

# Unraveling Chromosomes through Modeling

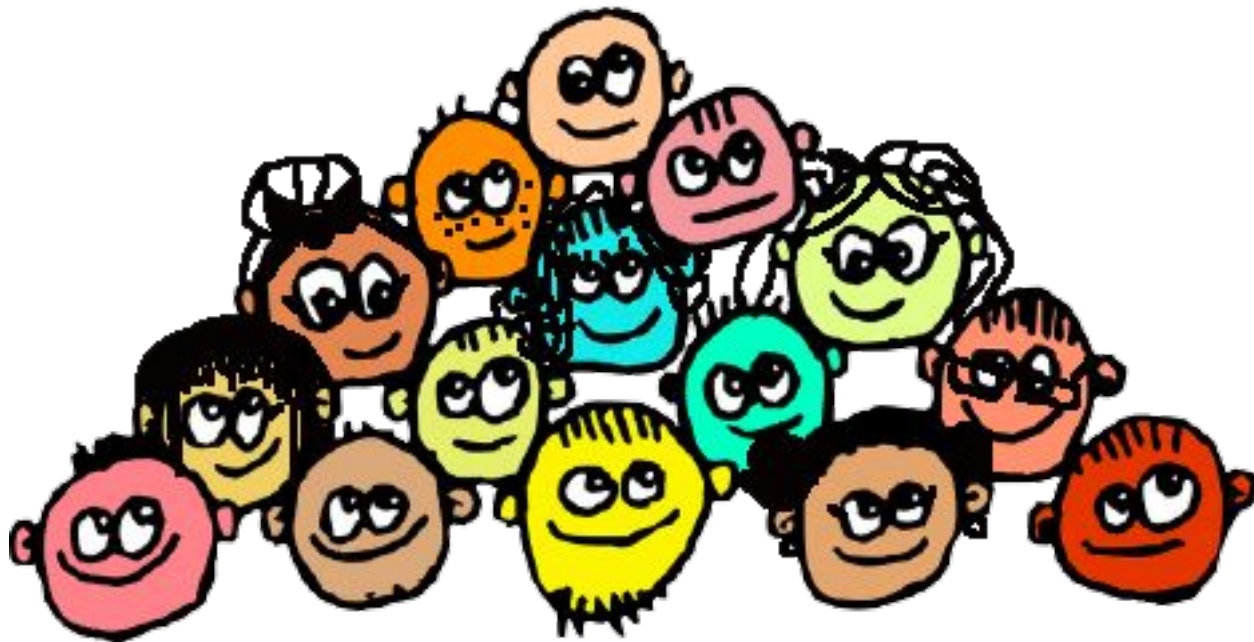
Keri Shingleton, Ph.D.



# Who am I?



# Who are you?





# Teaching with models...

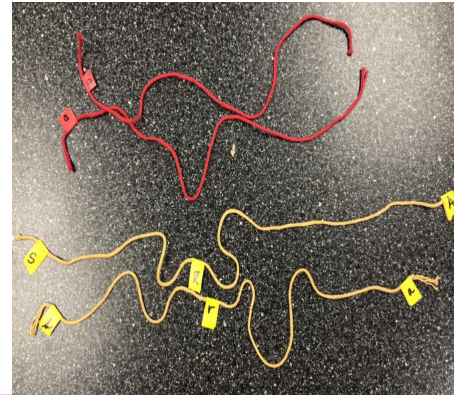
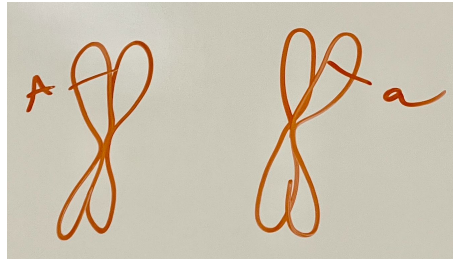
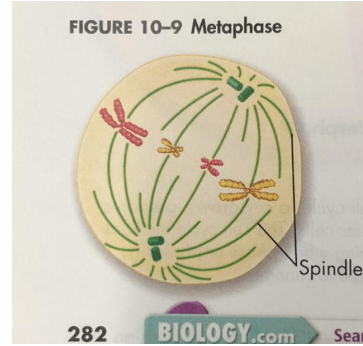
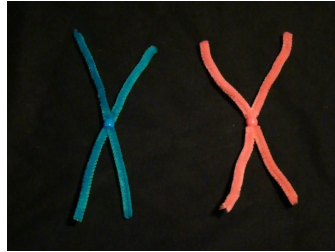


We all teach chromosomes with models of one sort or another...

**What kinds of chromosome models do you use?**



# What chromosome models do you use?



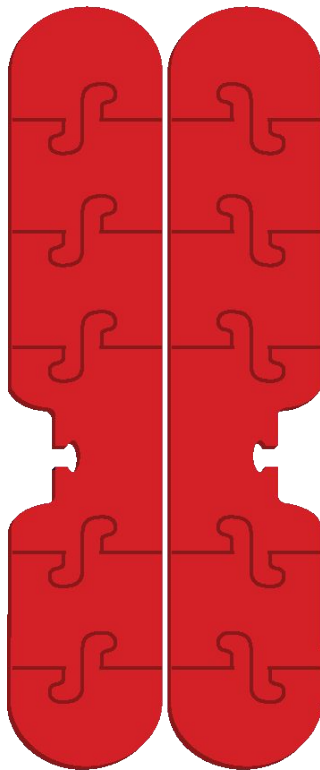


But what IS a chromosome? Build one!



**Chromosome  
Connections Kit<sup>®</sup>**  
*DNA ~ Cell Division ~ Inheritance*

Is this a chromosome?

