Objective:
The objective is to have students to create models for the hybridization of carbon's orbitals.

Target student audience:
Honors or Advanced Placement

ChemSense User Level:
Intermediate or Advanced

ChemSense Tools used:
Drawing, Animation, Feedback-Peer

Specialized Tools needed:
Models of hybridized orbitals

Classroom Implementation

Time: Including pre-laboratory discussion and computer work is 1.5 hours.
Student Grouping: Students are paired-up on the computers.
Activity Type:

Chemistry Concepts in Activity:
California State Standards in Chemistry 10.0 The student understands bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes, and chemical properties and provide the biochemical bases for life.
ChemSense Molecular Geometry/Shape Molecular structure involves more than connectivity, molecules also have shape. Sometimes, changes in shape influence greatly the understanding of the chemical process.

Prerequisite Chemistry Concepts:
The students must be versed in electron configuration and the requirements for an atoms to bond: available electrons and available orbitals.

Inquiry Skills (linked to NSES):

ACTIVITY Summary:
The lesson begins with a review of valence configuration and molecular geometry. The lesson moves on to hybridization and textbook pictures of hybridized orbitals. Next the students view models of hybridized bonding made out of plastic Easter eggs. This activity requires students to animate the hybridization of carbon's orbitals from the standard $2s^2p^2$ valence to the hybridized $2sp^3$ valence. The hybridized valence allows carbon to form 4 equal bonding orbitals and tetrahedral geometry.

Sources:
none

Application:
Changes in biological systems are an example of the importance of understanding molecular shape.

ACTIVITY:

HYBRIDIZATION CHEMSENSE EXPERIMENT

Purpose:

To create an animation sequence that shows the hybridization carbon undergoes to form sp^3 orbitals.

Goal:

The student will be able to visualize the hybridization process.

California State Standard:

10.0 The student understands bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes, and chemical properties and provide the biochemical basis for life.

Pre-laboratory Questions:

1. What is the valence of carbon? How many valence electrons does it have? How many bonds will it make to complete its valence?
2. Draw an "s" orbital.
3. Draw a set of "p" orbitals on the same 3-D axis. Draw in carbon's valence electrons.
4. On a new set of axes, draw the sp^3-hybridized orbitals. Draw in carbon's hybridized valence.
5. Sketch out 4 intermediate steps between the original orbitals and the hybridized set.

Procedure:

1. Use pre-lab questions 1-5 as a guide to a 20-40-frame animation sequence depicting the hybridization of carbon to an sp3 configuration. Include text as a description in your animation.
2. Send at least one message to a classmate regarding the content of their animation sequence.
3. Show your work to the instructor.
4. Save your work to your account folder.

Rubric for scoring:

Rubric Score	Level of Competence	Expectation Level
4	Mastery	Animation has smooth transitions between frames. Orbital shapes are accurate. Text accurately describes the animation process. Message sent is specific to the recipient work.
3	Skilled	Animation may not be smooth and orbital shapes may have minor errors. Text accurately describes the animation process. Message sent may be off topic.
2	Proficient	Animation is not smooth, but orbital shapes are accurate. Text accurately describes the animation process. Message sent may be off topic or inaccurate.

1	Introductory	Animation may not be smooth. Orbital shapes are not accurate. Text may contain errors relating to hybridization. Message sent may be off topic, inaccurate, or missing.
0	Incomplete	Animation may have smooth transitions between frames, but the orbital shapes are wrong and/or inaccurate. Text is incomplete. Message sent is off topic or missing.