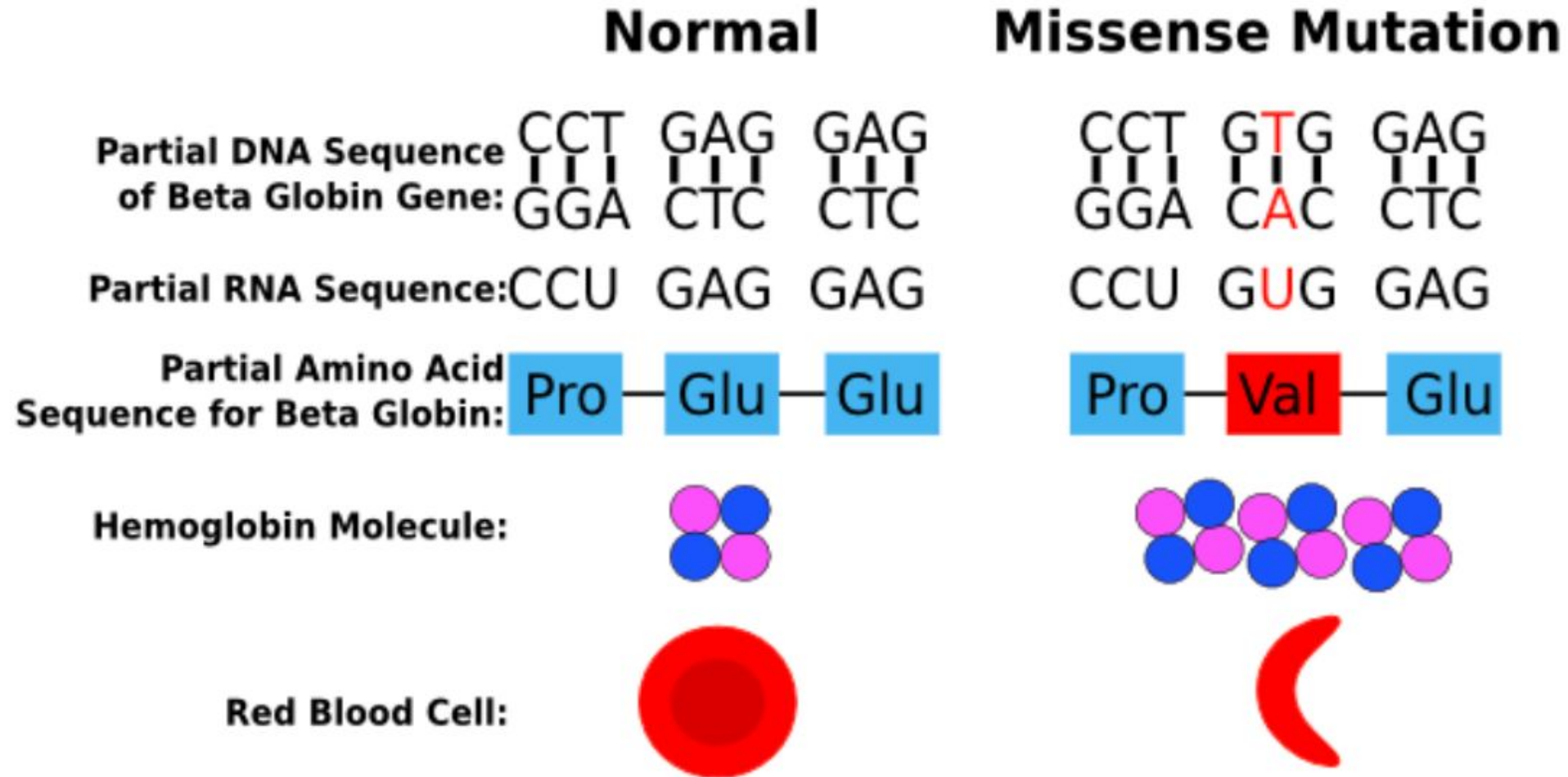
Inheritance of Traits

Using phenomenon to connect microscopic to molecular.

