Lemma

If $x, y \in \mathbb{Z}$, and p prime, then

$$(x+y)^p \equiv x^p + y^p \pmod{p}.$$

Proof.

From Binomial Theorem,

$$(x+y)^p = \sum_{k=0}^{p} \binom{p}{k} x^k y^{p-k}.$$

By Lemma 1, all of the interior coefficients are multiples of p, so modulo p this is

$$x^p + y^p.$$

□