Wikipedia Illustration Task Force

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Summary

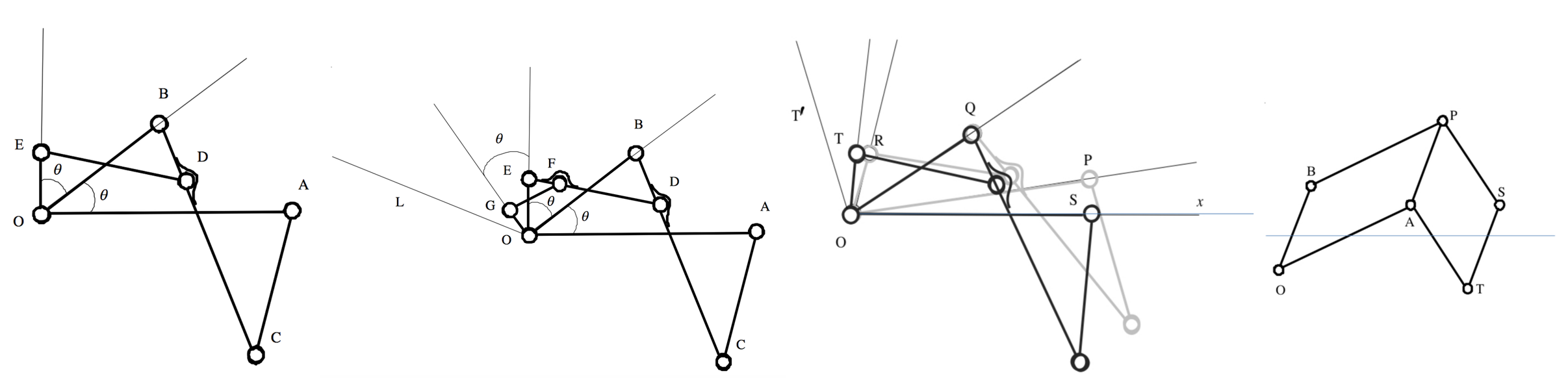
The purpose of this project was to use programming techniques and tools to create mathematical illustrations (animations, graphs, diagrams) that could enrich Wikipedia articles. The main focus was on algebraic curves and how they may be drawn using Kempe's Universality Theorem.

