Group name: _____ **Date:** _____
Team members: _____

Daylighting Design & Technique Worksheet
Answers

Part 1 – Design

Design a 1,000 sq. ft. house without using any daylighting techniques or methods.

Sketch:

Answers will vary

Lighting

Suppose you decide to use standard 60-watt incandescent light bulbs in your house. Estimate how many bulbs you will need, and approximate the amount of time each bulb will be used per day. Based on your estimates, compute the total electricity consumption in one day attributed to lighting (give your answer in kilowatt-hours)

$$electricity\ consumption = \frac{(\#\ of\ bulbs) * (bulb\ wattage) * (average\ \#\ of\ hours\ per\ bulb)}{(1000\ watts/kilowatt)}$$

1. Indicate number of bulbs and hours per day of operation: EXAMPLE ANSWER
   - 5 bulbs at 5 hours per day
   - 3 bulbs at 2 hours per day
   - 60 watt bulbs
2. Calculate average # of hours per bulb:

$$Avg\ hours\ per\ bulb = \frac{(5\ bulbs * 5\ hours) + (3\ bulbs * 2\ hours)}{8\ bulbs\ total} = 3.875\ hours$$

3. Calculate energy consumption :

$$electricity\ consumption = \frac{(8\ bulbs) * (60\ W) * \left(3.875\ {}^{hrs}/_{bulb}\right)}{(1000\ W/kW)} = 1.86\ kWh$$

Answer: 1.86 kWh

Part 2 – Investigation and Re-Design

Using what you have learned, implement a daylighting system into the design of your house. Consider the position of the sun when deciding where to place windows and other daylighting devices. Indicate which cardinal direction the house should face and why.

Sketches:

Answers will vary

Part 3 – Build

Build your model house according to your design. Make any necessary modifications.

Part 4 – Testing

Test your modified model house using a desk lamp to simulate the sun. Record any observations about the levels of natural light in each room due to your daylighting devices. Determine whether or not this has an impact on the amount of artificial light you designed the house to use.

Answers will vary

Because of your implemented system of daylighting, you should be able to reduce the amount of artificial lights required, the usage time of certain bulbs, or both.

Decide which lights can be removed or used for less time than stated earlier. Calculate the total energy savings per day attributed to daylighting (give your answer in kWh).

$$total\ energy\ savings = (energy\ consumption\ before\ daylighting) - (energy\ consumption\ after\ daylighting)$$

1. Indicate changes to required lighting: EXAMPLE ANSWER

- 1 bulb (5 hr/day) can be removed
- 3 bulbs can be reduced from 5 hours/day to 3 hours/day

2. Compute new average time of use per bulb:

$$Avg\ hours\ per\ bulb = \frac{(1\ bulbs * 5\ hours) + (3\ bulbs * (5\ hours - 3\ hours) + (3\ bulbs * 2\ hours)}{8\ bulbs\ total} = 2.125\ hours$$

3. Compute new electricity consumption:

$$electricity\ consumption = \frac{(7\ bulbs) * (60\ W) * (2.125\ ^{hrs}/_{bulb})}{(1000\ W/kW)} = 0.8925\ kWh$$

4. Calculated total energy savings:

$$total\ energy\ savings = (1.86\ kWh) - (0.8925\ kWh) = 0.9675\ kWh$$

Answer: 0.9675 kWh

Questions:

Does your house account for differences in solar altitude between summer and winter? If so, how? If not, explain how it might.

Answers will vary

What kind of lighting is provided by each different daylighting technique you used (dispersed, concentrated, high/low level of luminous flux)?

Answer: Depends upon devices used and models. Examples:
Solar tube: Dispersed light from many different angles
Light shelf: Illumination of ceiling, reflected light dispersed throughout space
Clerestory window: Concentrated level of luminous flux

How could you improve your design?

Answers will vary; may include re-location or addition of daylighting techniques and/or modification of interior walls for more open floor plan, etc.