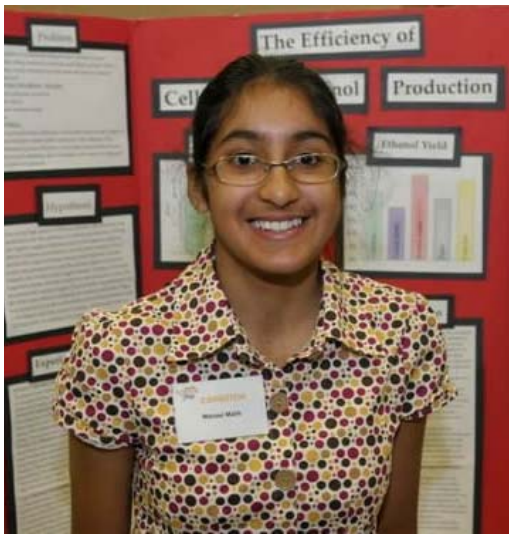

Region: III, Southwestern MA CleanTech, Honorable Mention:

Manasi Malik, Bishop Freehan High School, Attleboro

"Refuel with Rubbish"

ABOUT ME:

My name is Manasi Malik. I am 14 years old, and a sophomore at Bishop Feehan High School. I live in Attleboro, Massachusetts with my family, my two dogs, and a colony of sagging bookshelves. Apart from school, some of my other activities are piano, track, and full-time daydreaming. I am also involved with the school's concert band, math team, and Academic Decathlon team. In my spare time, I like to read, run, sing, write, and spend time with my family and friends. My favorite author is Terry Pratchett; my favorite composer is Beethoven; my favorite animal is the walrus; and my favorite color is green.

MY PROJECT:

The goal of my project was to design a home-based process to produce ethanol from compostable kitchen waste. The process needed to be cost-effective, energy-efficient, and safe enough to conduct in a home. I also wanted the ethanol yield of my process to be reproducibly higher than that of corn, so I set a goal ethanol yield of 30% weight/weight (ethanol production over substrate input). This would enable free kitchen waste to be used for fuel production with a higher ethanol yield than corn or other costly sources of biomass. My process would decrease the amount of waste that needs to go into landfills while providing fuel.

Kitchen waste is mainly composed of cellulose, a polysaccharide (complex sugar) that is very difficult to break down. There are two stages in cellulosic ethanol production: saccharification (during which cellulose is broken down into glucose monomers) and fermentation (during which glucose is fermented into ethanol and carbon dioxide using yeast.) In industrial processes, boiling sulfuric acid is used for saccharification. However, in some fungi and in cows' stomachs, an enzyme complex called cellulase enables some organisms to break down cellulose for fuel. Because I needed my process to be safe for home use, I decided to try to use cellulase for saccharification instead of boiling acid. I used common Baker's yeast for fermentation.

In the first stage of the project, I conducted five experiments to identify the most efficient conditions for ethanol production. The experiments showed that a one-vessel reactor operating at room

temperature using very little cellulase and a short time span could be used efficiently for ethanol production. However, the experiments also showed that a high yeast ratio and high water content are necessary to achieve the goal ethanol yield. A batch variability study showed that over different batches of kitchen waste, the ethanol yield stayed consistently above 30% with an average at 34.7%. Finally, I demonstrated my procedure for ethanol production in a kitchen blender. The demonstration reactor had no energy inputs except for a few seconds of pretreatment blending.