Beta Globin Gene~ Sickle Cell

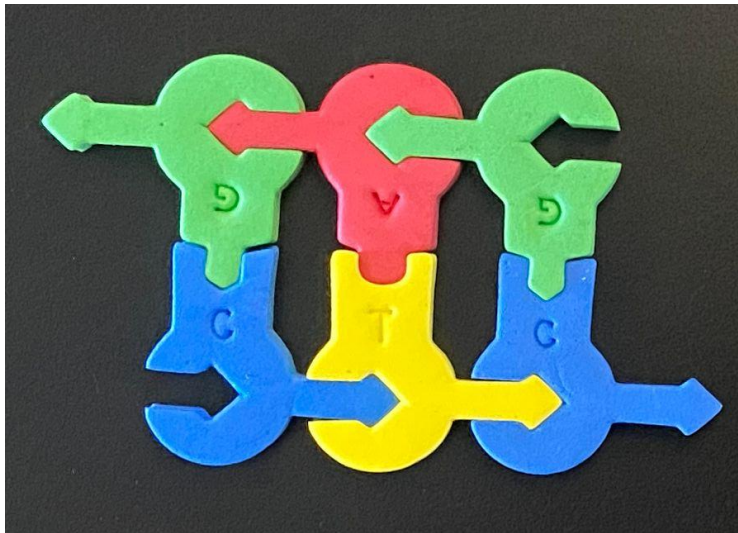


DNA Mutation



Build these variations in the HBB Gene!

Normal Beta Globin
Sequence



Sickle Cell Beta Globin
Sequence

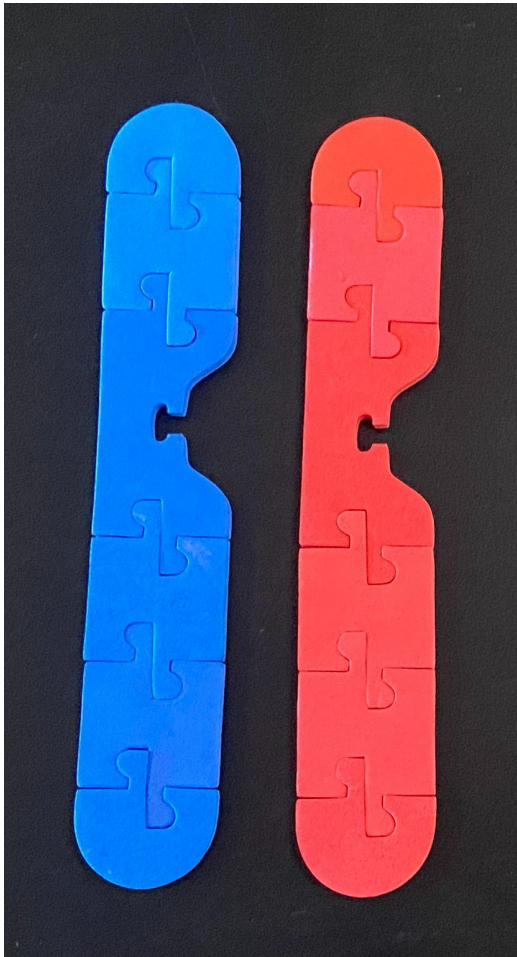


What differences do you see between these two variants?

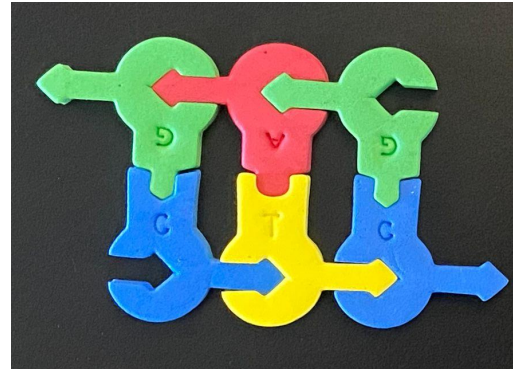
HBB Genotypes

Receive one copy of gene
each from each parent

What possible combinations of the alleles below
could an offspring receive from their parents?