Kempe's Universality Theorem

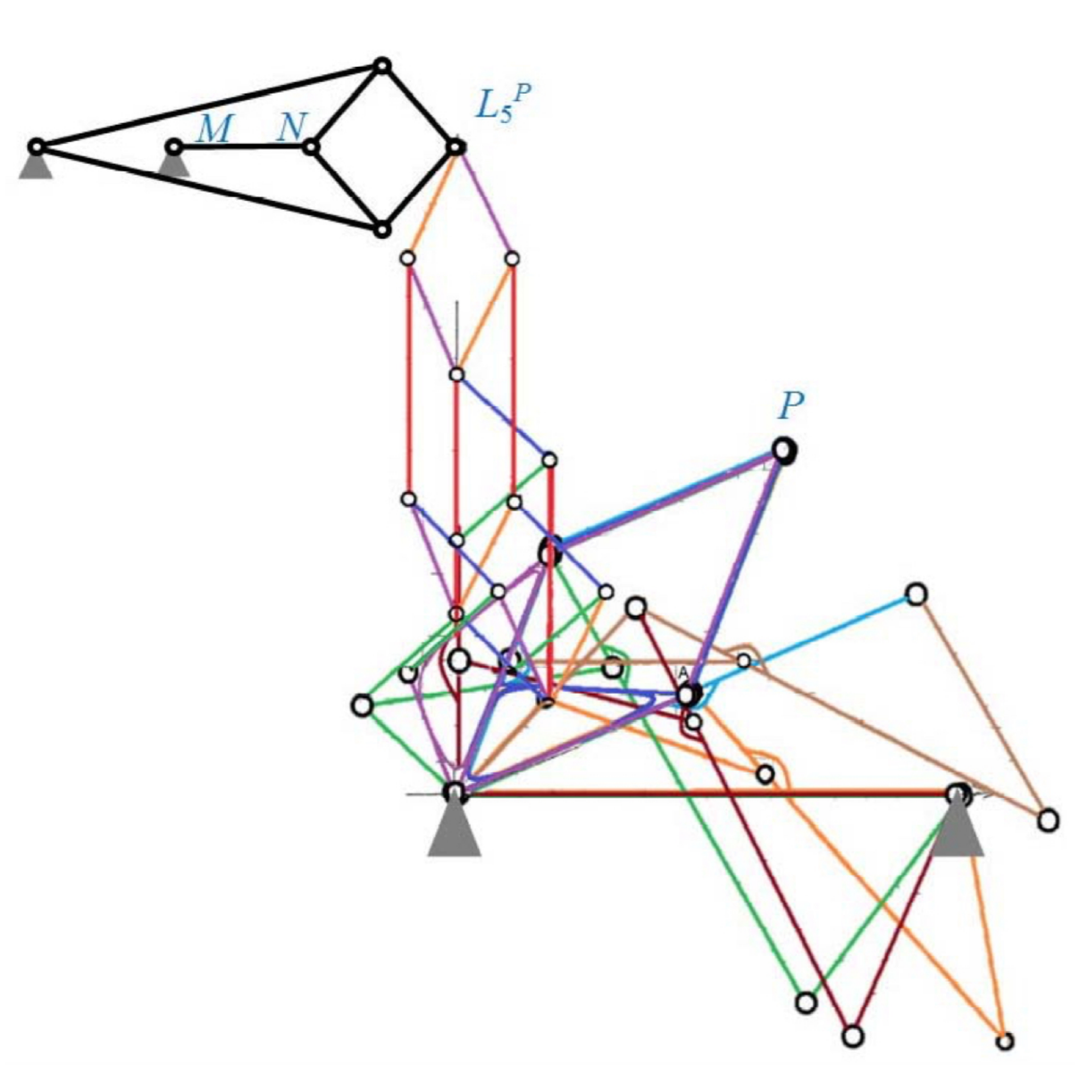
For an arbitrary algebraic plane curve a linkage can be constructed that draws the curve.

Kempe's Mechanisms

- Four calculating linkages: reversor, multiplicator, additor, translator



Below is an example of Kempe's mechanisms consisting of 48 links and 70 joints. It moves point P to draw two intersecting lines given by the equation $(x-y)(x+y+\frac{1}{\sqrt{2}})=0$.



- A generalization of Kempe's theorem tells us that a curve of degree n requires at least $\mathcal{O}(n^2)$ bars.

