UPPER-LEVEL DEFINITION CHAIN
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The writer's experience has included teaching the following in a high school class that included abstract algebra. A better example of a sequence of essential mathematics ideas is hard to imagine.

SET -- A collection. Must be described so that anyone knows exactly what is in it and what isn't (well-defined). *SET* is an uncertain concept because of paradox (Barber of Seville).

CARTESIAN PRODUCT (written A × B, and read "the Cartesian product of set A with set B") -- the <u>set</u> of all possible ordered pairs (x,y) where x is from A and y is from B.

RELATION -- non-empty subset of a <u>Cartesian product</u>. (Any set of ordered pairs).
> **DOMAIN** -- set of all first elements in a <u>relation</u>.
> **RANGE** -- set of all second elements in a <u>relation</u>.

EQUIVALENCE RELATION -- a <u>relation</u> which satisfies reflexive, symmetric, and transitive properties.

FUNCTION -- <u>relation</u> where each domain element has exactly one range element.

BINARY OPERATION -- <u>function</u> whose domain is a Cartesian product and whose range is a set of single elements.

PERMUTATION -- one-to-one <u>function</u> where domain = range.