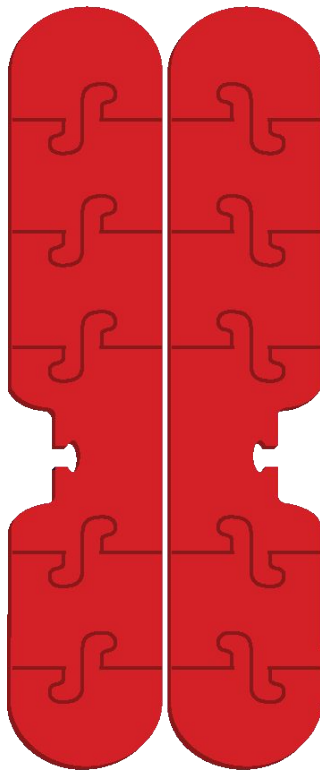


Or this?





Is this a chromosome?



Or this?



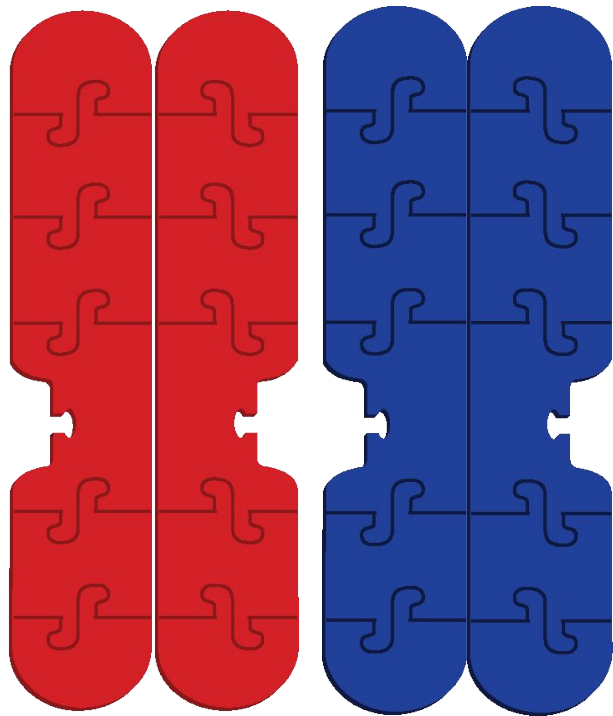
Or both?



Now build a homologous pair!

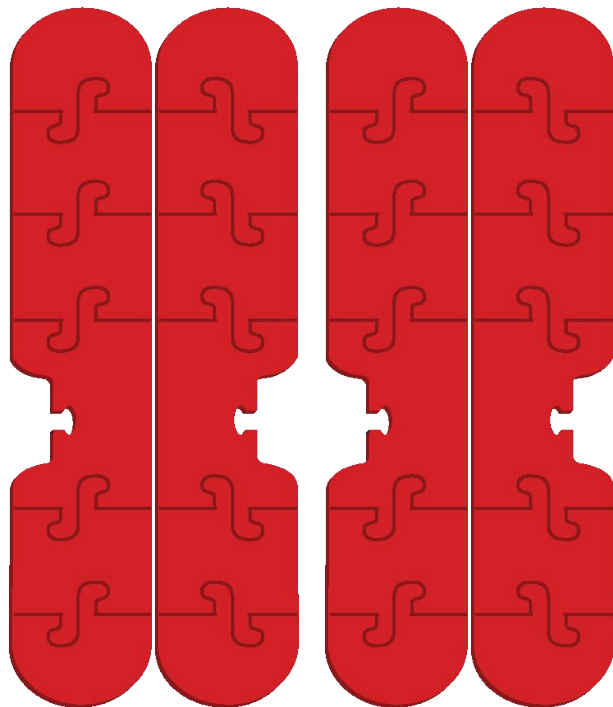


Now build a homologous pair!

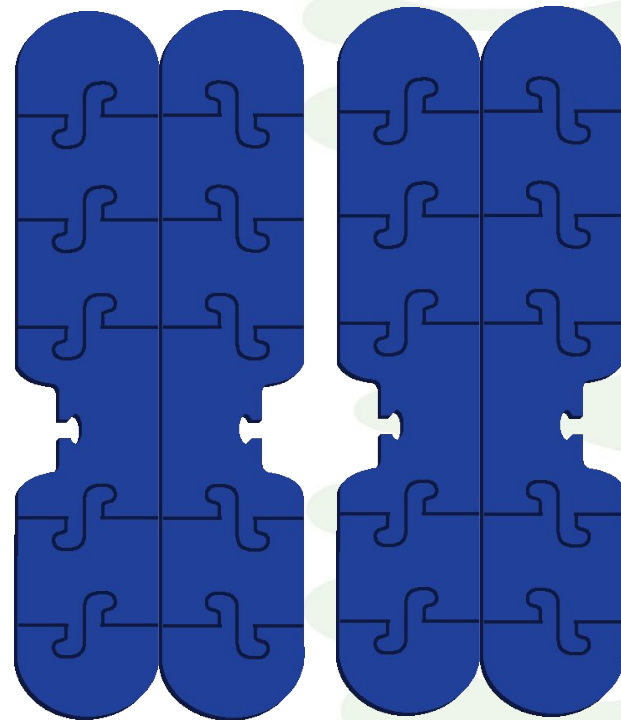




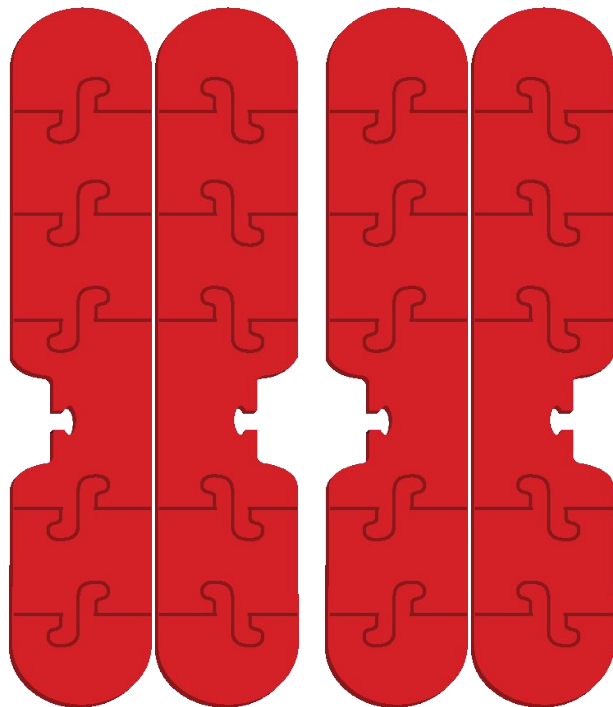
Could these be homologous pairs?



