Science Assessment System Through Course Task

Sibling Traits

Grade Levels:
9

Phenomena:
Inheritance of Traits

Science & Engineering Practices:
Developing and Using Models
Constructing Explanations and Designing Solutions

Crosscutting Concepts:
Cause and Effect

Designed and revised by Kentucky Department of Education staff
in collaboration with teachers from Kentucky schools and districts.

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Preparing to implement Through Course Tasks in the Classroom

What is a TCT?

- TCTs are 3-dimensional tasks specifically designed to get evidence of student competency in two dimensions, Science and Engineering Processes (SEPs) and Crosscutting Concepts (CCC), untethered from Performance Expectations (PEs)/standards. Tasks are sense-making experiences.
- Tasks are to be used formatively. The goal is for both students and teachers to understand areas of strength and improvement for the SEP(s) and CCC assessed within the task.

How do I facilitate a Through Course Task (TCT)?

- TCT facilitation is a collaborative process in which teacher teams calibrate understanding of the expectations of the task and refine strategies to be used during task facilitation.

Before the task:

1. Complete the TCT as a learner – compare understanding of task through the lens of success criteria (identified in the task) in order to understand expectations. Success criteria include:
    - What is this task designed to get evidence of?
    - What is the task asking the students to do?
    - What might a student response look like?
2. Identify the phenomenon within the task. Consult resources to assure teacher teams have a deep understanding of associated science concepts.
3. Collaborate to generate, review and refine feedback questions during facilitation.
4. Identify potential "trouble spots" and plan for possible misconceptions.

During the task:

5. Collect defensible evidence of each student's competencies in 3-dimensional sense-making for the task.
6. Ask appropriate feedback questions to support student access and engagement with the task in order to elicit accurate evidence of student capacities.

After the task:

7. Reflect on the task as a collaborative team.
8. Review student work samples to identify areas of strength and areas of need.
9. Determine/plan next steps to move 3-D sense making forward through the strengthening of the use of SEPs and CCCs.

Using the materials included in this packet:

- **Task Annotation:** The task annotation is a teacher guide for using the task in the classroom. Additionally, the annotation gives insight into the thinking of developers and the task overall.

    - Each task has science and engineering practices, disciplinary core ideas, and crosscutting concepts designated with both color and text style:
        - **Science and Engineering Practices**
        - *Disciplinary Core Ideas*
        - Crosscutting Concepts
- **Student Task:** The materials to be used by students to complete the TCT.

Sibling Traits Task Annotation

Task Template: After examining models that illustrate *various aspects of the inheritance of traits*, **construct an explanation** for what causes *siblings to each be unique*, **using evidence from the models to support your explanation**.

Phenomenon within the task:

Parents and offspring often show similar characteristics. This similarity can be described by patterns of inheritance, or how these traits are passed from generation to generation. The physical appearance (phenotype) is controlled by the recombination of alleles (genes) during sexual reproduction. There are various ways that are used to explain how this recombination can result in the observed traits.

Students will often use a Punnett square model to show how the inheritance of a trait occurs on a single gene. However, most observable traits (phenotype) are controlled by multiple genes and this is best shown using the Allele model.

How the phenomenon relates to DCI:

HS.LS3.A: Inheritance of Traits

Variations of inherited traits between parent and offspring arise from genetic differences that result from the sub-set of chromosomes (and therefore genes) inherited.

HS.LS3.B: Variation of Traits

In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome, and hence, two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other.

In grade 3, students first learned about the inheritance of traits from parents. In middle school, students learn about the mechanisms for that inheritance. Having a basic understanding of the genetic mechanisms of trait production, students will be equipped at high school, where they will connect the role of DNA replication to trait variations.

What information/data will students use within this task?

Students are provided with an image of a family that includes two parents and four children. Additionally, there is a table listing the genetic traits of each family member. Students will develop their understanding of inheritance, genes and the resulting traits by examining several models illustrating different aspects of genetics and inheritance. Students will use evidence from the models in order to construct an explanation as to why each of the children in this family are unique. Students should have some basic prior knowledge of genetically inherited traits.