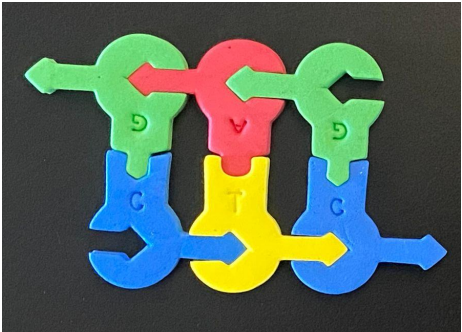
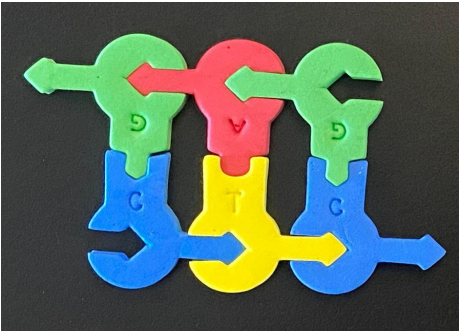
HbA



HbS



Possible Genotype Combinations

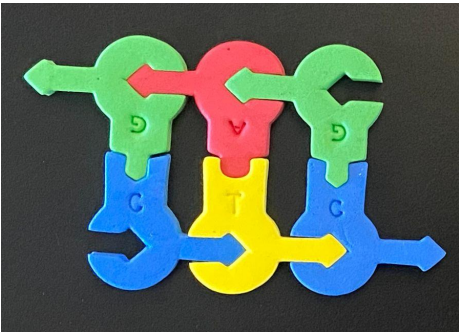


HbA

