PCS edventures!™

Experts in Hands-On STEM Education

BrickLAB Genetics

Grades 6-8

CURRICULUM SAMPLE

Brick LAB

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(800) 429-3110

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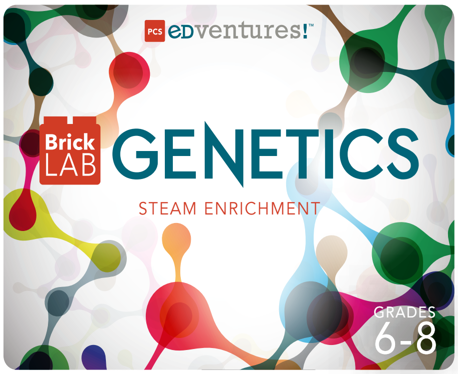


STUDENTS	TIME
Up to 30	12, one-hour lessons

SUBJECTS

- Life Science

SETTINGS

- Summer camps
- Before & After-school programs
- Classrooms

In each **scaffolded**, reusable lesson, learners explore human **inheritance** and trait variations. **Hands-on** activities with built-in assessments bring genes and DNA mutations to life.

◔ very few consumables

TECH REQUIREMENTS / PREREQUISITES

- None

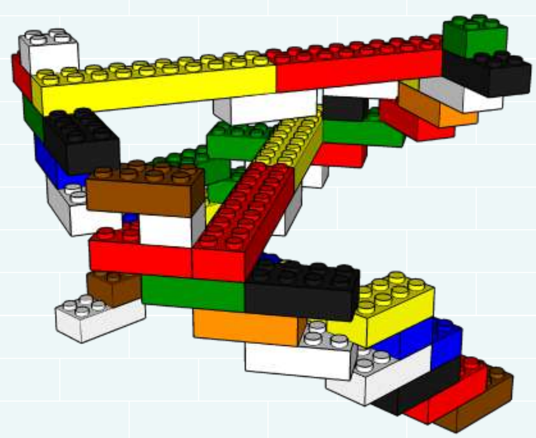
PRICING OPTIONS

- Complete Program: $975^{00}
- Curriculum Print & Digital: $395^{00}

COMPLETE POGRAM

PRINT MATERIALS

SAMPLE BUILD



Scan OR Click QR Code for:

PRODUCT ORIENTATION | FULL MATERIALS LIST | STANDARDS & ALIGNMENT

CONTACT US:

Call: **(800) 429-3110**

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Rev: 11/27/23

DAYS

8-9

Mutation

STEAM CONNECTIONS

Science: Inheritance and Variation of Traits

DURATION

2 x 60 Minutes

MATERIALS

- **BrickLAB**
- **Muslin bag full of bricks** (1 per pair)
- **Dry erase markers** (1 per pair)
- **Page pockets** (1 per pair) **holding:**
  - **Trait Coding Project** (Day 8)
  - **Brick Trait Cipher** (Days 8-9)
  - **Gene Sequence Construction Challenge** (Day 9)

SCHEDULE

- Introduction to the Universal Genetic Code (10 min)
- Creature Build (15 min)
- Trait Coding Project (35 min)

- Gene Sequence Construction Challenge (50 min)
- Wrap Up (10 min)

OBJECTIVE

Students reverse engineer segments of DNA, discovering the phenomenon of genetic mutation.

ALIGNED STANDARDS

NGSS MS-LS3-1

Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.

21ST CENTURY SKILLS

- Creativity and Innovation
- Critical Thinking and Problem Solving

HABITS OF MIND

- Responding with Wonderment and Awe
- Applying Past Knowledge to New Situations

KEY TERMS

Alleles: Different forms of the same gene (for example, the brown allele and the blue alleles are different forms of the same eye color gene). For each gene, we inherit one allele from our mother and one allele from our father.

Base: Any of the four chemicals that make up DNA: adenine, cytosine, guanine and thymine. The hydrogen bonds of these base pairs are what hold together the double helix structure of DNA.

Mutation: a change to one part of a DNA code. Sometimes a mutation changes the instructions a gene gives to its cell and results in a new or different trait.

BACKGROUND INFORMATION

All living things use the same genetic coding system using the same four bases. A pine tree and a dog? Same genetic coding system. A human and a beetle? Yep. If we all have the same coding system, then this is pretty powerful evidence that says all living things have shared ancestry. Humans like to think we're higher life forms than say, a strain of bacteria or a tiny fern. You'd think that with our bigger, more complex bodies we'd have a lot more genes, but weirdly enough lots of plants and even amphibians have more genes than we do. Not only do we have fewer genes, but we've also hung onto some genes from our primitive ancestors from a very long time ago. Even today, people share a lot of genes with other animals - 44% with honey bees, 69% with platypus, and 88% with mice.

