Theorem. Let $f(n)$ be an antiderivative of $g(n)$. Then

$$\sum_{n=a}^{b} g(n) = f(b+1) - f(a).$$

Proof. We have

$$\begin{aligned}
\sum_{n=a}^{b} g(n) &= \sum_{n=a}^{b} \Delta f(n) \\
&= \sum_{n=a}^{b} (f(n+1) - f(n)) \\
&= \sum_{n=a+1}^{b+1} f(n) - \sum_{n=a}^{b} f(n) = f(b+1) - f(a).
\end{aligned}$$