Rubik's Snakes: Learn and Play

Recently, I have been asked by a didactician "What is it good for?" and my answer has been "To play." All pupils like to play. They deserve to play. They can play games with some more or less hidden mathematics, and they will learn from them. They should be free to experiment without being told what to do, to unfold their creativity. They also like this freedom (Example: my partner Prof. Monsurró tested 50cm foldable rulers in Rome by distributing them to the pupils without instructions: pupils taught one another how to use them and did all sort of cool stuff with them, even team work.)

So we will give folded or straight Rubik's Snakes to pupils. The first small challenge is seeing how they can be twisted/untwisted. It is likely that some pupil knows the gadgets already, and then can instruct the others. But they can find out by themselves, and the teacher can show something if necessary.

A neat construction is "the dog", and this is easy to achieve if the picture is provided. More challenging is "the ball": the teacher should have ready a set of instructions because pupils could follow the instructions to do the ball if they prefer not to try themselves. And pupils can do all kind of artistic configurations with Rubik Snakes: these are simple, beautiful, and colourful, and they allow a great variety of shapes.

Pupils should think: Can they describe the shape of the Rubik Snake pieces? Can they describe the twists of the Snake with the 4 main directions? Can they compute the angle of the "non-planar" twists?
Exercises for planar configurations (making square frames, for example, but also evaluating the number of moves necessary and sufficient to obtain a configuration) can be taken from the article

Rubik Snakes on a Plane, Francesco Grotto, Antonella Perucca, Tatjana von Steenbergen Bergeron (the last author is a high-school pupil who did an internship at the University of Luxembourg), to appear in the College Mathematical Journal.

More challenging are the three-dimensional configurations, and some basic questions are still open (e.g. convex configurations, number of moves to achieve a configuration).

Counting configurations is very difficult, even for a computer. One should discard configurations that are only theoretical (a sequence of twists could give a Snake that intersects itself). Moreover, some seemingly feasible configurations may turn out not to be possible (if they cannot be constructed without braking the Rubik Snake into smaller parts). Algorithmic/Programming exercises can be given, configurations of short Snakes can be counted.

Notice that, even if the standard Snake has 24 pieces, more Snakes can be combined. And it is easy to introduce formulas that hold for any n, where n is the number of pieces. I would see this also as motivation for "abstract algebra", which allows us to understand any number of pieces, all at once.

This is a work in progress, didactical material will be produced, testing will be evaluated. In the meantime, feel free to play. Recommended age: 6-99.