$$
\begin{align}
Pr\{X = k\} &= \binom{n}{k} p^k (1-p)^{(n-k)} \tag{1}\\
E[X] &= \sum_{k=0}^{n} k Pr\{X = k\} \tag{2}\\
&= \sum_{k=0}^{n} k \binom{n}{k} p^k (1-p)^{(n-k)} \tag{3}\\
&= \sum_{k=0}^{n} k \frac{n!}{k!(n-k)!} p^k (1-p)^{(n-k)} \tag{4}\\
&= \sum_{k=0}^{n} \frac{n!}{(k-1)!(n-k)!} p^k (1-p)^{(n-k)} \tag{5}\\
&= np \sum_{k=0}^{n} \frac{(n-1)!}{(k-1)!(n-k)!} p^{(k-1)} (1-p)^{(n-k)} \tag{6}\\
&= np \sum_{k=0}^{n} \frac{(n-1)!}{(k-1)!((n-1)-(k-1))!} p^{(k-1)} (1-p)^{((n-1)-(k-1))} \tag{7}\\
&= np \sum_{k=0}^{n} \binom{(n-1)}{(k-1)} p^{(k-1)} (1-p)^{((n-1)-(k-1))} \tag{8}\\
&= np \sum_{k=1}^{n-1} \binom{(n-1)}{(k-1)} p^{(k-1)} (1-p)^{((n-1)-(k-1))} \tag{9}\\
&= np \sum_{a=0}^{b} \binom{b}{a} p^a (1-p)^{(b-a)} \tag{10}\\
&= np \times (p + (1-p))^b \tag{11}\\
&= np \times 1^b \tag{12}\\
&= np \times 1 \tag{13}\\
E[X] &= np \tag{14}
\end{align}
$$