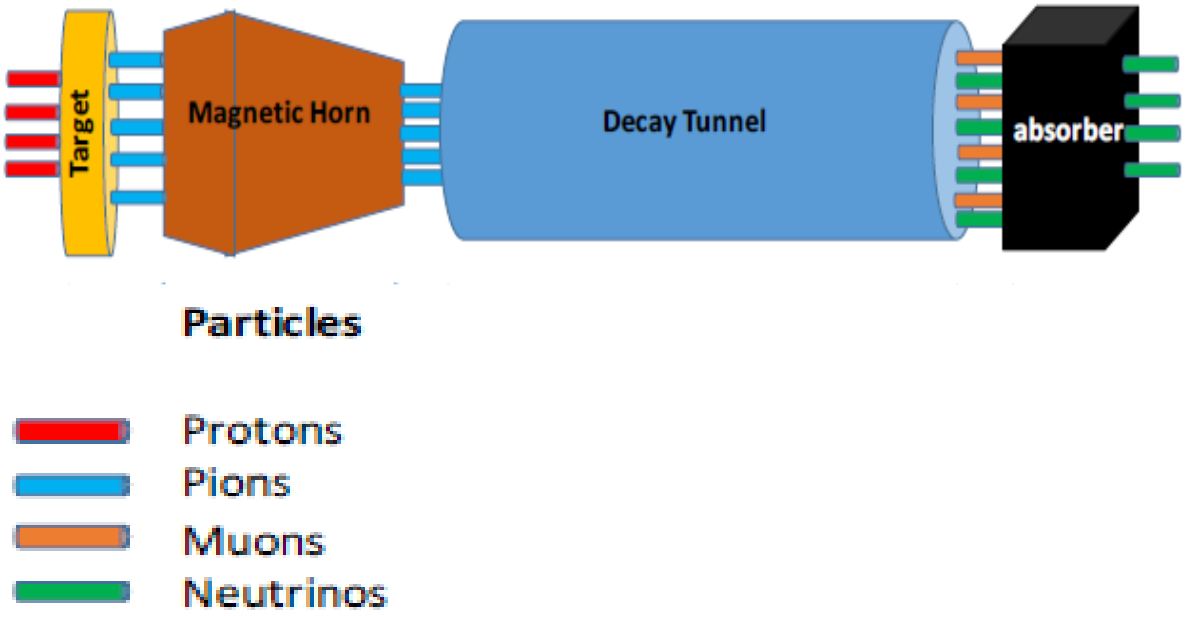
Can you make neutrinos from protons?

Neutrinos are among the most abundant particles in the universe, but they rarely interact with matter. To study neutrinos, Fermilab makes high-intensity neutrino beams starting with protons from a bottle of hydrogen gas. The protons accelerate to nearly the speed of light and smash into a target producing new particles, including pions — our source for neutrinos. A magnetic horn focuses the pions, directing them straight ahead through a tunnel, which gives them time to decay into neutrinos and muons. At the end of the decay tunnel is a wall of steel and concrete to trap particles that are not neutrinos. Neutrinos go easily through the steel and concrete of the walls and on to the experiments.



Materials: Modeling clay, color straws.

Activity: Make parts as shown in the diagram above (target, magnetic horn, decay tunnel, absorber) using modeling clay. Use color straws to represent particles. Smash protons into a target to make a beam of new particles called pions. Focus pions with a magnetic horn and send them through a decay tunnel to decay into muons and muon neutrinos. Use an absorber to trap all particles that are not neutrinos. Ta da! You have beam of neutrinos!

Questions to ask: What particles are produced after protons smash into a target? What is the magnetic horn doing with the pions? What is the purpose of the concrete wall? Can neutrinos go through the steel and concrete walls?

Useful links: https://ed.fnal.gov/lsc_exhibits/list.html

https://www.liveworksheets.com/id/jg40966di