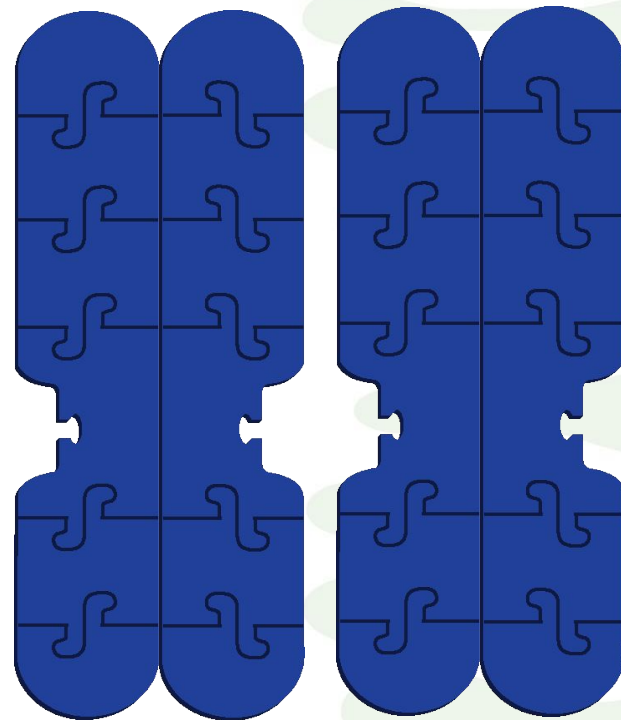
OR



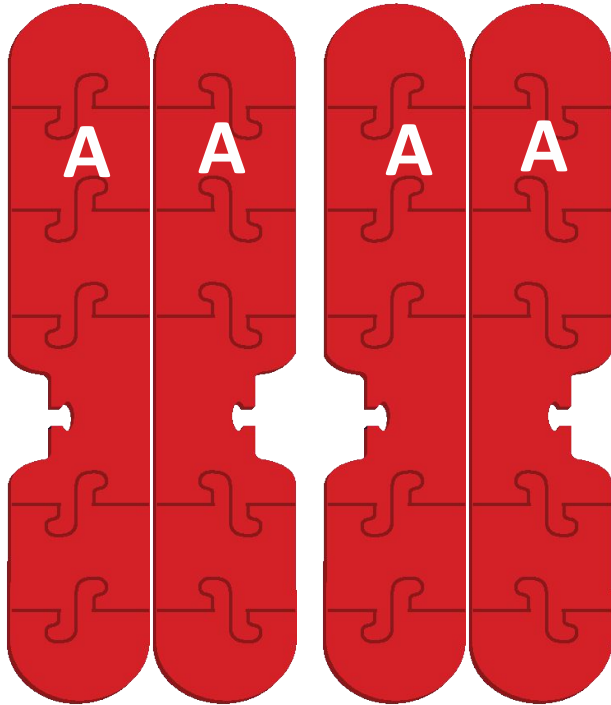
Could these be homologous pairs?  
What more would you need to know?



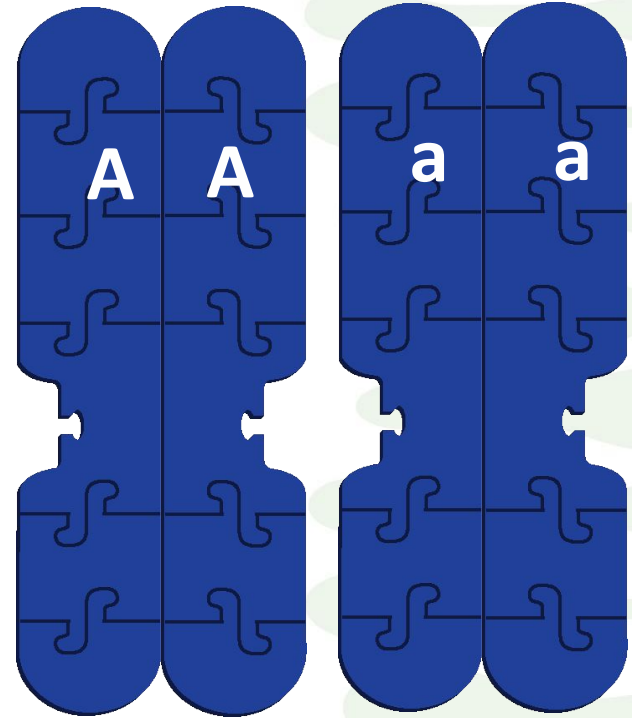
OR



Could these be homologous pairs?



