$$
\begin{aligned}
1+2+3+\cdots+n &= \sum_{1}^{n} k \\
&= \frac{1}{2}\sum_{1}^{n}(k+(n+1-k)) \\
&= \frac{1}{2}\sum_{1}^{n}(n+1) \\
&= \frac{n(n+1)}{2} \qquad (1)
\end{aligned}
$$