



# SMART Teams 2013-2014

## Research and Design Phase

### Messmer High School SMART Team

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### Structures of Thioredoxin Proteins TrxA and TrxC from *Mycobacterium tuberculosis* or Second Verse, Same as the First?

PDB: TrxC.pdb

**Primary Citation:** Olson, Andrew L., Neumann, Terrence S., Cai, Sheng, and Sem, Daniel. (2013). Solution structures of *Mycobacterium tuberculosis* thioredoxin C and models of intact thioredoxin system suggest new approaches to inhibitor and drug design. *Proteins: Structure, Function, and Bioinformatics* 81: 675-689.

**Format:** Alpha carbon backbone

**RP:** Zcorp with plaster

#### Description:

According to the World Health Organization, 8.6 million people became ill and 1.3 million died in 2012 from tuberculosis (TB). Thioredoxin A (TrxA) is a binding protein in the bacterium, *Mycobacterium tuberculosis*, the causative agent for TB. TB is prevalent in countries where infectious diseases have a high incidence due to weakened immune systems. TB mainly affects the lungs, but can also affect the lymphatic, circulatory, and central nervous systems. When a host organism is infected, the *Mycobacteria* in the lungs multiply often resulting in pneumonia, chest pain, and prolonged coughing. In response to this infection, host macrophages, a part of the natural immune system, engulf the *Mycobacteria* and attempt to destroy it by oxidizing bacterial proteins. To protect itself against this attack, the bacterial thioredoxin system, consisting of the redox protein thioredoxin reductase (TrxR) and the thioredoxin proteins TrxA, TrxB, and TrxC, gives electrons back to the oxidized proteins. As this system works to maintain cellular redox homeostasis, finding ways to stop it might provide a new method for treating people with TB. TrxA whose function is unknown and TrxC, whose function has been well studied, have similar structures, thus it can be hypothesized that their functions are similar. Comparing binding sites between the proteins could provide insight if TrxA reacts with TrxR similarly to TrxC. By modeling TrxA and TrxC with 3D printing technology, the Messmer SMART Team can compare the structures of the two thioredoxins, which may lead to new strategies for curing or preventing TB.



### Specific Model Information:

- The alpha carbon backbone is colored medium orchid.
- Amino acids in the active site are displayed in ball and stick and colored according to the following scheme:
  - Val 78 (391) – brown
  - Thr 67 (380) – teal
  - Cys 37 (350) – yellow
  - Trp 36 (349) – green
  - Thr 35 (348) – pink
  - Ala 34 (347) – dodger blue
  - Phe 32 (345) – medium violet red
- Hydrogen bonds are highlighted in goldenrod.
- Structural supports are colored papaya whip.

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