Pharmaceuticals and nanoparticles have been released into the aquatic ecosystem. Removing these contaminants from waters can be a challenge. This study explores the possibility of using algae to remove these contaminants. Algae from different locations were first tested looking for any trace of pharmaceutical contaminants in the algae biomass. Ibuprofen and estradiol were detected in some algal biomasses. That gave us a starting point that pharmaceuticals in the water have been transferred into the algae biomass. A mixture of six pharmaceuticals with various solubility were studied. Analysis of test water subjected to algae showed pharmaceutical
removal rates varied and specific to each pharmaceutical. Caffeine and estradiol had the highest removal rates while carbamazepine was not removed. The relative biomass density of the algal biomass exposed to pharmaceuticals was decreased for all the experiments. It seems that high concentrations of pharmaceuticals had more negative effect on the relative biomass density. Pharmaceuticals affected the organic and inorganic carbon contents and slight increase was observed at 5760 min. CHN data did not show any significant change for the algae exposed to pharmaceuticals with the exposure time. Pharmaceuticals increased the oxygen/ carbon ratio and kept hydrogen/carbon same. That means the pharmaceuticals lowered the heating values of the algae biomass. Pharmaceuticals used in this study increased the chlorophyll fluorescence intensity and absorbance with the exposure time.

The algae community was exposed to silver and gold nanoparticles and was also tested. The comparing of silver and gold ions were studied as well. Silver and gold nanoparticles were prepared according to literature studies. Data showed that biosorption of nanoparticles depends on contact time and the initial concentration. Biosorption was fast, reaching maximum efficiency in the first 24 hours. The initial concentration strongly affected the sorption process. AgNPs and Ag (I) ions had a small effect on the relative biomass density, but AuNPs and Au (III) ions had a larger effect and were decreased with the time of exposure. The algae exposed to heavy nanoparticles and ions lowered the organic content and increased the inorganic content. The algae exposed to high concentrations of silver and gold nanoparticles had the lowest organic. CHN data did not show any change in nitrogen and hydrogen contents. The nanoparticles and ions did not change the H/C ratio but did change the O/C ratio which was the highest for algae exposed to the high concentration of nanoparticles, 4.9 ppm of AgNPs and 9 ppm of AuNPs. The algae exposed to metals (nanoparticles of ions) lowered the H/C and O/C ratios which increased the heating values for the algae biomass.

Fluorescence intensity of algae exposed to nanoparticles was decreased with the harvest time and did not change in the first hour of the exposure but it was clear after 4 days. The chlorophyll absorbance of silver nanoparticles seemed not stable, but overall the absorbance was decreased.

Confocal laser microscopy was used to locate the nanoparticles in the algal cells and to transfer the nanoparticles to the bloodworms from the algae and the solution. Micrograph pictures showed that the PA-AuNPs, most likely inside the algal cells, where the nanoparticles appeared with
fluorescent with bright green color. PA-AuNP composite was transferred to the bloodworms from the solution more than from the exposed algae.