HbA

GENOTYPE

HH



HbA

HbS

Hh



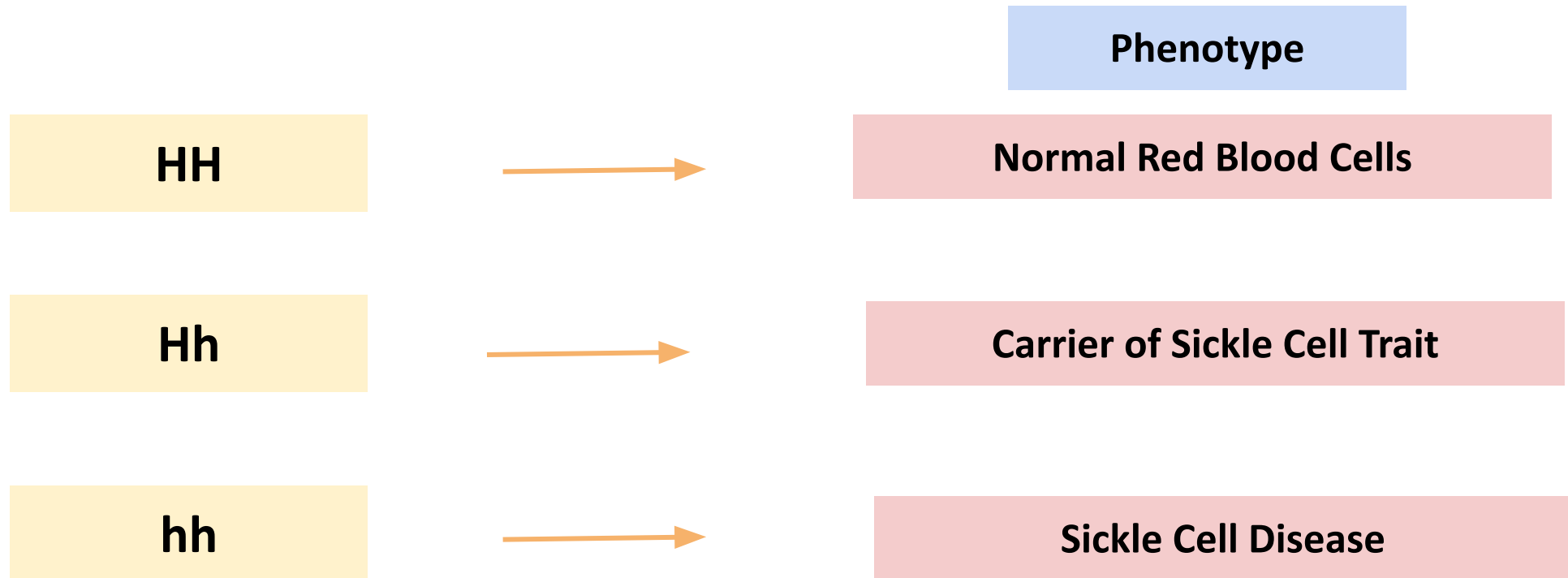
HbS

HbS

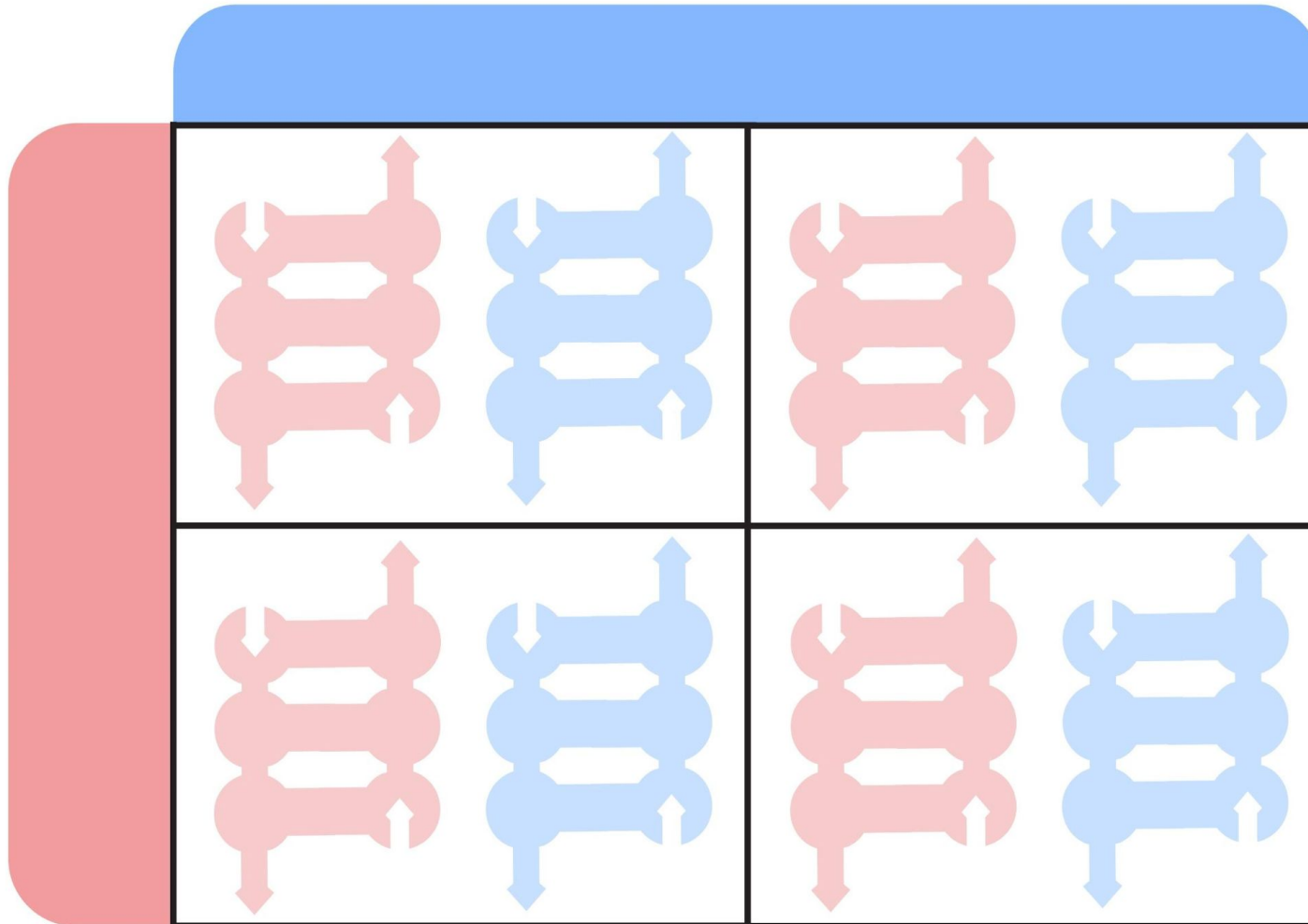
hh

Genes are instructions for making proteins!

