Juanita Ballesteros | **The Belousov-Zhabotinsky Reaction**

The Belousov-Zhabotinsky Reaction (ZB Reaction) for short, is one of a class of reactions that serve as a classical example of non-equillibrium thermodynamics. The reaction is self-sustaining for dozens of seconds; an extraordinary feat for a chemical reaction. This allows scientists to be able to study the properties of this reaction without constantly having to replenish reactants, since the system can function alone.

The only common element in these oscillating systems is the inclusion of bromine and an acid. Transitional metal ions catalyze oxydation of reductants (which are usually organic).

BZ Reaction

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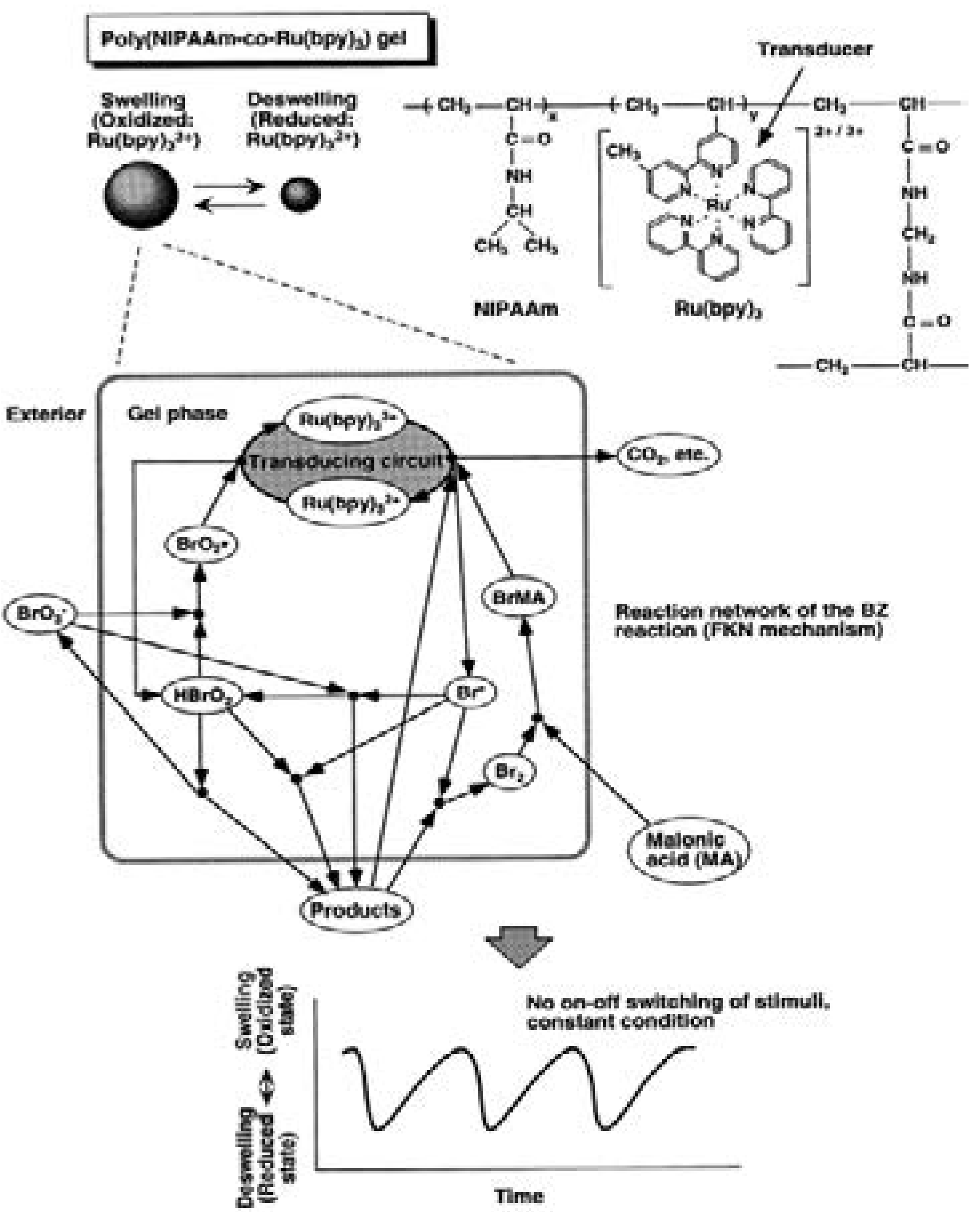
Photo of Belousov Zhabotinsky reaction with oxidation removed due to copyright restrictions. Source: Science Photo Library.

