BIO 480/680 Lab Exercise 8
Lizard Energy Budget Model
Due date: 30 March 2017

This exercise involves developing a program to solve the lizard energy budget using Newton’s method. You should be able to modify your previous program (root finding) to solve the energy budget. See the lizard budget handout for the relevant energy equations. The lizard data are as follows:

- Insulation resistance: 0.002 m$^2$ °C W$^{-1}$
- Mass: 0.067 kg
- Surface area: 0.018 m$^2$
- Animal emissivity: 0.95

We will consider a hot, sunny summer day during which lizards can come out of their underground burrow to hunt for food – but only if they will not overheat!

- Radiation absorbed: 700 W m$^{-2}$
- Wind speed: 2.0 m/s
- Air temperature: 40 °C
- Maximum body core temp.: 45 °C

The default, typical diameter for these lizards is 0.01 m. If your program is setup correctly, this should give a body temperature of about 43.2 °C, given the environmental conditions shown above.

Use your animal energy budget model to determine how large of a lizard can be out in the sun without overheating under these conditions. So you should try lizards smaller and larger than the default size until you can figure out how lizard size affects body temperature and therefore the maximum lizard size that will keep the body temperature from exceeding 45 °C. Your results should be presented in the form of a graph showing lizard body temperature as a function of body size.

Note that we are changing the lizard size and you might expect this to change the body mass / surface area ratio. But we will simplify this project by keeping those values constant for all lizard sizes.

**Programming notes:** If you wrote a good program for the previous project, you should only have to modify the actual function that is being solved. So instead of that function containing $x^2 - 7$, it will contain the complete lizard energy budget as described in class and in the handout summarizing the lizard energy budget. (1) Remember that the function you want to solve is the last one on the aforementioned handout, where we have eliminated the surface temperature as a term and now the outgoing radiation and convection terms include metabolic and evaporation energies. Of course, this will mean that your program will have to calculate the metabolic and evaporation energies before they need to be used in calculating the outgoing radiation and convection terms. (2) Also remember that the metabolism and evaporation energies have to be multiplied by the animal's mass to surface area ratio to convert the energy per mass units into per area units.