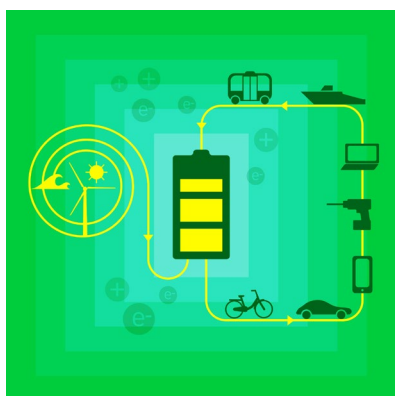


## Student Worksheet – Chemistry Prize 2019

### Developing the world's most powerful battery



The development of lithium-ion batteries laid the groundwork for wireless electronic devices. The potential for storing renewable energy in batteries also opens the way to sustainable energy use. **M. Stanley Whittingham, John B. Goodenough** and **Akira Yoshino** together contributed to the development of the rechargeable lithium-ion battery.

The three 2019 Laureates in Chemistry worked separately but made improvements on each other's research. Their various discoveries are behind the development of the world's most powerful battery.

**M. Stanley Whittingham** developed the rechargeable lithium battery, using the light lithium atom and another substance called titanium disulphide. Lithium is one of the alkaline metals and easily turns into the lithium ion by releasing its only valence electron, thus becoming stable.

**John B. Goodenough** made the battery more powerful by replacing titanium disulphide with a metal oxide. This increased the voltage of the battery without boosting its weight or volume.

**Akira Yoshino**, finally, made the battery safer by replacing the lithium atoms with a carbon-based material containing lithium ions, thereby avoiding the risk of violent explosions.

Lithium-ion batteries are used globally to power the portable electronics that we use to communicate, work, study, listen to music and search for knowledge. Lithium-ion batteries have also enabled the development of long-range electric cars and the storage of energy from renewable sources, such as solar and wind power.

### Vocabulary list

**ALKALI METALS** Group 1, the leftmost column in the periodic table of chemical elements, with only one valence electron.

**VALENCE ELECTRONS** Electrons that are located in the outer shell of an atom.

**FOSSIL FUELS** Energy sources in the form of hydrocarbons, for example oil, natural gas and coal.

**GREENHOUSE GASES** Gases that contribute to global warming.

## What do you think?

What is the most interesting thing about the Laureates' work?

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Alfred Nobel wanted the work of the Nobel Laureates to "have conferred the greatest benefit to humankind". What will be the greatest benefit of the 2019 Laureates' achievements?

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