In the BZ system, the formation of HBrO2 is accompanied by the oxidation of the metal ion which is added to the bromine solution.

The change in color is due to the oxydation of the metal catalyst.



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A small excess of HBrO2 is formed (due to spontaneous concentration fluctuation or via a non-uniform reaction with a dust particle or some other random variable).

The excess HBrO2 catalyzes more of its own production. Thus, a front of reaction propagates out from the initial perturbation. This is how the appreance of waves occurs.

During these reactions, transition-metal ions catalyze oxidation of various, usually organic, reductants by bromic acid in acidic water solution.

Waves in the BZ system propagate as rings of oxidation, called “trigger waves” which form “target patterns.”

The reaction starts off in equillibrium. Then. a small disturbance occurs which causes the solution to rapidly change into a wave-like pattern.

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Progression of Reaction

Photo courtesy of Marlith on Wikimedia Commons.

To understand the underlying principles in this reaction, one must understand the properties of Oxidation. In simplified terms, oxidation is the joining of (in this case) oxygen and hydorgen to the metal ions.

This oxidation is more easily recognized as "rust."

We only see the large-scale effects of oxidation as the oxygen causes free radicals on the surface to break away.

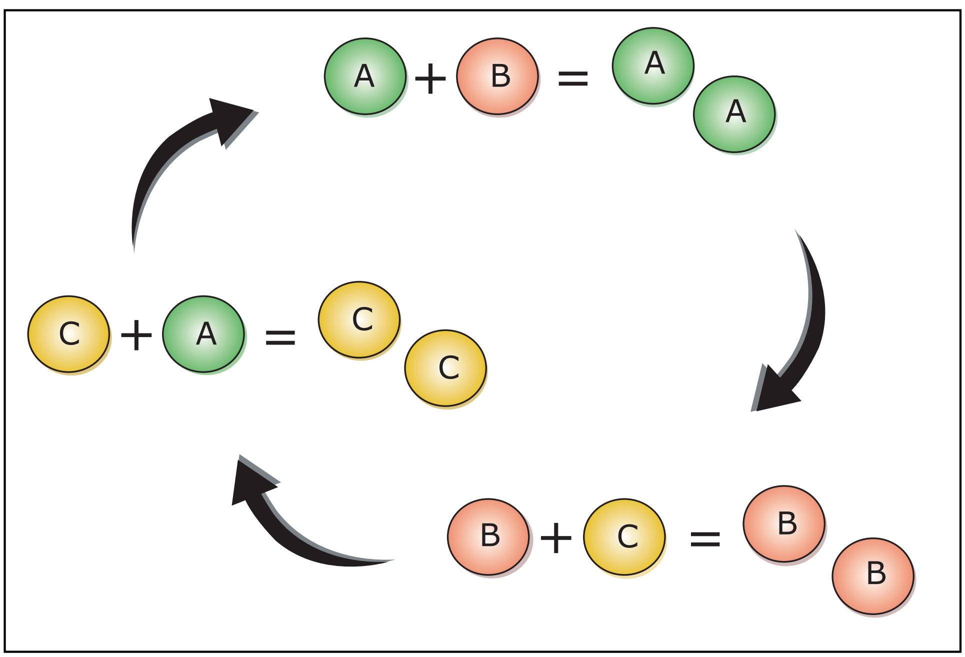


Image by MIT OpenCourseWare.

