COMMON CORE CONNECTIONS:

Mathematical Practice Standards
Every math circle activity, by very definition, engages participants in the first, and most important, Mathematical Practice Standard:

> **MP1:** *Make sense of problems and persevere in solving them.*

And, because of the collaborative nature of math circles, the third practice standard is in the fore as well:

> **MP3:** *Construct viable arguments and critique the reasoning of others.*

The interplay between labeling and the geometry of fixed points certainly attends to:

> **MP2:** *Reason Abstractly and Quantitatively.*

One can even argue, especially with the open problems in part 2 of this activity, we must also attend to:

> **MP5:** *Use appropriate tools strategically.*

Content Standards
One can (and I personally have) used Brouwer's Fixed Point theorem to motivate the Common Core State Standards on transformational geometry (which is the basis for developing geometric thinking in these standards). For example, placing small maps on large ones and looking at scaled copies of rulers placed next to larger ones provides an intriguing problem motivating the desire to study dilations (and rotations and translations).

Instead of crumpling a piece of paper, where are the fixed points under a simple rotation? A reflection? (Do translations have fixed points?)

The fact that we talk about "where points move to" develops the necessary language and thinking to describe geometric mappings and translations.

In short, discussing the Brouwer Fixed Point Theorem sets the stage and a natural context for the content standards in the geometry cluster:

> **8.G.A** *Understand congruence and similarity using physical models, transparencies, or geometry software.*

Sperner's Lemma has no connection to the content standards (but it is a whopper of an idea for MP1!).