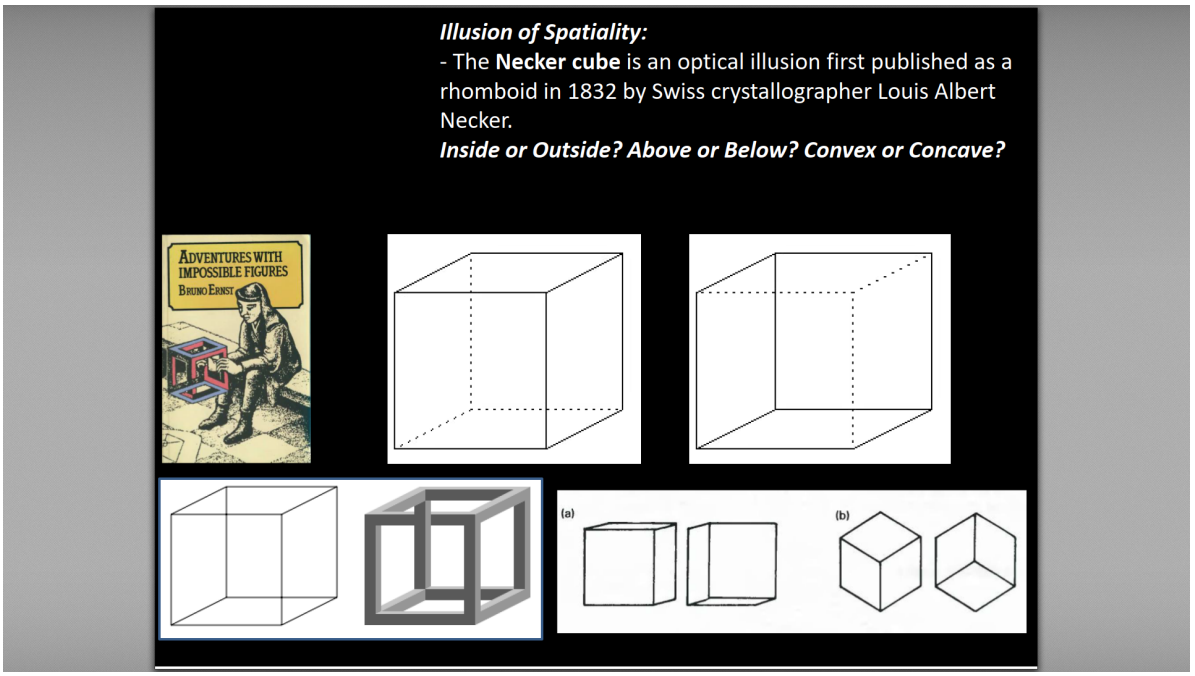
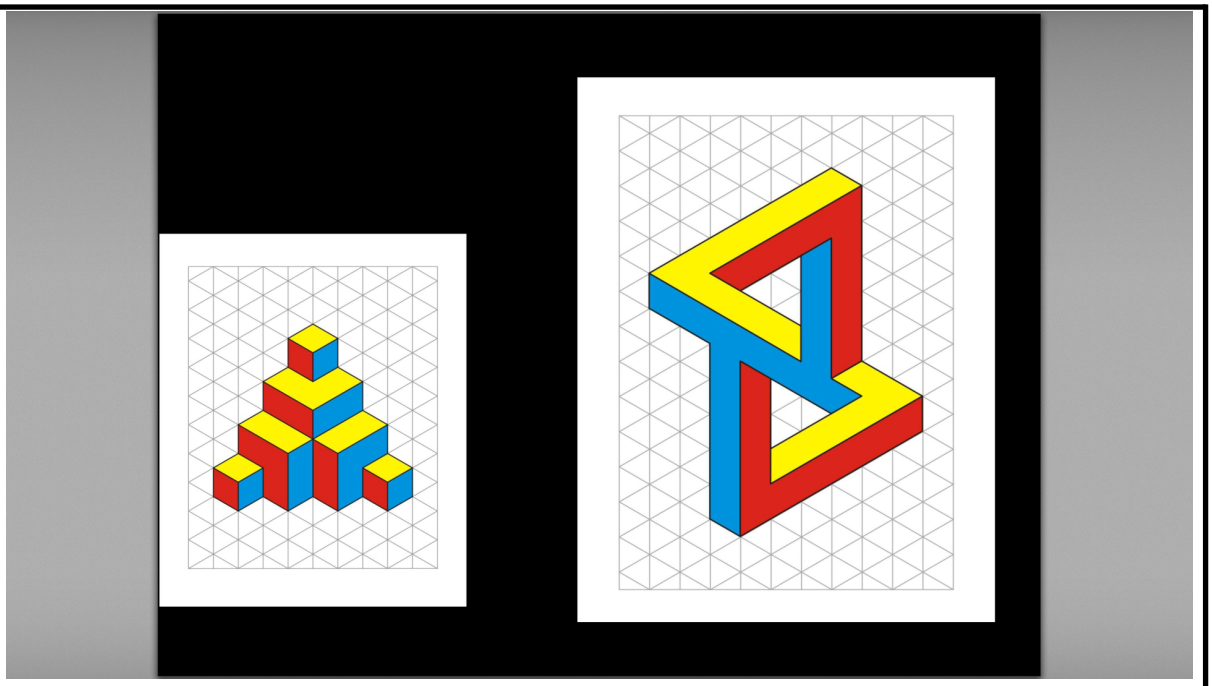
**Grade / Age: 12-16 years old**
**Topic: A Multidimensional Exploration of Art and Mathematics**
**Subject area:Mathematics, Arts, Cognitive Science**
**Keywords:Visual Illusions, Impossible Figures, Geometry, Spatial Reasoning, Artistic Creativity, Cognitive Science**
**Single/ team work:Team work (Groups of 3-4 students)**
**Language:English**
**Duration:8 hours**