A simplified description of the BZ reaction as a series of chemical equations of the form:

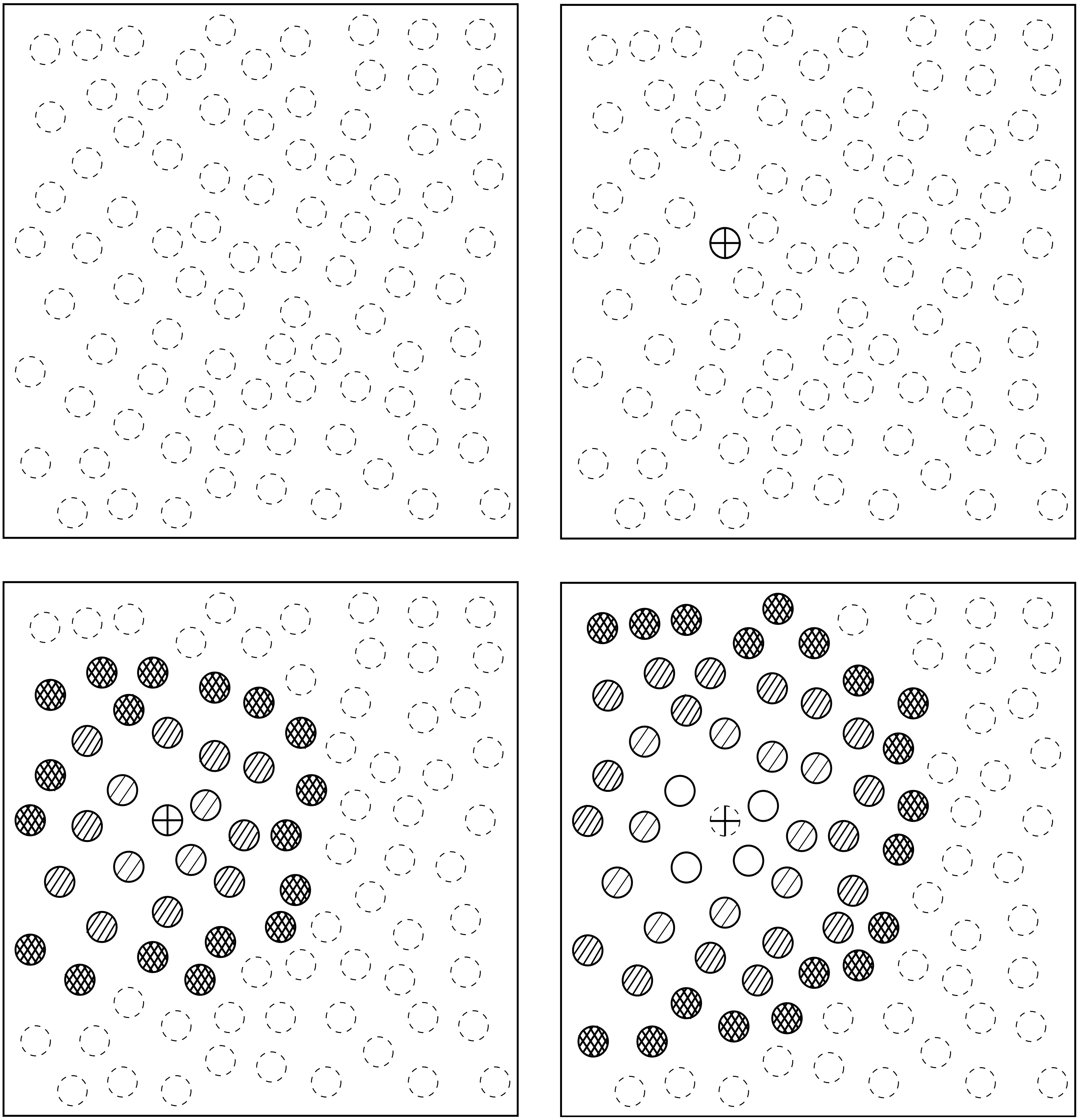
$$A+B = 2A$$

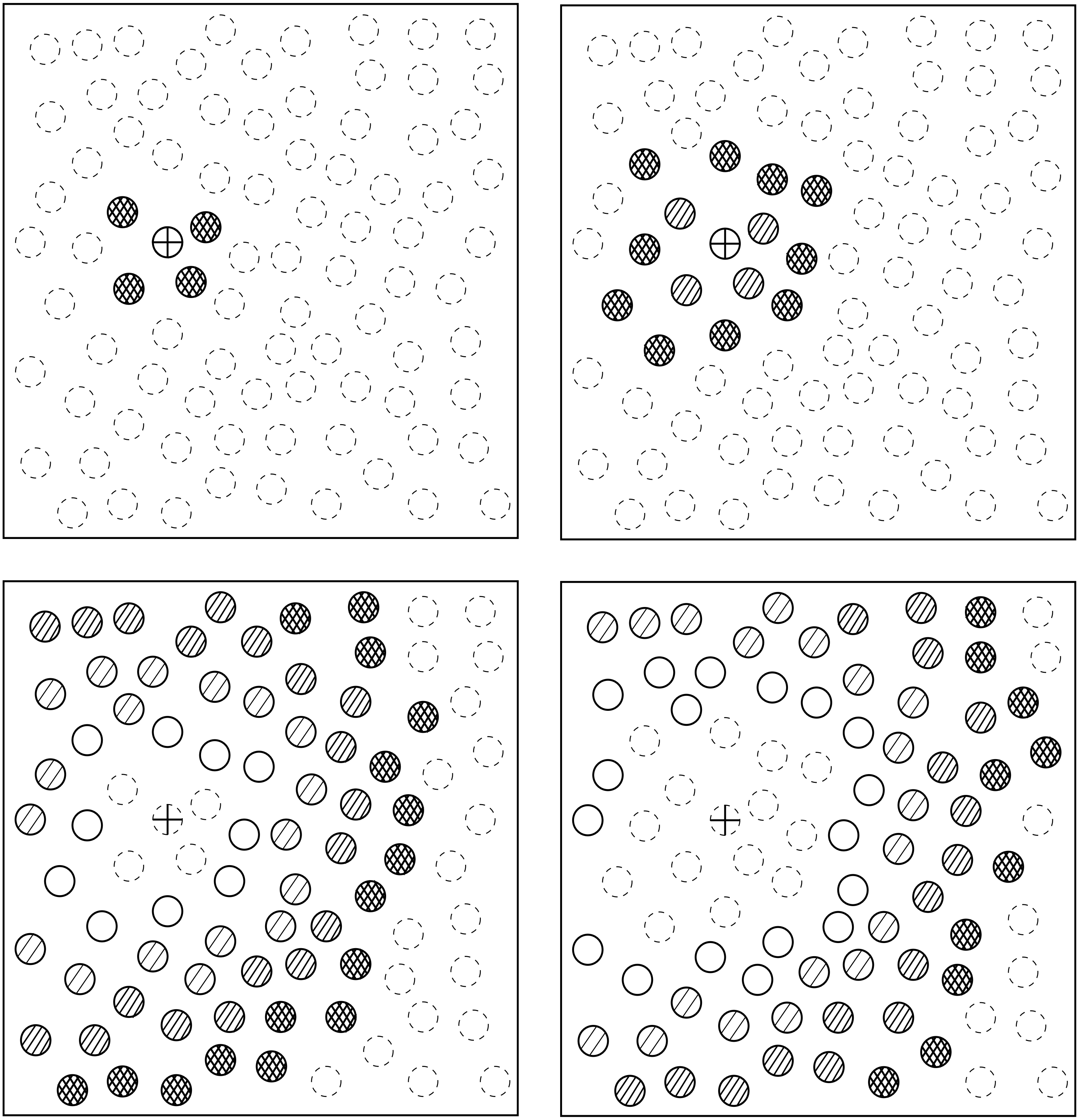
In this equation, provided there is some quantity of B, the creation of A is autocatalyzed until the supply of B expires. A set of competing reactions can be formed by adding two similar chemical equations:

$$B+C = 2B$$

$$C+A = 2C$$

With the addition of these equations, B can be created, but only if there is a quantity of C, and C can be created, but only if there is a quantity of A, bringing the reaction full circle.





Simplified diagrams