Ideas for setting up the task with students:

This task could be used as a learning task to introduce the concepts of genetics and inheritable traits, as all of the concepts needed for understanding are addressed in the models within the task. Students could complete the task individually to begin a unit on genetics, as this task could be a great starting point to build understanding, which could be supported with more detail and direct instruction within the course of the genetics unit. It could also be used as more of a formative assessment to assess student understanding of the key concepts addressed within the models of the task. The task was designed to stand alone with any pertinent information and vocabulary addressed within the models themselves, but it may be helpful to provide students the opportunity to work together in analyzing each of the models to build a common understanding of the concepts they illustrate. The models build from one another, so it is important that students understand each model before moving on to the next one.

Intent of the Task for Assessment;

This task was designed to determine if students can analyze and interpret models to construct an explanation regarding how we inherit our traits from our parents. This task requires students to synthesize information presented in several models to construct an explanation about inheritance and how genes cause specific traits. The crosscutting concept of cause and effect is central throughout the task as students develop their explanation of how the genes we inherit from our parents determine our traits, or are what causes organisms to have the traits they do. The models presented provide information that builds on one another to illustrate the process of inheritance. The focus of the task is constructing an explanation of this process using evidence from each of the models to clearly communicate the causal mechanisms. Thus, evidence of a student's ability to use various model forms in order to make sense of a complex process and then construct the explanation for the process is the central goal of this task.

List components of the task / resources used with the task:
Sibling Traits Student Task.

Success Criteria:

Evidence of Learning Desired based on Progression from Appendices

Developing and Using Models

- Develop and/or use a model to predict and/or describe phenomena.

Constructing Explanations and Designing Solutions

- Construct an explanation using models or representations.

Cause and Effect

- Cause and effect relationships may be used to predict phenomenon in a natural or designed system.

Success Criteria

Explanation includes concepts illustrated in each of the models presented. Evidence from the models are used to support the explanation.

Explanations include components that show cause and effect relationships, i.e., the inheritance of specific genes determines our traits.

Possible Student Response

Every person has 23 pairs of chromosomes, one set that came from their mother and one from their father. Through the process of meiosis, sex cells (egg and sperm) are created with a unique combination of genes from each parent. Those sex cells will then combine to form a baby with a new, unique combination of genes from his/her parents. Genes will determine the trait that is expressed, but because some alleles are dominant and some are recessive, it is possible for a child to express a different form of the trait than the parents if two recessive forms of that gene are inherited. We can use Punnett squares to make predictions about the genes that may be inherited and the resulting trait that is expressed, but that is only looking at one trait at a time. Meiosis creates unique sex cells every time a new egg or sperm is created, and there are countless combinations of genes that will determine the traits of the baby, therefore each child will have a unique set of traits. That's why no two people are alike, even siblings!

Other information teacher teams might find useful when preparing to use this task in the TCT process:
Most students have not encountered chromosomal inheritance for humans before 8th grade. Since they have only had limited exposure to genetics in previous years, this task builds a more thorough explanation of the inheritance of traits and can be a jumping off point to go into further detail on this complex process.

Extensions and/or other uses after the task is implemented.
If this TCT is used as an introduction to genetics, use the website **http://learn.genetics.utah.edu/content/basics/oldtour/** for students to learn how alleles line up on chromosomes. Using the interactive activities can clear up any misconceptions. This site can also be used to during the unit to teach genetic inheritance, before giving the TCT.

Through Course Task – Sibling Traits

Name _____ *Period* _____

We've all heard of genes before, and understand the basic idea that our genetic makeup determines our traits. We also know that we inherit our genes from our parents. So, why are siblings of the same biological parents each unique?