OR

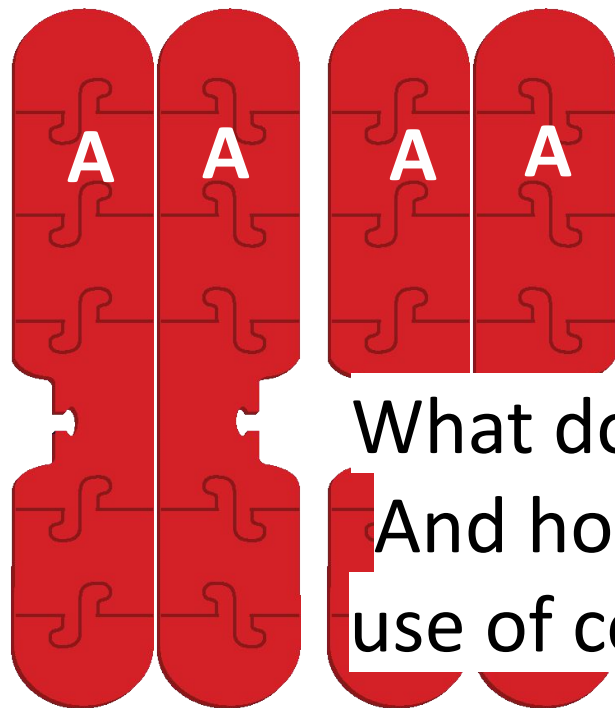




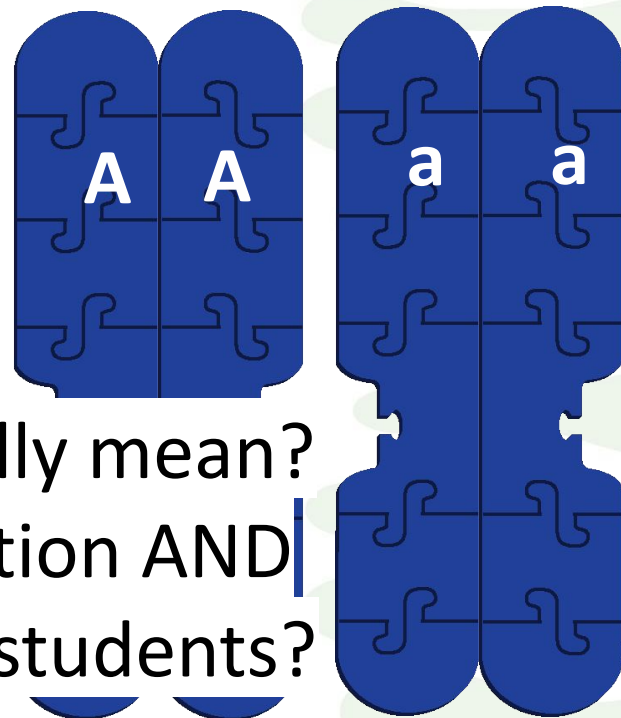
What do our students key into when we model this way?



Could these be homologous pairs?



OR

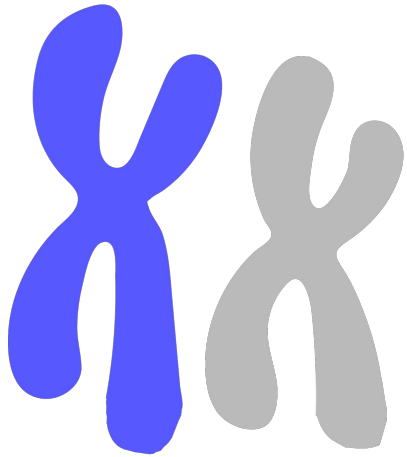


What does “A’ or “a” really mean?  
And how does this notation AND  
use of color confuse or sstudents?

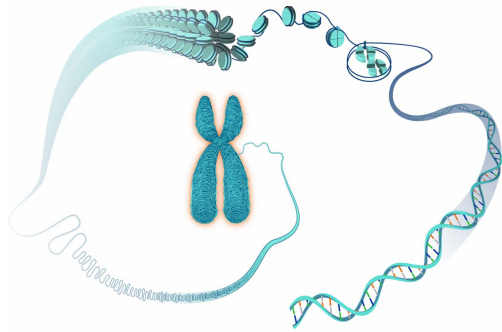




# How does this model inform the definition of a chromosome?



Chromosome: The compact structure into which a cell's DNA is organized, held together by proteins. The genomes of different organisms are arranged into varying numbers of chromosomes, and human cells have 23 pairs.



Chromosomes are threadlike structures made of protein and a single molecule of DNA that serve to carry the genomic information from cell to cell. In plants and animals (including humans), chromosomes reside in the nucleus of cells.



# Chromosomes: one word, several meanings, much confusion!

## Students Fail to Transfer Knowledge of Chromosome Structure to Topics Pertaining to Cell Division

Dina L. Newman,\* Christina M. Catavero, and L. Kate Wright\*

School of Life Sciences, Rochester Institute of Technology, Rochester, NY 14623

Submitted January 10, 2012; Revised June 14, 2012; Accepted July 12, 2012

Monitoring Editor: James Hewlett

Cellular processes that rely on knowledge of molecular behavior are difficult for students to comprehend. For example, thorough understanding of meiosis requires students to integrate several complex concepts related to chromosome structure and function. Using a grounded theory approach, we have unified classroom observations, assessment data, and in-depth interviews under the theory of knowledge transfer to explain student difficulties with concepts related to chromosomal behavior. In this paper, we show that students typically understand basic chromosome structure but do not activate cognitive resources that would allow them to explain macromolecular phenomena (e.g., homologous pairing during meiosis). To improve understanding of topics related to genetic information flow, we suggest that instructors use pedagogies and activities that prime students for making connections between chromosome structure and cellular processes.



