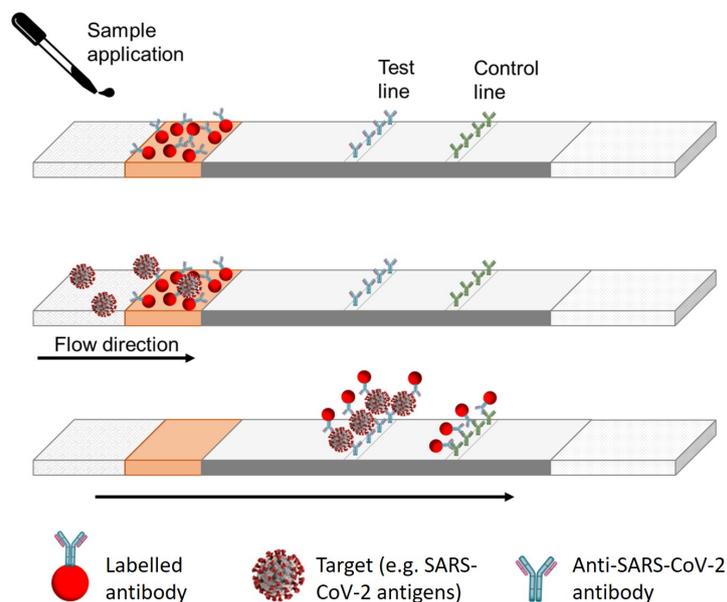


### Summary handout

# Much ado about nothing: spot misleading science claims and explore rapid antigen tests and buffers

## Function of Ag-RDT (lateral-flow method) using COVID-19 tests as an example



Scheme of molecular processes in positive COVID-19-testing

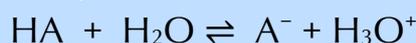
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1. The sample is applied to the sample pad.
2. The sample migrates through the conjugate pad, which contains antibody–gold complexes (red colour) in excess. In the case of infection, antigens on the coronavirus surface bind to the antibody–gold complex.
3. The sample migrates to the test line. When coronavirus is present, the immobilized test-line antibodies capture the coronavirus particles, which are also bound to the antibody–gold complexes connected to the immobilized antibodies on the test line, giving a red test line (positive result). When there is no virus present, the antibody–gold complexes just pass over the test line (negative result).
4. Next, the sample migrates to the control line. Here, excess antibody–gold complexes are bound directly by the control-line antibodies.
5. The remaining sample migrates until it reaches the absorbent pad.

## Buffer systems

A buffer system always contains a corresponding acid–base pair (HA/A<sup>-</sup>).

General reaction equation for buffer systems:



Two different cases can occur:

**1. Addition of an acid:** Concentration of oxonium ions (H<sub>3</sub>O<sup>+</sup>) increases.

- The higher concentration of H<sub>3</sub>O<sup>+</sup> results in an excess on the right side of the equation, thus forcing the reaction towards the left side, to rebalance the equilibrium.
- Most often, the added oxonium ions decompose to form water.
- The pH level does not change.

**2. Addition of a base:** Concentration of hydroxide ions increases.

- OH<sup>-</sup>, which is A<sup>-</sup>, again causes an excess on the right side of the equation. The chemical balance reforms when the reaction towards the left side occurs.
- Hydroxide ions can react with the existing oxonium ions to form water.
- The pH level does not change.

In general, these reactions stabilize the pH level of the buffer system until the buffer capacity is reached. At this point, all the molecules of the corresponding acid–base pairs have reacted.

### Why does the test show a positive result with cola?

- The test was performed incorrectly.
- Using beverages (e.g., cola or energy drinks) as the sample without adding the buffer solution might result in a positive outcome of the test.
  - Protein structures of the immobilized antibodies on the test may be destroyed by the wrong pH level of the applied sample. Additionally, antigen–antibody reactions only occur correctly at a particular pH level.
- When performed correctly: cola has no influence on the outcome of the antigen rapid test.

! Watch out when replicating the experiment at home: some tests already contain a buffer in the sample pad. => Not all tests have a positive outcome when performing the test without the enclosed buffer solution.