Modeling in Biology

CAST
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Professional Learning Facilitator

The Charles A. Dana Center

What we do and how we do it
The Dana Center collaborates with others locally and nationally to strengthen education systems so that they foster opportunity—particularly in mathematics and science—for all students.

We are dedicated to ensuring every student leaves school prepared for success in postsecondary education and the contemporary workplace—and for active participation in our modern democracy.

We carry out our work by advocating for high academic standards and by building the capacity of education systems to ensure that all students can master the content described in the standards. We help translate research into practice and adapt promising innovations to meet local needs.
Modeling in Biology

A quote to consider…

“All models are wrong, but some are useful.”

~ Box & Draper, 1987

How does this quote relate to your understanding of modeling in science?

“Scientists use models … to represent their current understanding of a system (or parts of a system) under study, to aid in the development of questions and explanations, and to communicate ideas to others.”

Why is modeling important?

Nature of science. Science, as defined by the National Academy of Sciences, is the "use of evidence to construct testable explanations and predictions of natural phenomena, as well as the knowledge generated through this process." This vast body of changing and increasing knowledge is described by physical, mathematical, and conceptual models. Students should know that some questions are outside the realm of science because they deal with phenomena that are not scientifically testable.

Science, systems, and models. A system is a collection of cycles, structures, and processes that interact. All systems have basic properties that can be described in space, time, energy, and matter. Change and constancy occur in systems as patterns and can be observed, measured, and modeled. These patterns help to make predictions that can be scientifically tested. Students should analyze a system in terms of its components and how these components relate to each other, to the whole, and to the external environment.

Types of models used in science...

<table>
<thead>
<tr>
<th>Types of Models</th>
<th>Physical</th>
<th>Conceptual</th>
<th>Mathematical</th>
</tr>
</thead>
<tbody>
<tr>
<td>A copy of an object or system that (in its original form) may be too large, too small, too fast, or too slow to study</td>
<td>Explicit representations of objects, systems, or processes that correspond in some way to real-world phenomena</td>
<td>An abstract representation of a system, process, or phenomenon using the language of mathematics</td>
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<tr>
<td>Works or behaves like the object or system it represents</td>
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</tbody>
</table>


**Modeling in Biology**

**Physical models**

Results after exposure to SUNLIGHT for 48 hours

**Conceptual models**

<table>
<thead>
<tr>
<th>Normal Hemoglobin</th>
<th>Mutated Hemoglobin</th>
</tr>
</thead>
<tbody>
<tr>
<td>3' TAC ... GGA ... CTT ... ATT 5' (DNA)</td>
<td></td>
</tr>
<tr>
<td>5' AUG ... CCU ... GAA ... UAA 3' (mRNA)</td>
<td></td>
</tr>
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Mathematical models

- Examine your assigned pedigree.
- Use mathematical or conceptual modeling to determine the type of inheritance represented.
- Discuss and come to consensus as a group.
- Be prepared to share your thinking with the whole group.

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Genetic Disorder A

Cystic Fibrosis
Autosomal, Recessive

Genetic Disorder B

Hemophilia
X-linked, Recessive
Genetic Disorder C

Huntington’s disease
Autosomal, Dominant

Genetic Disorder D

Hypophosphatemia
X-linked, Dominant
**Modeling in Biology**

**Modeling heredity**

Biology TEKS

(6) Science concepts. The student knows the mechanisms of genetics, including the role of nucleic acids and the principles of Mendelian Genetics. The student is expected to:

(F) predict possible outcomes of various genetic combinations such as monohybrid crosses, dihybrid crosses and non-Mendelian inheritance;

(G) recognize the significance of meiosis to sexual reproduction and support it with evidence from the activity.
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Contact Information

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For information on the Dana Center’s professional development opportunities and resources, see
www.utdanacenter.org/pd

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