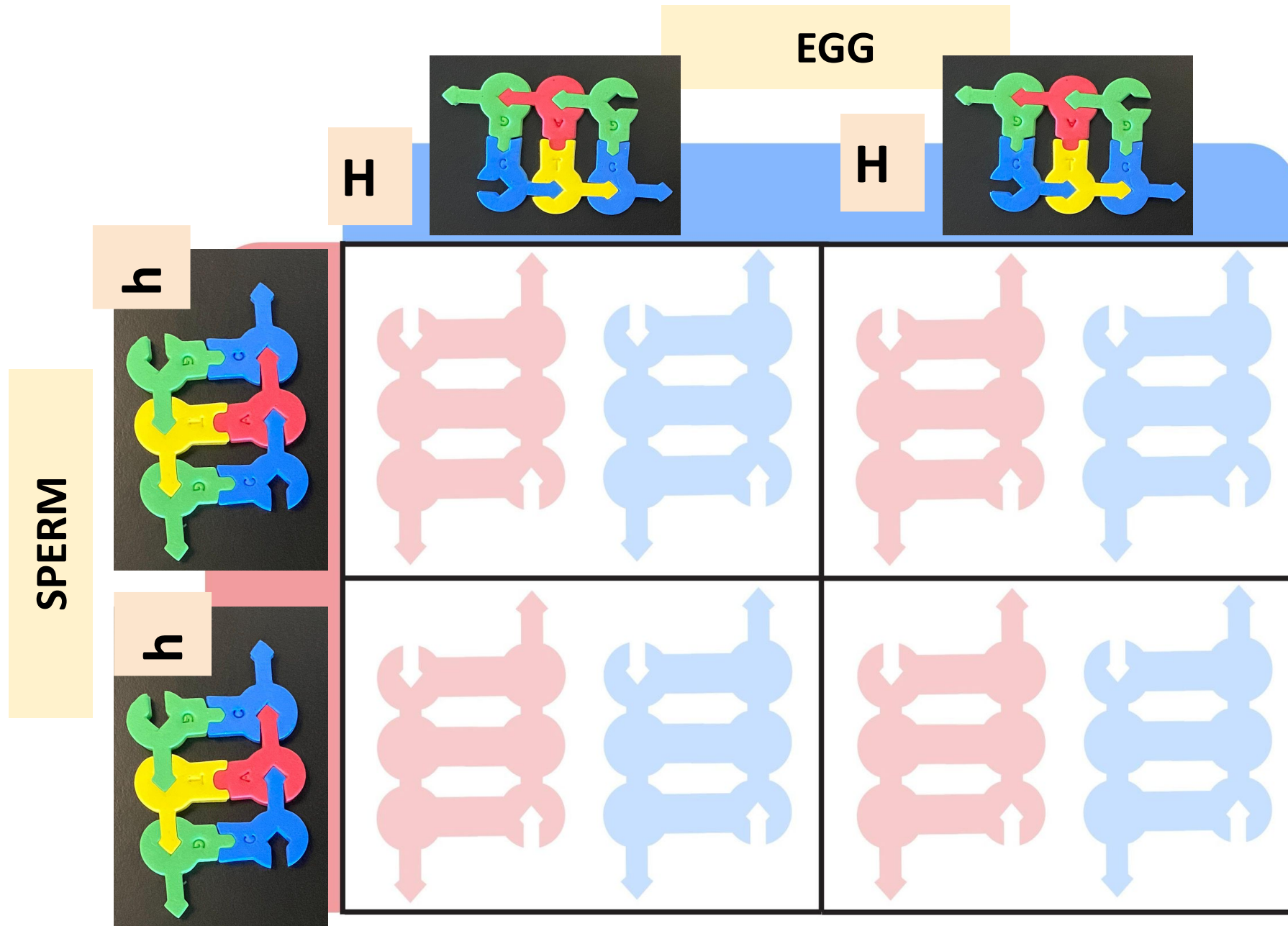
What might the Hemoglobin protein look like?
How does the combination of alleles affect the structure and function?