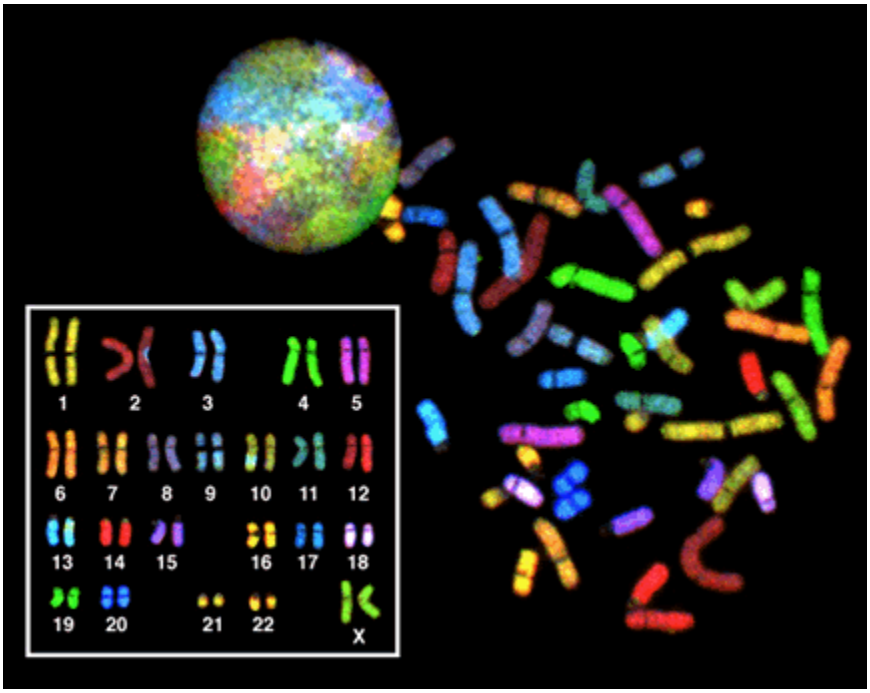
Understanding inheritance and genetics can be very complicated. We can use models to track the genes you inherit from each parent and try to understand and even predict inheritable traits. Take this family, for example.

The family in the picture consists of four children, who are genetic offspring of the two parents on the left and right in the photo. The visible traits of each family member is listed in the table below. You'll notice that each of the children have different traits even though they have the same parents. Even when the parents have the same trait in common (thumb), it's possible to have a child with a different form of the trait. So, how does this happen?

Family Member	**Hair Color**	**Eye Color**	**Earlobes**	**Thumbs**
Dad	Dark Brown	Brown	Attached	Straight
Mom	Blonde	Blue	Detached	Straight
Child #1	Dark Brown	Brown	Detached	Straight
Child #2	Light Brown	Blue	Detached	Hitchhiker's
Child #3	Light Brown	Brown	Attached	Straight
Child #4	Blonde	Brown	Detached	Straight

While the photo and table on the previous page shows visible inheritable traits, models can be used to illustrate how traits are inherited and why they may vary from child to child. In this task, you will use the models provided to develop an explanation of how and why the four children in the family above are all unique. You must include evidence from each model to support your explanation.

Model #1:

