

10TH GRADE HIGH SCHOOL PHYSICS EDUCATION VIA SOLAR COOKING

Hezi Yizhaq^{1,2} and Daniel Feuermann¹

¹Swiss Institute for Dryland Environmental and Energy Research,

J. Blaustein Institutes for Desert Research, Ben-Gurion University of the Negev, Sede Boqer Campus, Israel.

²Sde Boqer Environmental High School Midreshet Ben-Gurion 8499000, Israel.

email: H. Yizhaq yiyeh@bgu.ac.il, D. Feuermann daniel@bgu.ac.il



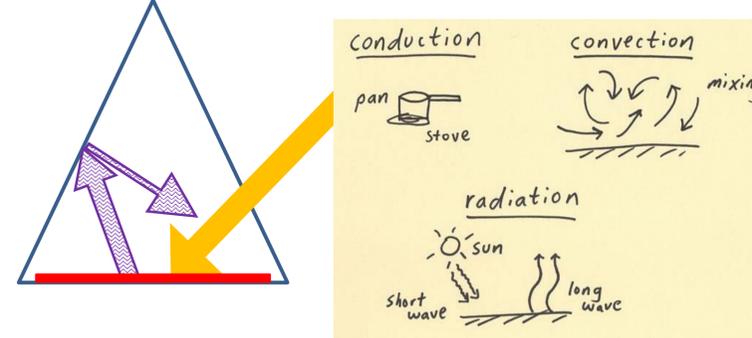
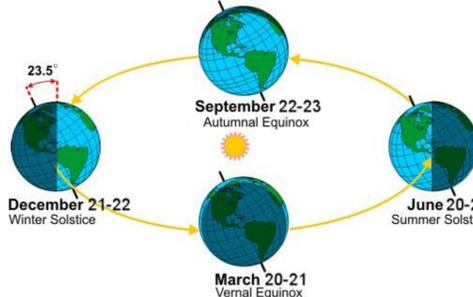
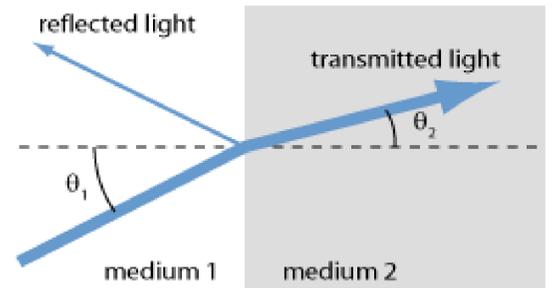
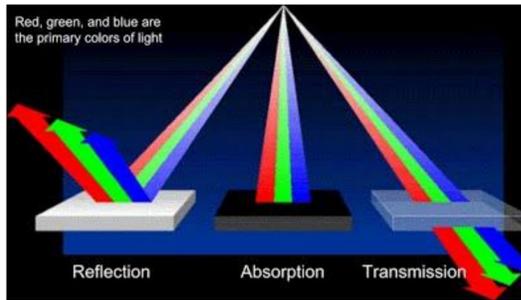
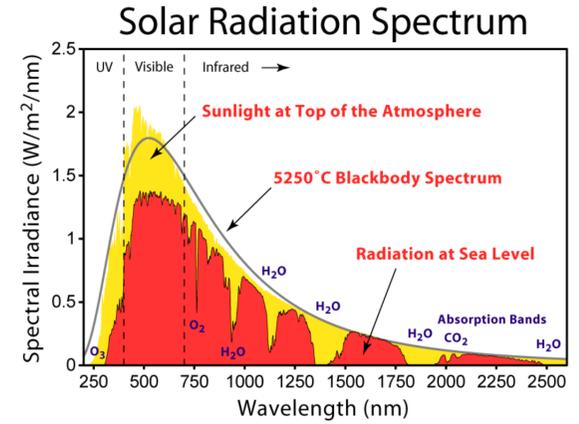
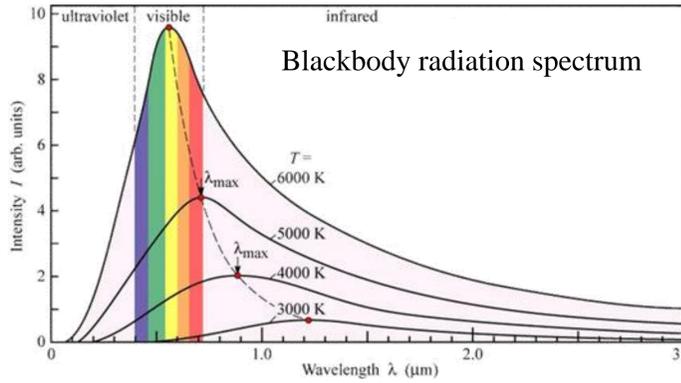
- The course involves both theory and experiment, including learning basic measurement techniques and data analysis.
- Duration of the course: two semesters; the course was taught over three years
- Program:
 - Semester A: Theory and first solar cooker designs towards the end of the semester
 - Semester B: Completing design and building the cookers. Learning experimental techniques, experimenting with the cookers.

Semester A:

- Properties of light:** electromagnetic waves
- Blackbody radiation:** function of temperature
- Solar spectrum:** visible light; near infrared
- Light-matter interaction:** spectral absorption, reflection, transmission (example aluminum mirror reflecting visible near and far infrared (IR); white paint reflecting visible and near IR but not far IR); glass is transparent in the solar spectrum but not in the far infrared – ‘greenhouse effect’.
- Refraction:** how do lenses work
- Heat transfer:** conduction, convection and radiation (radiation heat loss for cookers is in far infrared).
- Concept of radiation intercept:** (Cosine of the angle between the radiation and the normal on the surface).
- Greenhouse effect:** Trapping thermal radiation due to glass (or plastic) transmission being a function of the spectrum.
- Concentration:** purpose of concentration is to reduce area for heat loss.
- Solar geometry:** Origin of the seasons – due to the tilt of the earth’s axis of rotation.

Semester B

- Solar cooker design:** Panel, box or concentrating cooker. In-class discussions.
- Solar cooker construction:** Produced with low-cost material, cardboard, polycarbonate sheets, aluminum foil, glue, Perspex (for glazing).
- Measurement instruments:** Radiation – the working of a solarimeter, temperature measurement (thermocouples), data logger.
- Testing the cookers:** How to define efficiency of a cooker? What is more important? The speed at which the cooker heats up or the stagnation temperature (what is it?). How can one measure it? What is a thermocouple, how does it work?



Testing and competition of box cookers