DNA is like a little computer, and it does a darn good job. But the thing is, it's not perfect. And those small imperfections, or mutations, are what cause genetic variation within species. It's part of what makes us unique from one another. Mutations can occur when DNA is copied incorrectly or is affected by environmental factors like radiation. These can be a good thing or a bad thing. Have hypertrichosis, aka "werewolf syndrome," a rare condition causing hair to grow all over your face? That's a mutation. Have red hair or blue eyes? You're a mutant too.

OVERVIEW

This module has a variety of challenges, each of which folds in more and more concepts. Your group of learners may get through one or more in a day. If the next challenge expects that you carry over builds from previous days, certain re-construction may be necessary. Keeping a written record can help them accomplish this, if needed.

Learners will be extending the coding system they used in the last activity. The major differences are:

- We're encouraging them to experience the fact that all living things have the same coding system by using a different animal for the traits.
- Heredity concepts are being folded in, generating offspring for the two faces by applying the dominant/recessive Punnett Square concepts from before.
- They are including the intermediate step of the brick genes from the Brick Baby activity — last time these two bricks were attached to their model babies' bellies.

DAILY PREP

- Construct a 4-gene strand of DNA and an animal model associated with that DNA "molecule". In case the learners make no errors replicating their DNA, you can use your model to force a mutation to occur.
- Prep the Trait Coding Project, Brick Trait Cipher and Gene Sequence Construction Challenge handouts in page pockets (1 per pair).

BRICK MANAGEMENT

- **Recommended Learner Build Groups:** Groups of 4
- **Additional Considerations:** Learners will need to keep their animal builds small to save bricks at the beginning of the lesson. To account for consecutive builds, learners will need to disassemble all their builds at the end of the session.

STEP-BY-STEP DIRECTIONS FOR INSTRUCTORS

Whole Group Discussion

INTRO

Share a fact that may be surprising to students: the DNA inside of each of their cells is made of the same parts as the DNA inside of monkeys, dogs, bananas--all living things.

- What does it mean that plants, animals and people all use the same DNA coding system?

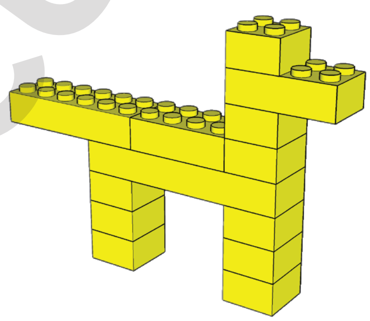
Spend some time talking in groups, and then choose groups to share their thoughts. Encourage discussion and debate. *If it comes up, you may even point out that many of the same codes have been found in different organisms, coding for the same things!*

Individual

CREATURE BUILD

Explain that because DNA is a universal genetic code, the first challenge for today is for each person to build an animal model out of bricks. These animals will be used for the gene construction challenge later on.

- Each animal model should have at least 4 traits that could be modified.



We suggest a fox as an option (hair color, tail length, leg height, tail color could all be modified), but feel free to leave room for some creativity (without using up too much time doing so). Students will need to keep their builds small to save bricks.

Small Groups

TRAIT CODING PROJECT

This is a reverse engineering project from the one that closed the previous sequence.

- Form teams of 4.
- Pick one of the team's animal models to create a code for.
- Create two "parent" models of the chosen animal with four particular traits represented, making sure that the two "parents'" traits differ somewhat from one another.
- Decide which traits are dominant and which are recessive and assign a brick to represent each gene.
- Fill in the Brick Trait Cipher showing the brick associated with each gene.
- Give each animal parent a brick genotype (like the pairs of bricks attached to the bellies of the Brick Babies).
- Build an animal "offspring", using some features from each parent.
- Compare families with a partner group.

Note: *This is a good breaking point. Be sure to have students make a written copy of their Brick Trait Ciphers to use for the Gene Sequence Construction Challenge.*

DAY 9

Small Groups

GENE SEQUENCE CONSTRUCTION CHALLENGE

Note: *Unless your time frames for the earlier activities ran long or short, plan to start here on Day 9.*

Groups now use their animals to challenge one another to construct a DNA strand from a cipher and an animal model. Each team needs to:

- Adding to the cipher from the Brick Trait Cipher from the Trait Coding Project, assign a 3-base sequence code for each trait.
- Reconstruct a model of their animal.
- Exchange animals and ciphers with another group.

- Examine the new animal's traits and use the other group's cipher to reconstruct its DNA.
- Trade back DNA sequences, animals, and ciphers and check each other's work, announcing any errors as mutations.

The most enjoyable part of this activity is if a mutation occurs (i.e. someone makes a mistake). (If everyone does a perfect job replicating their DNA, then be sure to announce "MUTATION!" to get the conversation going.) Regardless of whether the mutation is yours or on a student model, explain that errors in replicating the complicated DNA molecule cause mutations. Ask for ideas from the class about what this mutation should result in for the animal.

Explain to them (you may make it up as you go) where the error occurred and what trait it was associated with. Point out the two "normal" traits that were options originally. Modify the model to include a characteristic that wasn't an option before. For example, if you had black and brown eye options, perhaps the new animal has white eyes!