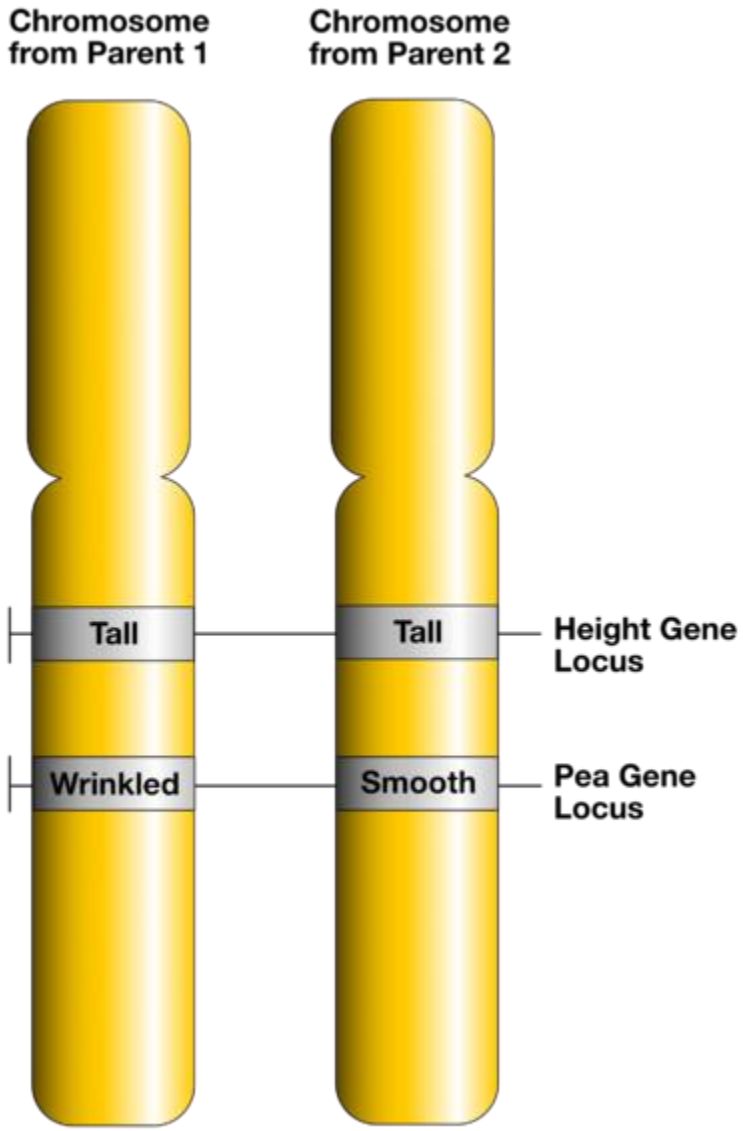


This is a **karyotype**, a picture of a person's chromosomes. There are 23 pairs of chromosomes. The first 22 chromosomes are called autosomal chromosomes, and contain genes that code for our traits. The last pair of chromosomes are called sex chromosomes, since they determine the gender - XX for female and XY for male.

Image Courtesy: National Human Genome Research Institute

Model #2:

This is a model of a single pair of homologous chromosomes from a pea plant. **Homologous chromosomes** are a pair of like chromosomes, one inherited from mom and one from dad that contain the same genes.

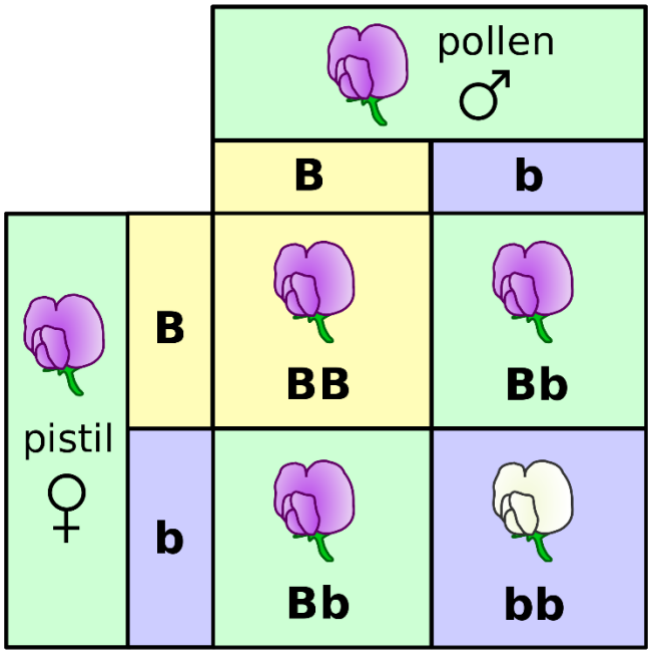


There are two genes shown on these **homologous chromosomes** - height and pea. The **locus** is the location that particular gene is found on the chromosome. An **allele** is a form of a gene. In this example, the homologous pair has the same allele for height (tall) on each chromosome, but different alleles (wrinkled vs smooth) for the pea gene.

"Schematic of Two genes" by Keith Chan is licensed under Creative Commons Attribution-Share Alike 4.0 International license

Model #3: Punnett Square

Punnett Squares are a classic genetics model that can be used to study the inheritance of a specific trait (gene). It allows scientists to make predictions on the possible combinations of alleles for a given gene (known as the **genotype**) given the genetic makeup of the parents, and predict the physical trait itself (known as the **phenotype**) based on the basic genetic principle of dominance.



This is a Punnett Square that models the inheritance of flower color in pea plants. The B allele is **dominant** for purple color, while the b allele is **recessive** for white color.

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TASK

The study of genetics is based on the fundamental cause and effect relationship between genes and traits. We inherit our genes from our parents, which then ***causes*** us to have particular traits. Use the models provided that illustrate different aspects of inheritable traits, and develop an explanation for what causes siblings with the same biological parents are each unique.

You must use evidence from each model to support your explanation.