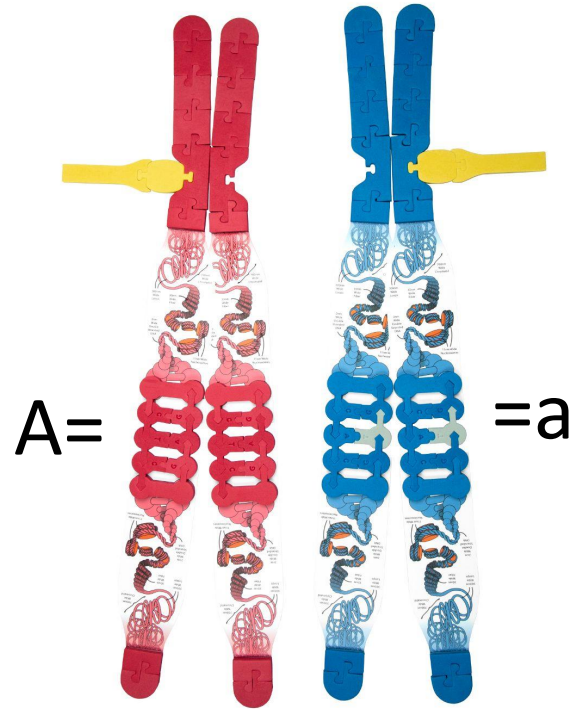
“To improve understanding of topics related to genetic information flow, we suggest that instructors use pedagogies and activities that prime students for making connections between chromosome structure and cellular processes.”



How can we improve this model so students make these connections?

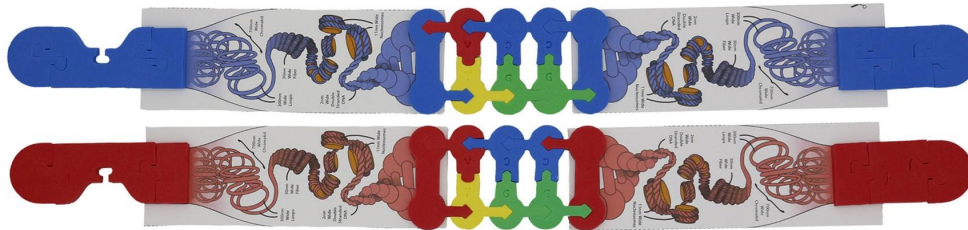
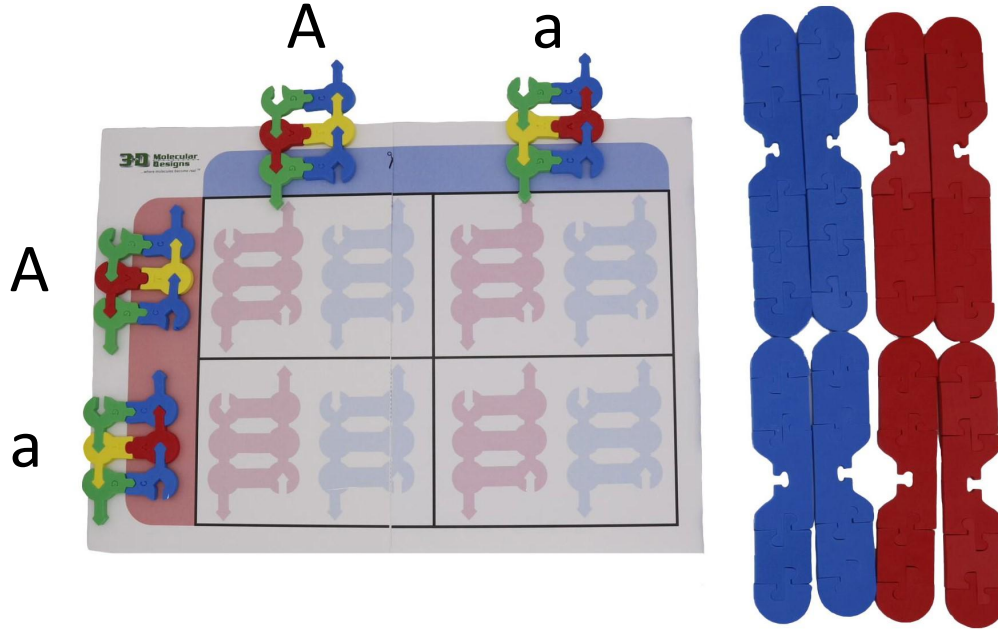