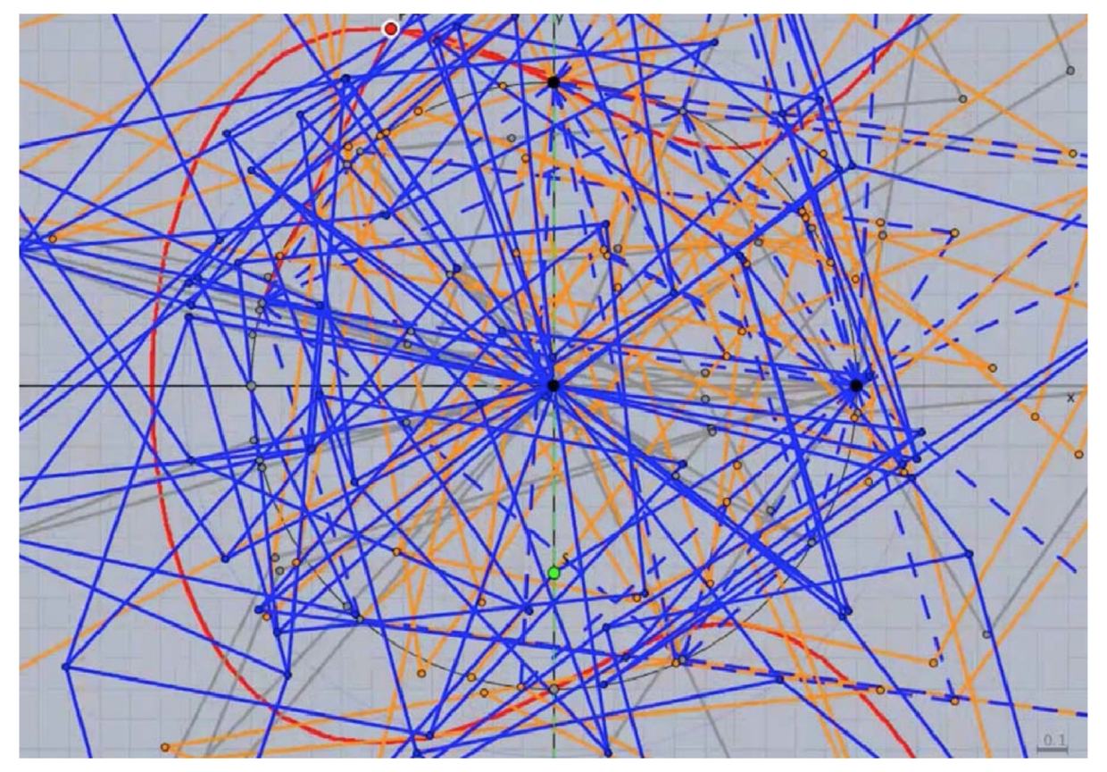
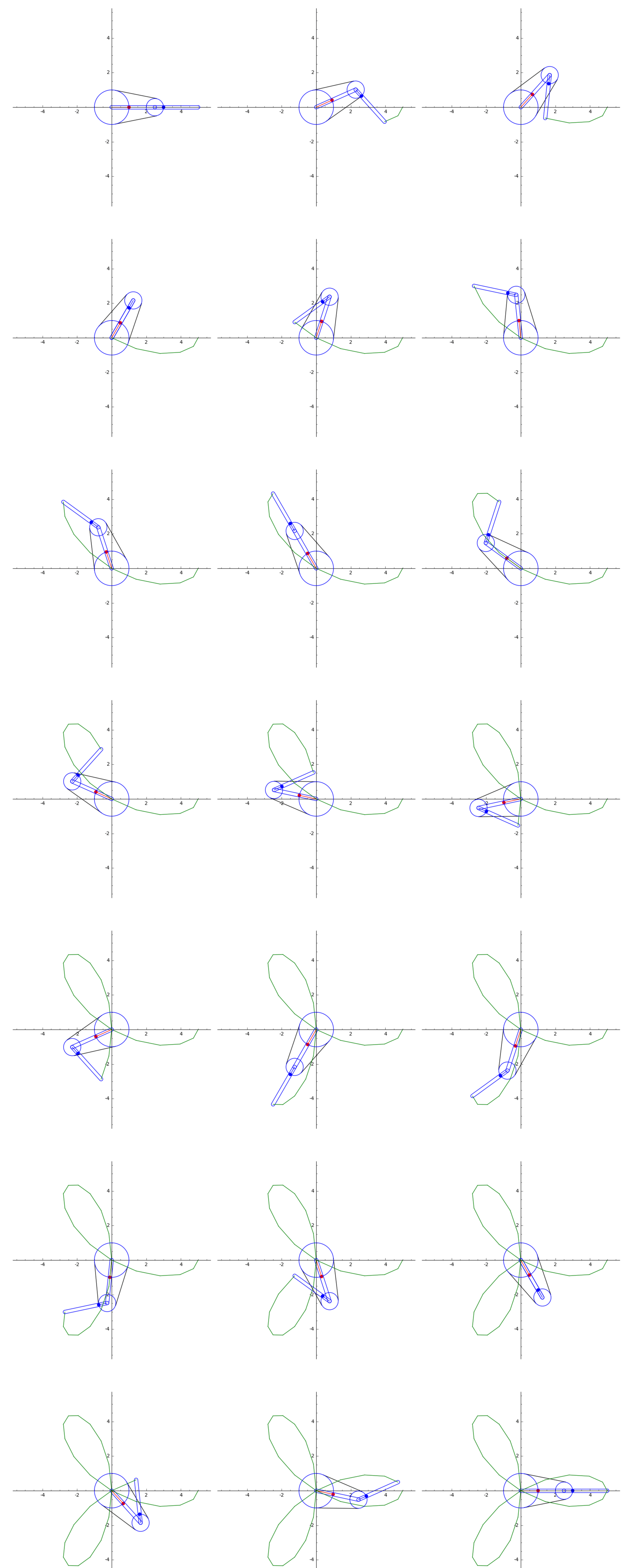


Figure: The dynamic geometry system Cinderella shows the linkages that would draw an elliptic cubic curve (the curve can be seen in red).

