In this beginner lesson, upper elementary students will be introduced to the 2x2 Rubik’s Cube with attention to problem solving and other related STEM standards. This lesson is designed to give students early success with solving stages of the 2x2 Rubik’s Cube in order to reach the larger, more difficult goal of solving the entire cube independently. Some students who solve the 2x2 Rubik’s Cube may be inspired to solve the 3x3 Rubik’s Cube. In addition, this lesson might be helpful first time teachers and beginning student users of the 2x2 Rubik’s Cube. Several extension ideas using the Rubik’s 2x2 Cube are shared at the end of this lesson.

**Grade level:** Third, Fourth, Fifth

**Common Core Standards:**

**Introduction**

**Grades 3, 4, 5 – Geometry. Focus:**

- Reason with shapes and their attributes

**Grades 3, 4, 5 – Mathematical Practices. Focus:**

1) Make sense of problems and persevere in solving them.
2) Reason abstractly and quantitatively.
6) Attend to precision.
8) Look for and express regularity in repeated reasoning.

**Related Goals:**

- Informal Learning Opportunity for Inquiry, Problem Solving, and Scientific Process
- Goal-Setting, 7 Mindsets (example: Everything Is Possible, Passion First)
- Inspire Others

**Objectives:**

Students will complete small problem solving goals with the 2x2 Rubik’s Cube in order to inspire them to solve the entire cube independently.

**Materials:**

- 2x2 Rubik’s Cubes (one per student)

**Procedure:**

**Before class:**

- Safety: Sanitize all Rubik’s Cubes.
- Organize Rubik’s Cubes for distribution
With students:

1. Introduce “Experiment, Fail, Learn, Repeat” by discussing how this process is important in science. Ask students to share examples of this process in their everyday lives or hypothetically. Discuss the positive aspects of failure in science (ex. you can learn from failure, isolate variables, etc.). Share:

“I have not failed. I've just found 10,000 ways that won't work.”
- Thomas A. Edison

2. Introduce the 2x2 Rubik’s Cube as example of how to practice “Experiment, Fail, Learn, Repeat”. Before giving students the cube, discuss the following:

- Try. Ask students to control frustrations and attempt the cube with simple goals (see below). Challenge students to discover at least one method for solving one face of the cube.
- Respect for materials. Examples for discussion: no forceful turning of the cube, spinning, or turning the cube without focus. If you are borrowing cubes (ex. Rubik’s Cube Lending Program). Explain that students who do not respect using the cube appropriately will immediately have it taken away.
- Build knowledge: Watch a video (teacher choice) that shows the complete process of solving the 2x2 Rubik’s Cube so that students can see what is involved.
  - Example: How to Solve a 2x2x2 Rubik’s Cube: (Easiest Tutorial in High Quality)
    by Noah Richardson link (YouTube)

3. Distribute cubes and allow students to begin exploring methods for solving. Explain and encourage short term goals that allow students to become familiar with the motions of the cubes and low levels problem solving. Examples (in order of increasing difficulty):

- Solve one face for any one color. Try to solve for all six colors separately (in no particular order).
- Solve for any two colors on any two faces.
- Solve for white and top pairs using the Rubik’s solution guide (Stage 2: Solve the First Layer).
- Solve the entire cube using any method (online video, solution guide, peer to peer, etc.). Encourage personal devices and use of technology for viewing “how to” videos, etc.

4. Lesson End / Class Discussion.

- How were you inspired to complete any portion of the cube today? What goals have you set for yourself for solving the cube? etc.
- Share examples of other Rubik’s puzzles for inspiration.
- Video. Share the following video for inspiration:
  How a 15-year-old solved a Rubik’s Cube in 5.25 seconds by Vox link (YouTube)
Extensions. These extension ideas can provide on-going student opportunities for solving the 2x2 Rubik’s Cube.

- **Develop a game.** Allow students to create a game with the 2x2 Rubik’s Cube. Example: Solve for any color the fastest. How many letters of the alphabet can be made using any one 2x2 Rubik’s Cube face? Think creatively and determine how many other letters can be made with multiple cubes.

- **Art.** Using the 2x2 Rubik’s Cubes you have available, either as a group or class, design, draw, and create a work of art. Share pictures of Rubik’s mosaics.

- **Create Your Own Directions.** Create your own written directions and steps for solving any portion or color face of the cube. Include step by step directions and visuals. Share your directions with a friend and see if they can follow them successfully.

Notes to Teacher:

- **Model.** Become familiar with being able to solve the cube yourself as the teacher, either using the Rubik’s solution guide or from memorization of algorithms. Don’t hesitate to share with students what worked for you and what didn’t work for you when solving the cube.

- **Inspire.** While students are solving, provide inspirational music and videos if possible. Example: *Rubik’s cube world records New Edit* by Xael 98 [link](https://www.youtube.com/watch?v=98Xael) (YouTube)

- **Differentiate.** Help students understand that there is more than one way to learn how to solve the 2x2 Rubik’s Cube. Share and compile strategies. Examples: Peer to peer, written solution guides with visuals, online videos (ex. YouTube), etc.

- **Celebrate:** A poster comes with the kit from the *You CAN Do the Rubik's Cube* Lending Program, or you can create a poster for students who complete the cube to sign. This gives students recognition while also providing a peer contact for other students to learn from.

- **Don’t force it.** Ask students to try the cube for at least 15 minutes. If you have students who are continually frustrated beyond this point, consider providing an alternative activity.

- **Practice.** Provide opportunities for students to continue to learn how to solve the cube. These could be unstructured times in your classroom (ex. when students complete their work), break times, etc.


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