# What can we do with a model like this that we could not do before?

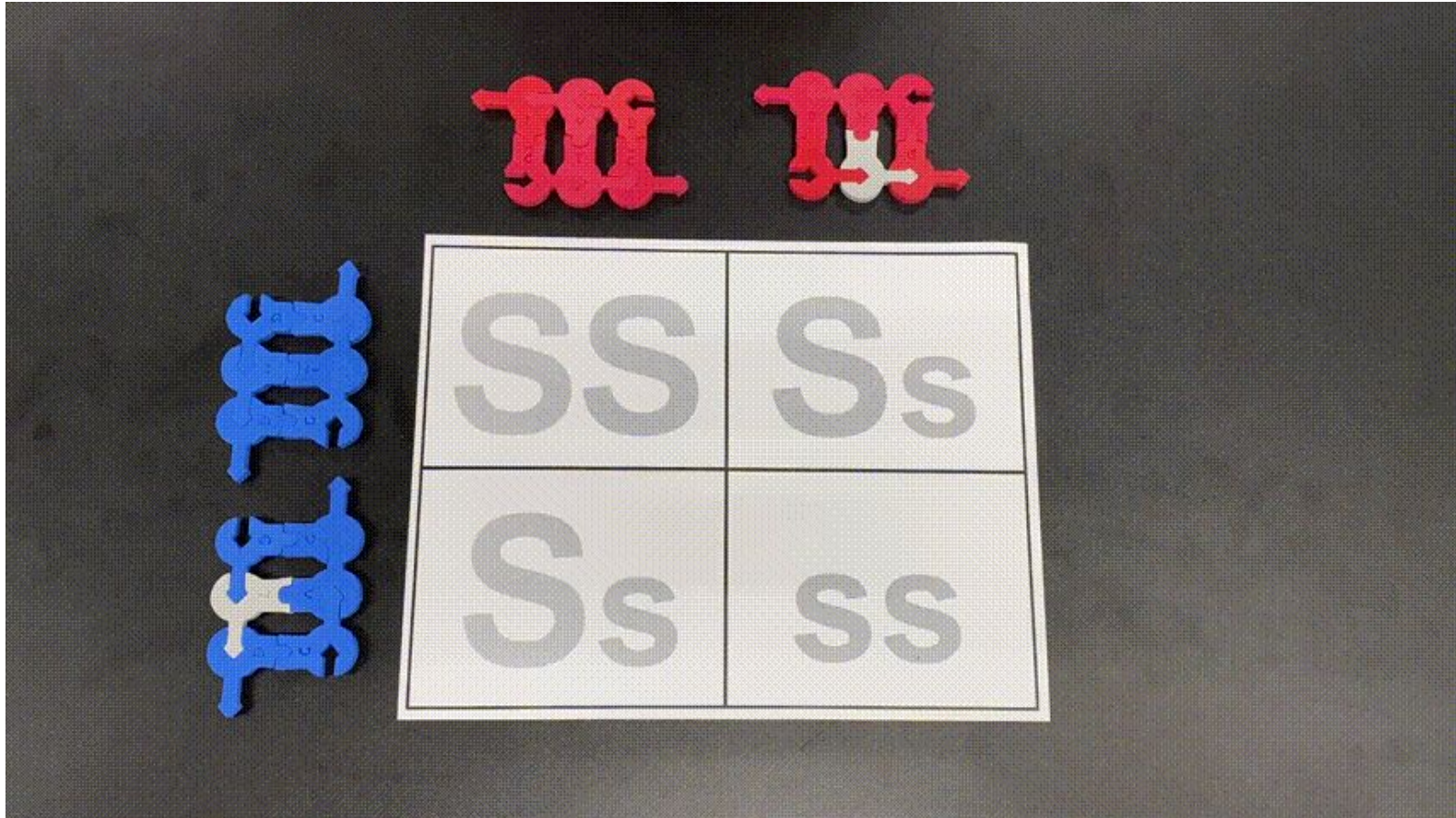




# Punnett Squares!



# GIF of Punnett Square