- Kempe himself asked for a mathematical artist to discover the simplest linkworks that will describe particular curves

Animation



Trigonometric Plane Curves

A trigonometric plane curve, $P=(x(\theta),y(\theta))$, is a parameterized curve with coordinate functions that are finite Fourier series.

For example, this is the trigonometric plane curve equation for the trifolium:

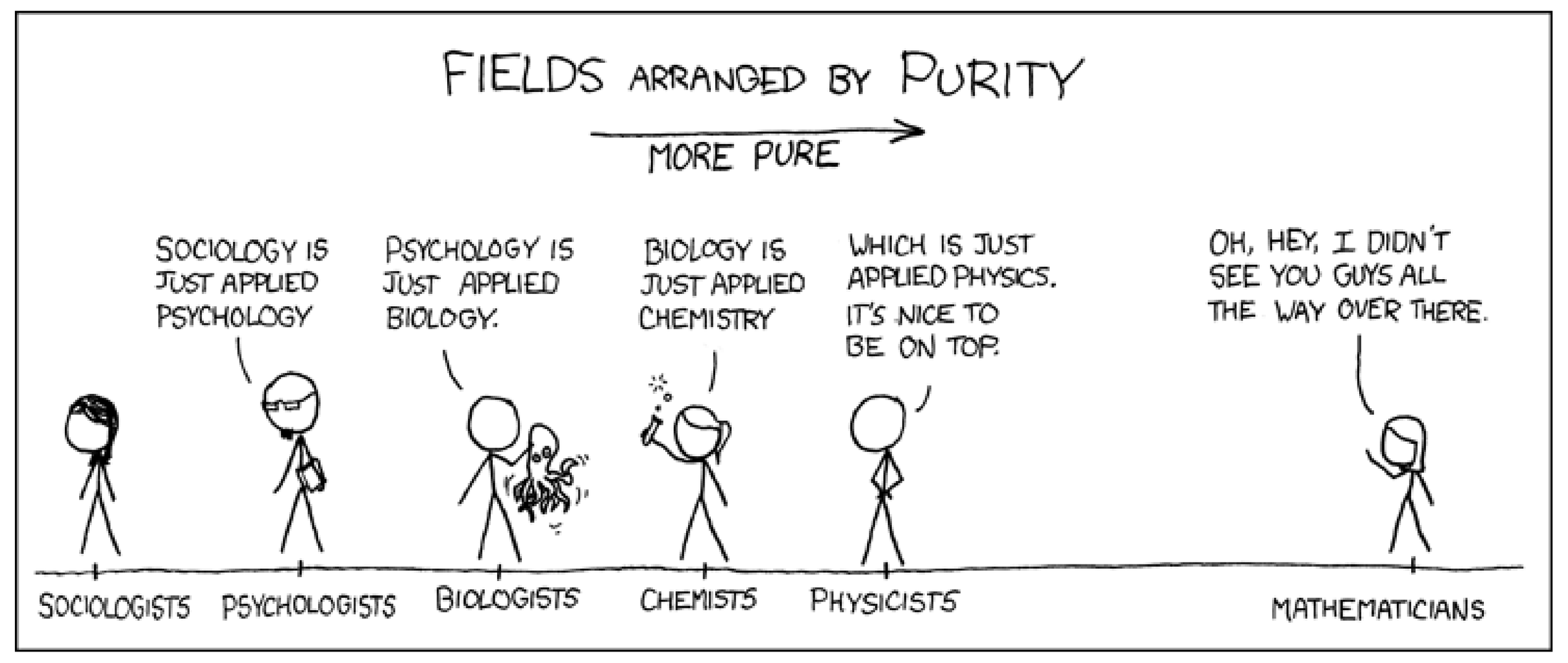
$$P_T = \begin{cases} -\cos 2\theta - \cos 4\theta \\ \sin 2\theta - \sin 4\theta \end{cases}$$