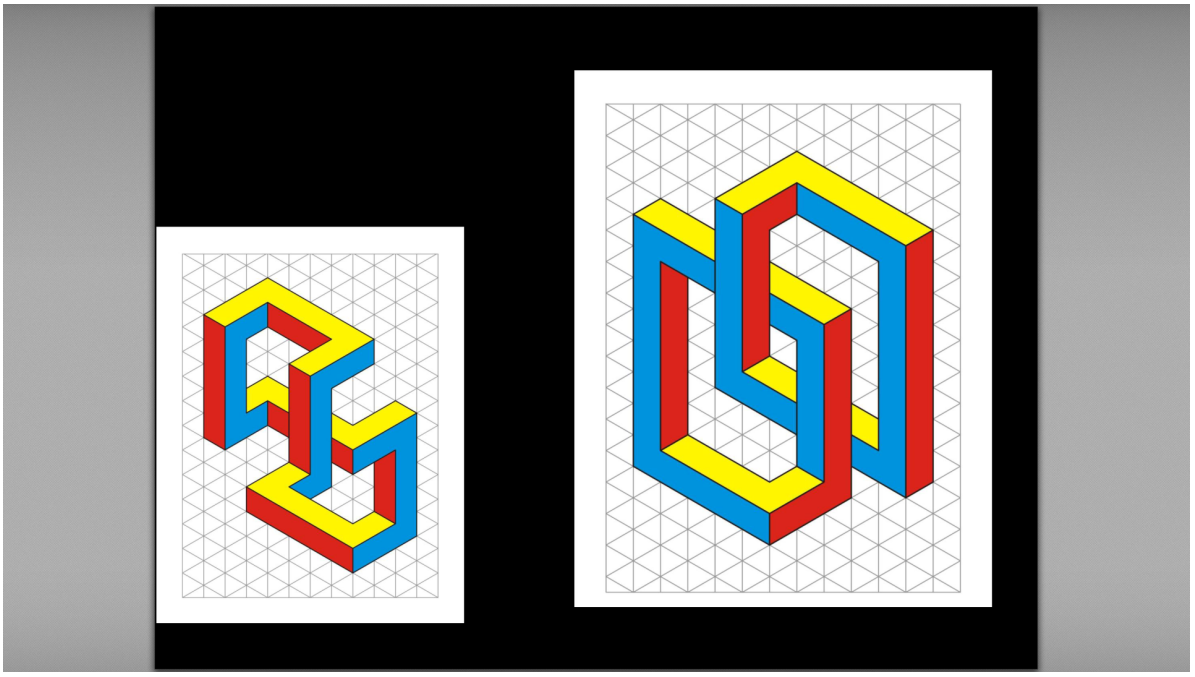
**Description of the Task:** Students will work in teams to create a visual illusion or impossible figure that integrates mathematical concepts. They will start by exploring the mathematical principles behind visual illusions and impossible figures, and then transition into an artistic challenge where they will bring their designs to life.