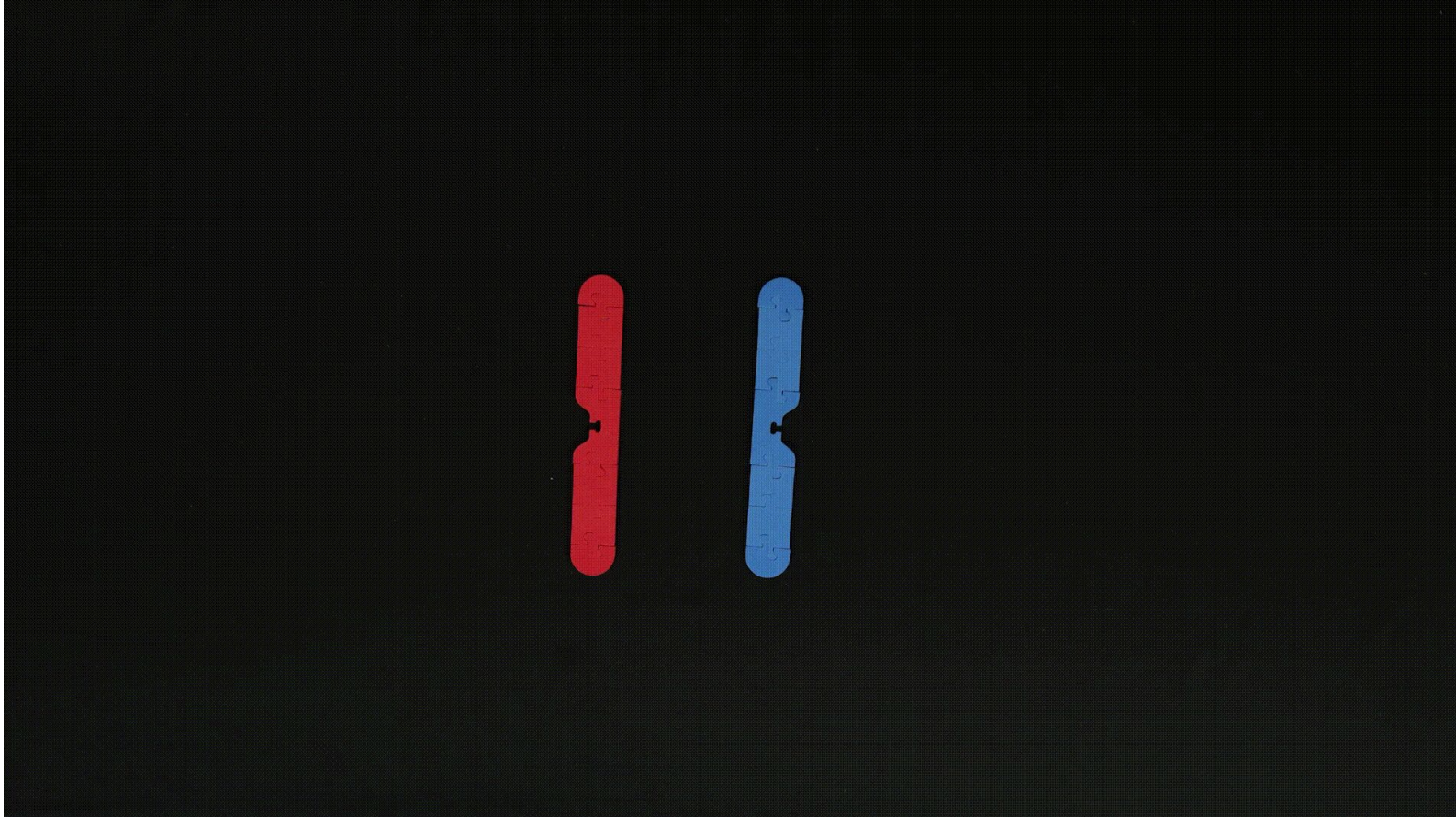




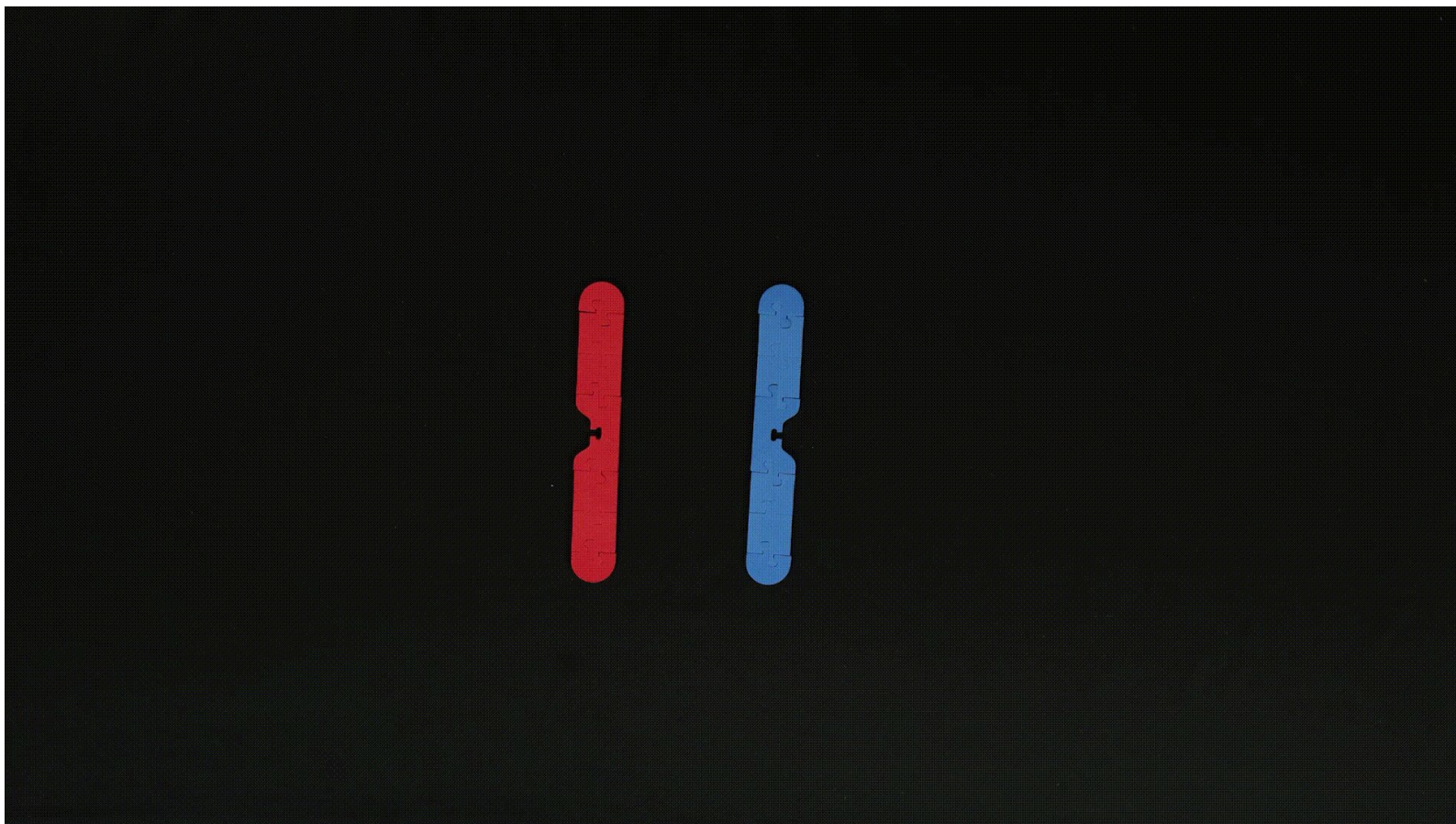
And of course you can still do mitosis and meiosis...  
But what is different in this picture?



