Maths Circle August 8, 2026, session 66

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We will deal with some physical applications of the mathematical ideas on knots and links developed by Pranav in the last two sessions. It turns out that the mathematics of knots and links is closely related to ideas in physics. We will illustrate these relations with some simple experiments.

Materials Needed: Paper, Pencils, cello tape, string, scissors, balls of wool.

Sailors love knots. So do mountain climbers, scouts, tailors, knitters, crocheters, and many others. You use knots to tie your shoelaces and perhaps to put on a tie. It turns out that physicists and biologists also deal with knots and links. We will explore these ideas in a few simple experiments.

In the late nineteenth century, Lord Kelvin and Peter Tait suggested that atoms may be knots in the ether, with different atoms represented by different knots. This gave an impetus to the mathematical classification of knots, which is still a work in progress. Links are somewhat simpler, and we will focus on them. Finally, you will be asked to find a method to decide if two loops of wool are linked by just looking at their projections and their crossings.

In preparation for this maths circle, you can use the internet to find out how a motor works and the principle of a transformer.

We will focus on two applications.

Electrical Circuits and Links:

Those of you who have studied circuits in school can think about this thought experiment: $C1$, $C2$ are two closed curves neither of which is knotted. But $C1$ and $C2$ may or may not be linked. A wire is wound around $C1$ and connected to a battery, switch and a resistor . A second wire is laid along $C2$ and connected to a a volt meter.

1. Switch on the $C1$ circuit, what happens if $C1, C2$ are not linked?
2. Now link C1, C2, and check the voltmeter reading.
3. What do you expect if you keep the link but move $C2$ around?
4. What happens when you increase the linking

What do you conclude from this observation ?

In the last session the notion of linking of ropes was introduced in the exploration sheet. In this session we will explore connections between the mathematical notion of links and the experimental observation made above.

Elasticity of DNA and Links:

We will explore the notion of Links appearing in Biology. We will see how Links come into play in the context of elastic properties of DNA.

If time permits we will do a couple of demos illustrating links in the domain of fluids.

Figure 1: Ha! Ha! He's got a knot in his tail!