This is likely to lead to some confusion about the origin of multiple variations, since up to this point we have been using a super-simplified heredity model, with one pair of alleles for one trait. That's fine, though. Use it as an enticing introduction to the complexities of multi-gene phenotypes, redundancies, etc.

Whole Group Discussion

WRAP UP

Finally, once everyone is done and extra bricks are returned, debrief the class.

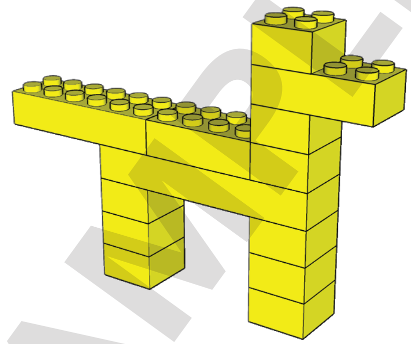
- What was most difficult or surprising?
- Are mutations good or bad?

DAYS

8

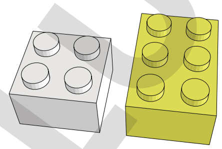
MUTATION

Trait Coding Project



1. Each team member constructs an animal. Each model should include at least 4 traits that you could modify if you wanted to. We suggest a fox as an option, but feel free to use an alternative animal.
2. Decide as a team which animal to code for and create two "parent" models of the chosen animal.
   - Make sure that the parents have the same four changeable traits. For example, you might change eye color, fur color, leg length, tail length, etc.
   - Make the traits of each parent at least slightly different.
3. Decide which trait options are dominant and which are recessive for each trait.
   - Assign a single brick to each gene, one for dominant and one for recessive (just like the brown brick and the blue brick used for eye color with the brick babies).
   - Use larger bricks for dominant traits and smaller bricks for recessive traits.

Recessive white hair



Dominant yellow hair

4. Fill in the Brick Trait Cipher to show which bricks are associated with each trait. Label each gene as dominant or recessive.
5. Create pairs of brick "genes" for all of the different traits (not DNA strands, but the pairs of bricks like you used on the bellies of the eye color models) and set them in front of each animal parent.
6. Create a third "offspring" animal, using some features from each parent.
   - You may want to use Punnett Squares to determine all the possible traits for the offspring.
7. Pair up with another team.
8. Compare your "family" with that of your partner team.
   - Help them identify any problems with their coding system, so that they're ready for the complicated challenges that follow. Use Punnett Squares to help settle any debates.

DAYS

9

MUTATION

Gene Sequence Construction Challenge

1. Expanding on the Brick Trait Cipher from the Trait Coding Project, assign a 3-base sequence code for each trait. The brick base color choices are:

   2x4 lime

   2x4 pink

   2x2 purple

   2x2 teal

- Indicate whether the red side or the yellow side is used for the code.

2. Reconstruct a model of your animal. Be sure that the models include the traits listed in the cipher.
3. Exchange your animal, along with your cipher page, with another group.
4. Examine the traits of the other group's animal. Then, use their cipher to reconstruct the animal's DNA.

- Work together by having each team member build sections of DNA for a certain trait.

5. Connect the sections together and build the opposite side of your DNA molecule to complete the strand.
6. Trade the completed DNA sequences, ciphers and animals back with your partner group and check their work. If you find errors, CONGRATULATIONS! You just discovered a mutation!

- If this happens, let everyone know. Say "**MUTATION**," just like you won a Bingo game.

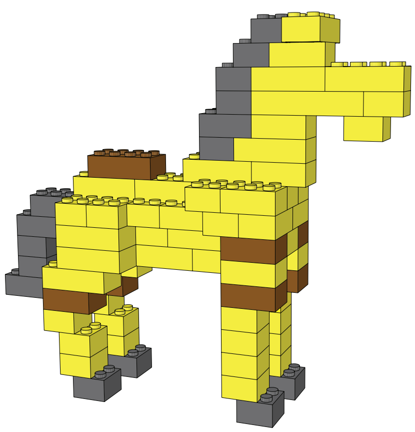
DAYS 8-9

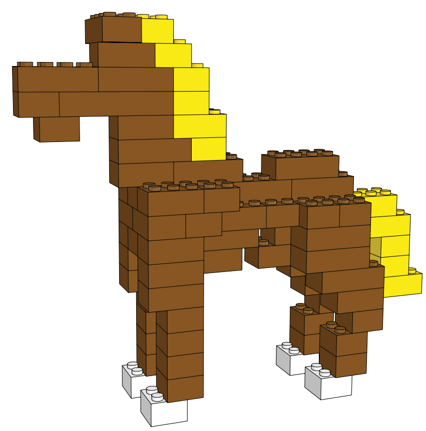
MUTATION

Brick Trait Cipher

Trait	Single Brick "Gene" (Dominant or Recessive)	DNA Sequence (Brick Arrangement)

Need a Custom Solution?





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