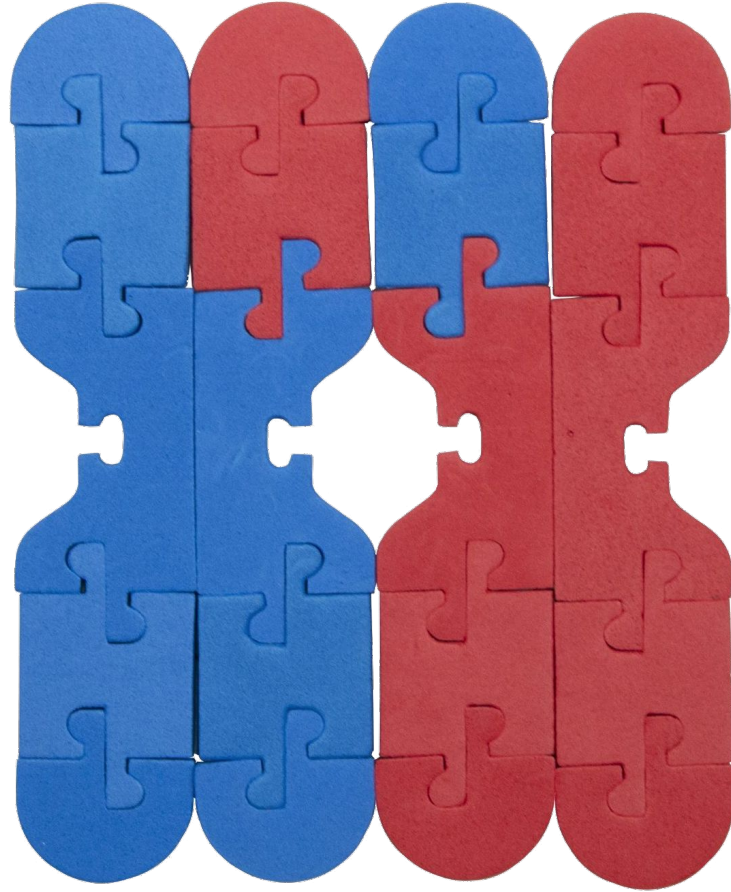
# Gif of Mitosis







Crossing over... **THIS?**

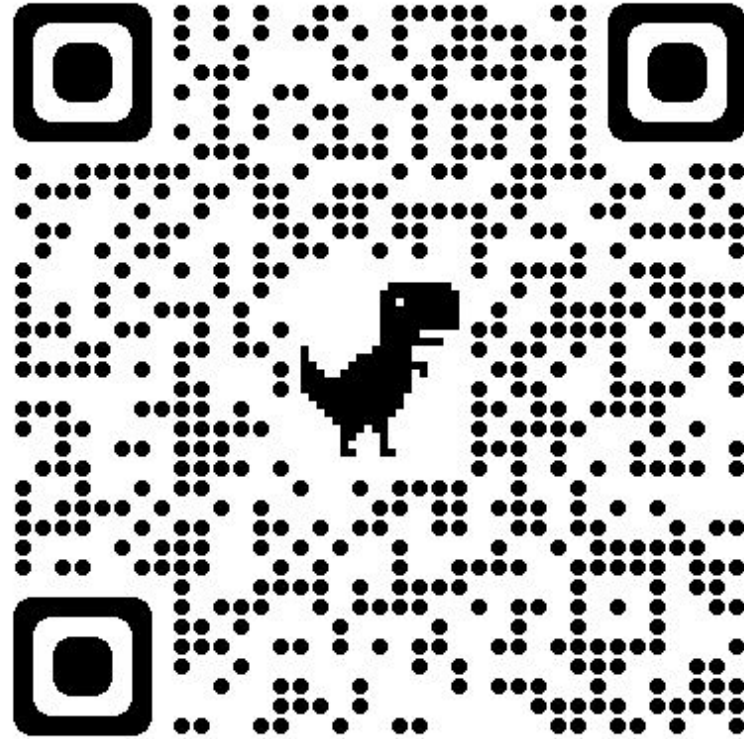




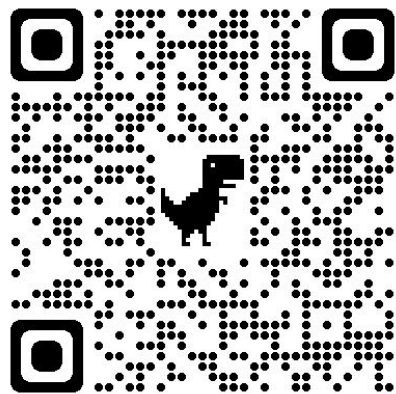
Crossing over... or **THIS?**



# Summer Courses!



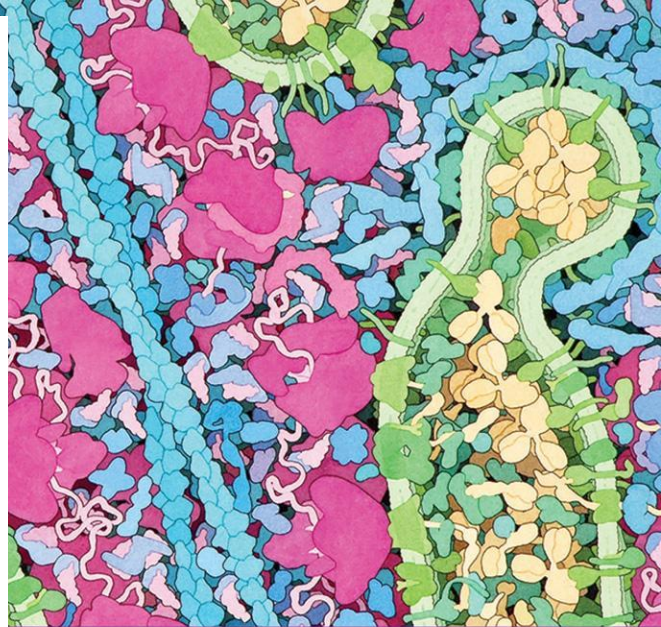
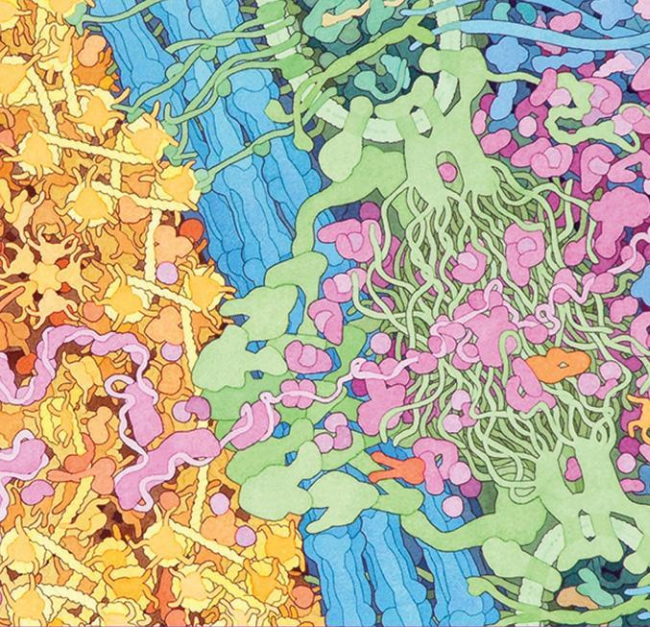




THANK YOU!!  
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Keri Shingleton  
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