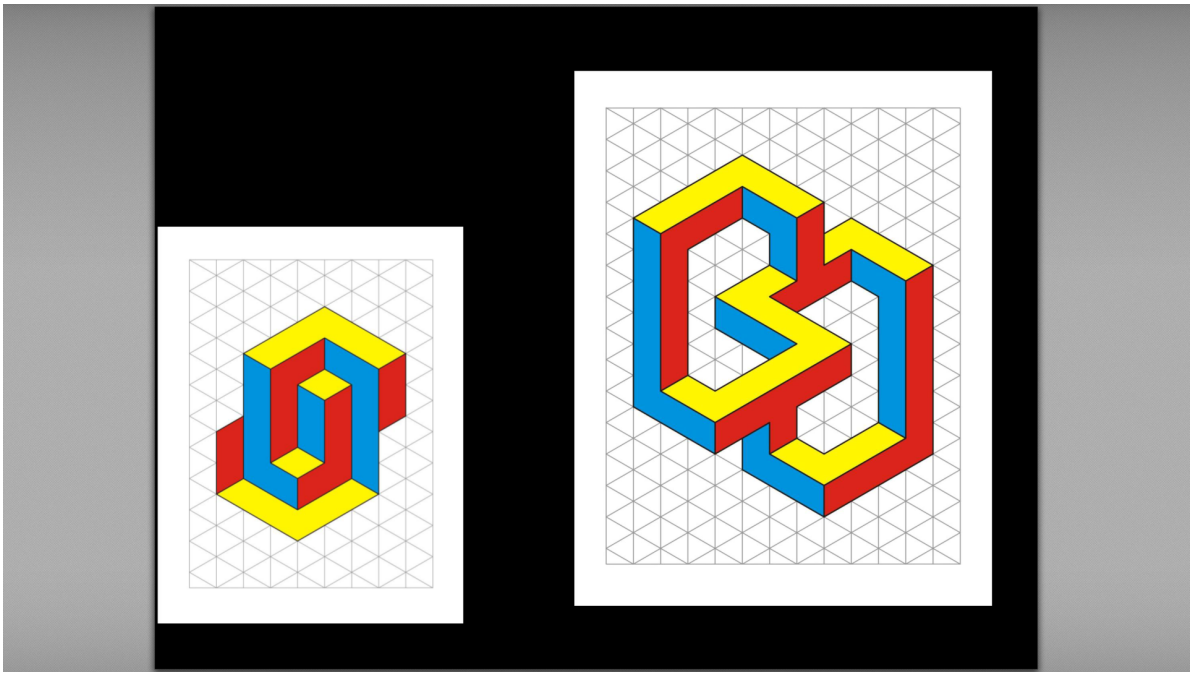

- Objective: To engage students in a comprehensive STEAM initiative that challenges their understanding of geometry and spatial reasoning while fostering artistic creativity. The project aims to cultivate critical thinking by requiring students to reconcile mathematical impossibilities with artistic representation, thereby enhancing their understanding of both disciplines.



- Methodology: The project employs a multi-step, problem-based learning approach. It starts with a theoretical framework where students explore the mathematical principles behind impossible figures, such as isometric and axonometric projections, geometric transformations, and perceptual inversion. This is followed by hands-on artistic tasks where students create their own impossible figures, either digitally or on paper, applying the mathematical principles they've learned. The project culminates in a peer-reviewed presentation, where students must defend the mathematical and artistic choices they made in their designs.



- Tools Used: In addition to traditional art supplies and mathematical tools, the project incorporates advanced technology such as graphic design software for digital rendering and geometric modeling tools for mathematical validation. This allows students to test the limits of what is mathematically possible before translating it into art.



- Learning Outcomes: Beyond the acquisition of specific skills in geometry and art, students are expected to develop a nuanced understanding of how mathematical principles can both enable and constrain artistic expression. They will also gain experience in defending their creative and intellectual choices, thereby honing their argumentation skills.

- Impact on STEAM Education: This project serves as a pedagogical model for how complex mathematical concepts can be made accessible and engaging through art. It challenges the traditional boundaries between disciplines, encouraging students to think more holistically about problems. The project thus contributes to a more integrated and interdisciplinary approach to STEAM education, preparing students for the multifaceted challenges they will face in their future academic and professional endeavors.

This lesson plan aims to offer a comprehensive, hands-on approach to understanding the intersection of mathematics and arts, while also touching upon cognitive sciences. It fosters creativity, critical thinking, and problem-solving skills, making it a well-rounded STEAM activity.

Day 1:
Step 1: Introduction to visual illusions and impossible figures (1 hour)
Step 2: Exploration of mathematical principles (1 hour)
Step 3: Brainstorming and sketching initial designs (1 hour)

Step 4: Planning (1 hour)

Day 2:
Step 5: Constructing the model (2 hours)
Step 6: Evaluating and refining the model (1 hour)
Step 7: Presentation and discussion (1 hour)

**Solutions of the Task:**
A successfully created visual illusion or impossible figure that integrates mathematical concepts.
A presentation explaining the mathematical and artistic principles involved.

**Prior knowledge:**
Basic understanding of geometry and spatial reasoning.
Basic artistic skills (drawing, sketching).

**Comments:**
Teachers should provide a variety of materials for students to experiment with, such as art supplies, graph paper, and mathematical tools.
Digital tools like graphic design software can also be incorporated for creating the illusions.

**Connection to other subjects/topics/areas:**
Science: Understanding of cognitive science and visual perception.
Technology: Use of graphic design software.
Engineering: Planning and designing the visual illusion or impossible figure.
Arts: Art history, artistic techniques, and creativity.
Mathematics: Geometry, spatial relationships, and mathematical reasoning.