There are few reactions of aldehydes and ketones that do not in some way affect the carbonyl function. For this reason, it may be necessary to protect the carbonyl function when it is desirable to avoid reaction at this function. For example, you may plan to synthesize 4-cyclohexylidene-2-butane by way of a Wittig reaction (Section 16-4A), which would involve the following sequence:

\[
\begin{align*}
\text{CH}_3\text{C} & \text{CH}_2\text{CH}_2\text{Br} + \text{PR}_3 \rightarrow \text{CH}_3\text{C} & \text{CH}_2\text{CH}_2\text{PR}_3 + \text{Br}^+ \\
\text{CH}_3\text{C} & \text{CH}_2\text{CH}_2\text{PR}_3 + \text{C}_6\text{H}_5\text{Li} \rightarrow \text{CH}_3\text{C} & \text{CH}_2\text{CH}_2\text{PR}_3 + \text{C}_6\text{H}_5 + \text{Li}^+ \\
\text{CH}_3\text{C} & \text{CH}_2\text{CH}_2\text{PR}_3 + \text{O} \rightarrow \text{CH}_3\text{C} & \text{CH}_2\text{CH} = \text{CH}_2 + \text{R}_3\text{P} = \text{O}
\end{align*}
\]

This synthesis would fail in the second step because the phenyllithium would add irreversibly to the carbonyl group. To avoid this, the carbonyl group would have to be protected or blocked, and the most generally useful method of blocking is to convert the carbonyl group to a ketal, usually a cyclic ketal:

\[
\begin{align*}
\text{C} & = \text{O} + \text{HO} & \text{CH}_2 \\
\text{HO} & \text{CH}_2 & \text{H}^+ \\
\text{HO} & \text{CH}_2 & \text{H}_2\text{O} \\
\text{C} & = \text{O} & \text{CH}_2
\end{align*}
\]

With the carbonyl group suitably protected, the proposed synthesis would have a much better chance of success:

\[
\begin{align*}
\text{CH}_3\text{C} & \text{CH}_2\text{CH}_2\text{Br} + \text{HOCH}_2\text{CH}_2\text{OH} \rightarrow \text{CH}_3\text{C} & \text{CH}_2\text{CH} & \text{CH}_2\text{Br} \\
\text{C}_6\text{H}_5\text{Li} & \rightarrow \text{CH}_3\text{C} & \text{CH}_2\text{CH}_2\text{PR}_3 \rightarrow \text{CH}_3\text{C} & \text{CH}_2\text{CH}_2\text{PR}_3 + \text{C}_6\text{H}_5 + \text{Li}^+ \\
\text{CH}_3\text{C} & \text{CH}_2\text{CH}_2\text{PR}_3 + \text{O} \rightarrow \text{CH}_3\text{C} & \text{CH}_2\text{CH} = \text{CH}_2 + \text{R}_3\text{P} = \text{O}
\end{align*}
\]

Notice that the carbonyl group is regenerated by acid hydrolysis in the last step.

Contributors