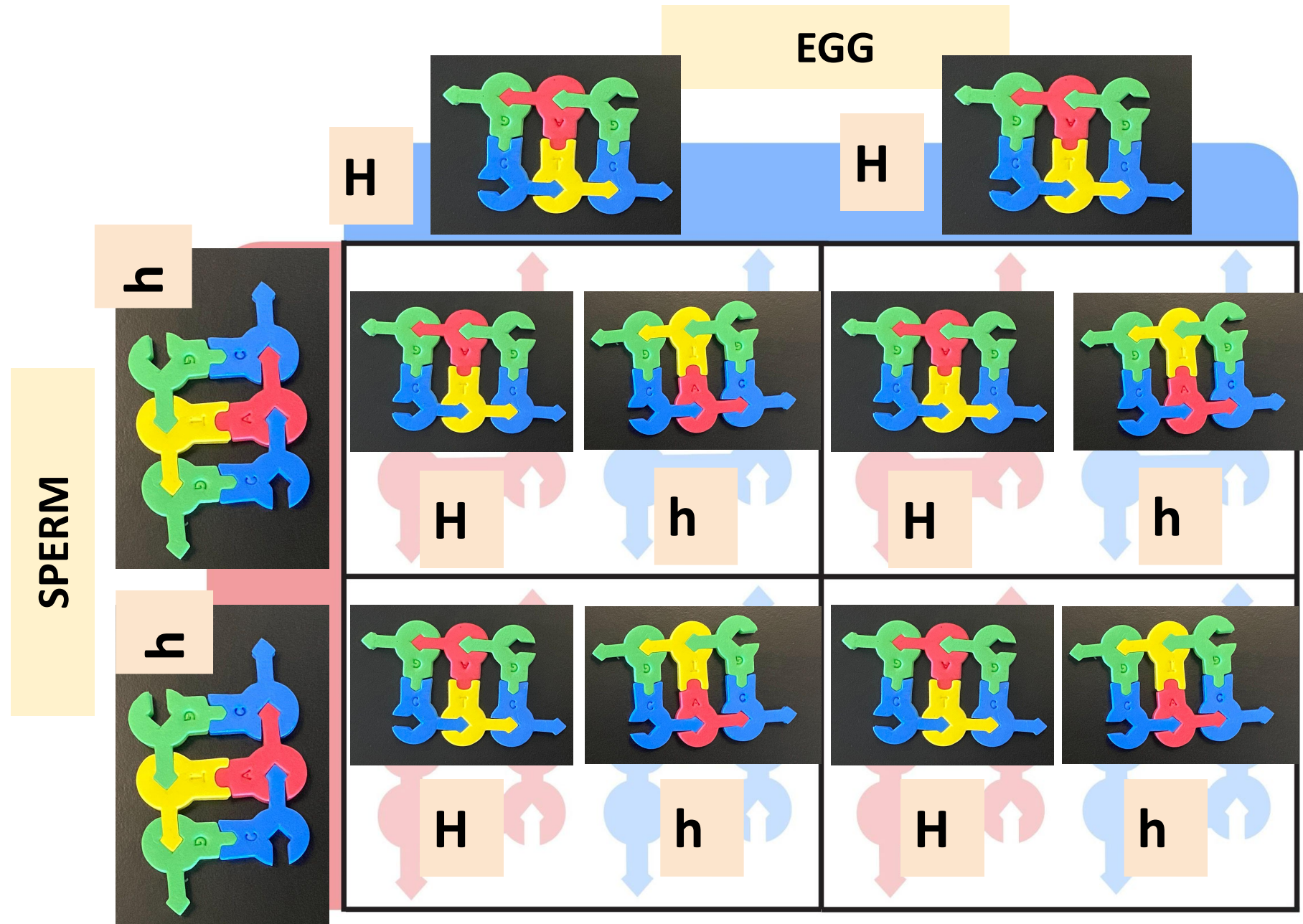
Punnett Square



**You can print and
make copies of this
punnett square
from 3D Molecular
Designs teacher
resource page**



WHAT ARE
THE PARENT
GENOTYPES
IN THIS
EXAMPLE?



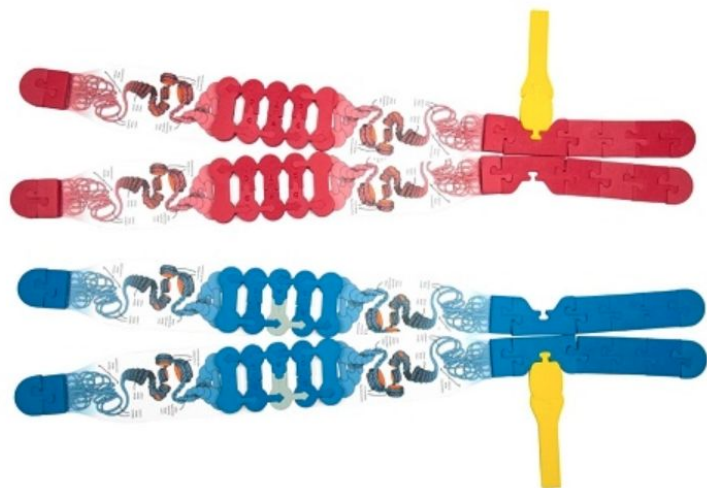
What are the genotypes and phenotypes of the offspring?

