

## **Instructor Notes: Land Surface Experiment**

### **Materials**

- Heat lamp and stand
- Tubes filled with different land surfaces (approximately 5 cm in diameter): gravel, mulch, asphalt, grass, and soil
  - Two (or three) per land cover type
  - Ensure the bottom of the tubes are sealed
- Handheld IR thermometers
- Water bottle or graduated cylinder
- Analytical balance measured to at least nearest 0.1 g
- Infrared camera, tripod, and monitor (*optional*)
- Portable infrared cameras for walking tour (*optional*)
- Ethanol spray bottle (*optional*)

### **Suggested Lesson Plan (for 2.5-3 hour lab block)**

- Setup of the apparatus, initial measurements (*30 min*)
  - Set up the heat lamp, thermal infrared camera, and computer screen before students arrive
  - Students will have two tubes of each surface type, one dry and one they fill with water to the top of the land surface
  - Conduct initial measurements: time recorded, initial mass of each tube, initial surface temperature, area of each tube opening (diameter, or radius)
- Derivation of energy balance equations and discussions of assumptions (*30 min*)
  - Mass Balance, Energy Balance, Sensible and Latent Heat Fluxes, Evapotranspiration (ET) rate from Latent Heat Flux
  - Set up example calculations for all equations in a spreadsheet
- Campus walk with thermal infrared camera(s) and discussion of urban heat across different surfaces (*30–60 min*)
- Final set of measurements (*30 min*)
  - Time recorded, final mass, final surface temperature
  - Once warm, it is possible to use a 3<sup>rd</sup> set of land cover tubes and ethanol to visually demonstrate ET cooling. This is most effective when using a thermal infrared camera, allowing students to observe the rapid cooling and reheating associated with the evaporation of the ethanol.
- Calculations, answering questions (*30 min*)
  - Enter values into the spreadsheet for change in mass (mass balance) and surface temperature differences (energy balance) to calculate mass and energy balance ET for each surface type.