

THE OPTICS OF LIFE

ONE: INTRODUCTION

What is light?
What this book is
What this book is not

TWO: UNITS AND GEOMETRY

Photons versus watts
Frequency versus wavelength
Irradiance
Radiance
The conservation of radiance
Photometric units
In conclusion

THREE: EMISSION

Thermal radiation
Sunlight and skylight
Twilight
Moonlight
Moonless nights
The aurora
Light pollution
Bioluminescence
Mechanoluminescence
Sonoluminescence

FOUR: ABSORPTION

Light and matter
Absorptivity, absorptance, absorption, absorbance, absorbilicious
Going from absorbance to absorption: The absorption coefficient
Absorption and scattering
Absorption and color
Seeing things upside-down
Visual pigments

FIVE: SCATTERING

Refractive index
How light scattering is measured
Small particles
Large particles
Medium particles
Hiding power
Scattering by large collections of particles
Multiple scattering
Back to refractive index

SIX: SCATTERING WITH INTERFERENCE

Interference in a very small nutshell
Does light travel in a straight line? Transparency
Does light bounce? Reflection

Does light bend? Refraction
Photonic crystals
Conclusion

SEVEN: FLUORESCENCE

Excitation, emission and efficiency
How fluorescence can make things appear brighter
Fluorescence in animals
Phosphorescence and inelastic scattering
Conclusion

EIGHT: POLARIZATION

Kinds of polarization
Partial polarization
Sources of polarized light
Birefringence
Detection of polarized light by animals
Ecological functions of polarization sensitivity
Final word of warning

NINE: MEASURING LIGHT

Types of spectrometers
How to use a spectrometer
Getting the most out of your spectrometer
Reflectance
Transmission
Calibration
Irradiance
Radiance
Scattering coefficient
Volume scattering function

TEN: WHAT IS LIGHT, REALLY?

The two-slit experiment
Quantum entanglement
The end of the road

APPENDICES

Converting spectral irradiance to lux
Calculating the absorbance spectrum of a visual pigment
Refractive indices of common substances
Optical properties of very clear water
Optical properties of natural waters
Useful formulas
Equipment and software suppliers

BIBLIOGRAPHY

INDEX