I love learning from other Teachers

**What are some other phenomenon or stories
you could use with this Kit?**



Chromosome Connections Kit® Teacher Resources



Help your students make the connection between chromosomes at the microscopic scale and chromosomes at the molecular scale! The Chromosome Connections Kit will enhance your classroom exploration of cell cycle, cell division and genetics.

- Contents and Assembly Instructions
- Disinfecting Kits
- Teacher Guide*
- Molecular Meiosis Activity*
- Punnett Square Brief*
- Punnett Square Student Activity Guide*
- Punnett Square Student Answer Sheet*
- Punnett Square (Print and laminate for repeated use.)
- Gamete Cards (Print, laminate and cut for repeated use.)

**Teacher resources located
under the teacher
resource tab on
3dmoleculardesigns.com**

Link in the chat!

Workshop NGSS Connections

SEPs	CCCs	DCIs
Asking Questions and Defining Problems	Patterns	LS1.A: Structure and Function
Developing and Using Models	Cause and Effect: Mechanism and Explanation	LS1.B: Growth and Development of Organisms
Constructing Explanation and Designing Solutions	Scale, Proportion, and Quantity	LS3.A: Inheritance of Traits
Engaging in Argument from Evidence	Structure and Function	LS3.B: Variation in Traits
Analyzing and Interpreting Data	Stability and Change	

3DMD Augmented Reality Break Slide

03:00

CHROMOSOME WEBINAR

TUESDAY | MARCH 22 6:30 - 8 PM CST

PRESENTER:

TIM HERMAN, PhD

MSOE Center for BioMolecular Modeling &
3D Molecular Designs

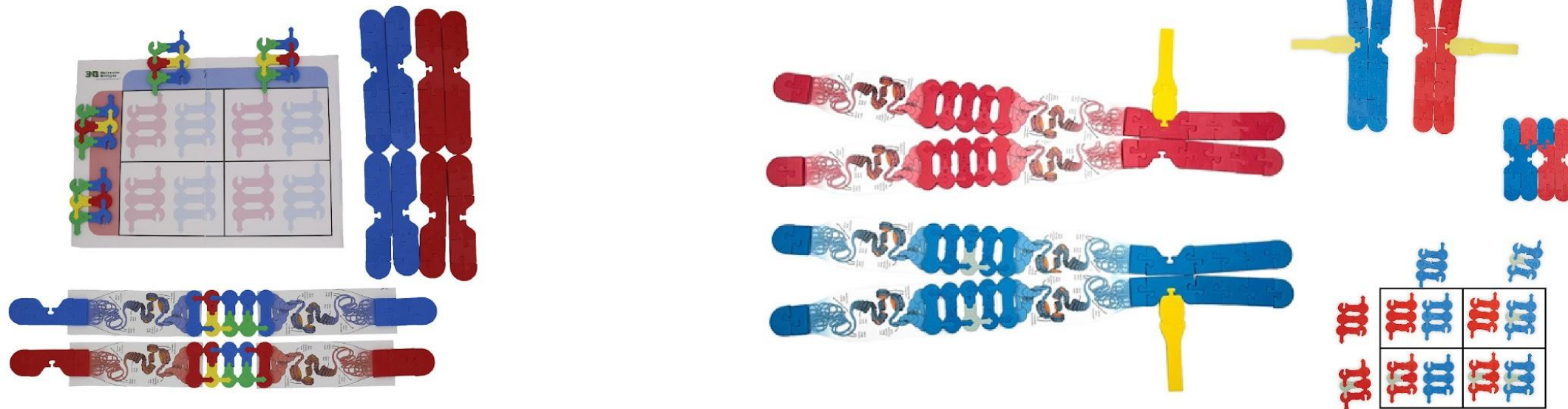
Modeling Methylation in Epigenetics



**MODELING
MARVELS**
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