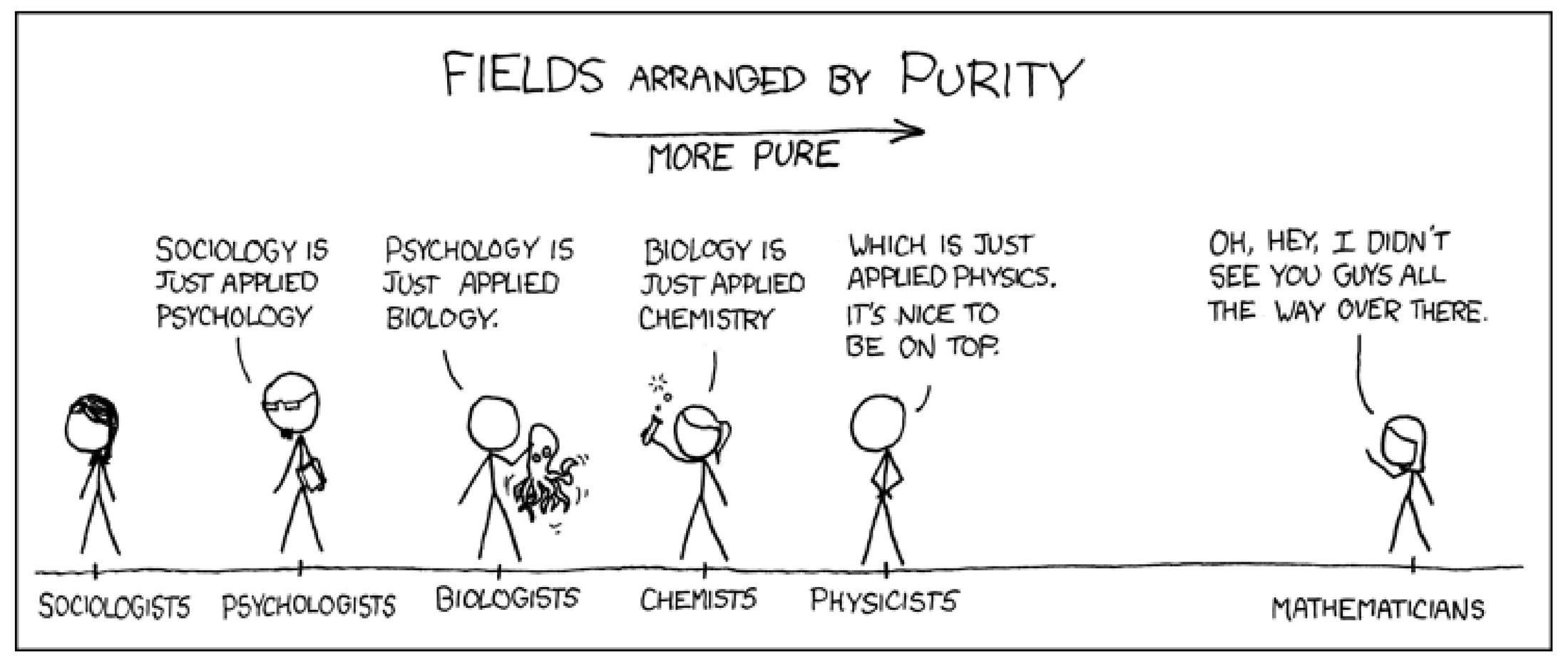
Math

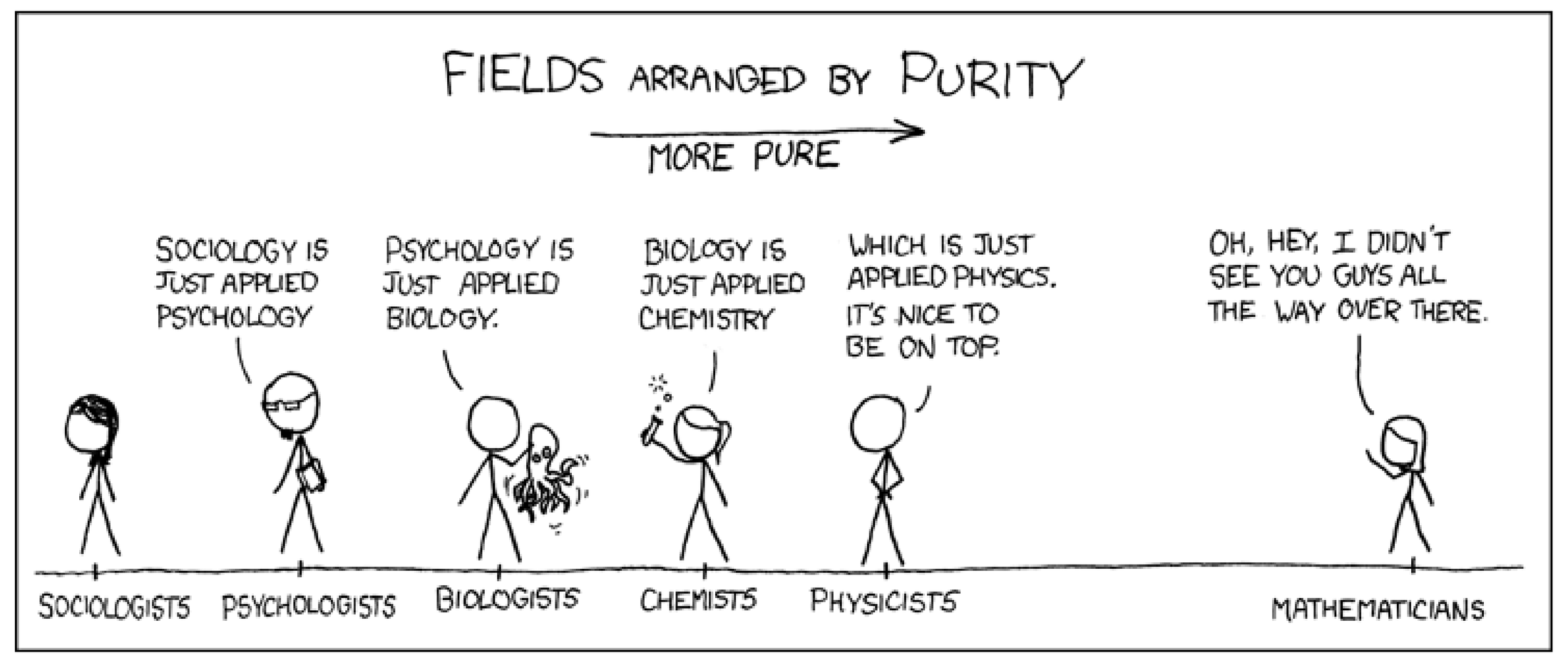
Include math within the text is as simple as $1+1=2$. You can also highlight more important equations like this:

$$\int_0^1 \sin(x)+\cos^2(x)+\alpha x\, dx$$

Three Pictures







Theorems

The beamer `theorem` environment takes up a lot of space and adds various decorations. Dividing the poster into blocks probably provides enough modularity and decoration.

Another way to typeset theorems in the poster is:

Theorem. An even perfect square is a multiple of 4.

Corollary. The number 18 is not a perfect square.

Experiments

Answer the question posed by each block heading as efficiently as possible. A block titled "experiments" should get right to the point of explaining what experiments were conducted.

Theorem

Another option for typesetting theorems is to make the statement its own block.

Conclusions

We find that there are infinitely many primes, and that most of them are odd. Also,

- Primes less than n are slightly more likely to be quadratic non-residues mod p, when p is a fixed prime and n is large.
- There are infinitely many consecutive prime pairs p_n, p_{n_1} satisfying $p_{n+1}-p_n < 300$.

References

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