Organic chemistry: reduction of aldehyde to alcohol

The reduction of an aldehyde to an alcohol is carried out using lithium tetrahydridoaluminate or sodium tetrahydridoborate. Usually the reducing agent is abbreviated to [H].

Aldehyde + [H] -> alcohol.

But why is it a reduction?

Usually at A-level you are taught to look at the average oxidation number on carbon in an organic compound. For example, take the reaction

$H_3C\text{-}CHO + 2[H] \rightarrow H_3C\text{-}CH_2OH$.

On the reactant side, the oxidation numbers on ethanal are:

H = +1 (x4)

O = -2

The total is +2.

So the oxidation numbers on carbon must add up to -2. Let's take the average (divide by 2 as there are two carbon atoms), and we end up with an oxidation number of -1.

On the product side, the oxidation numbers on ethanol are:

H = +1 (x6)

O = -2

The total is +4.

So the oxidation numbers on carbon must add up to -4. Again, let's take the average, and the oxidation number of carbon is -2.

As the oxidation number has decreased, this is a reduction.

Instead of looking at the average oxidation number on carbon, you may look at the carbons one at a time. You will find that the oxidation number on the carbon bonded to oxygen decreases, again showing that this is a reduction.