TEACHER GUIDE

Includes Student Worksheets

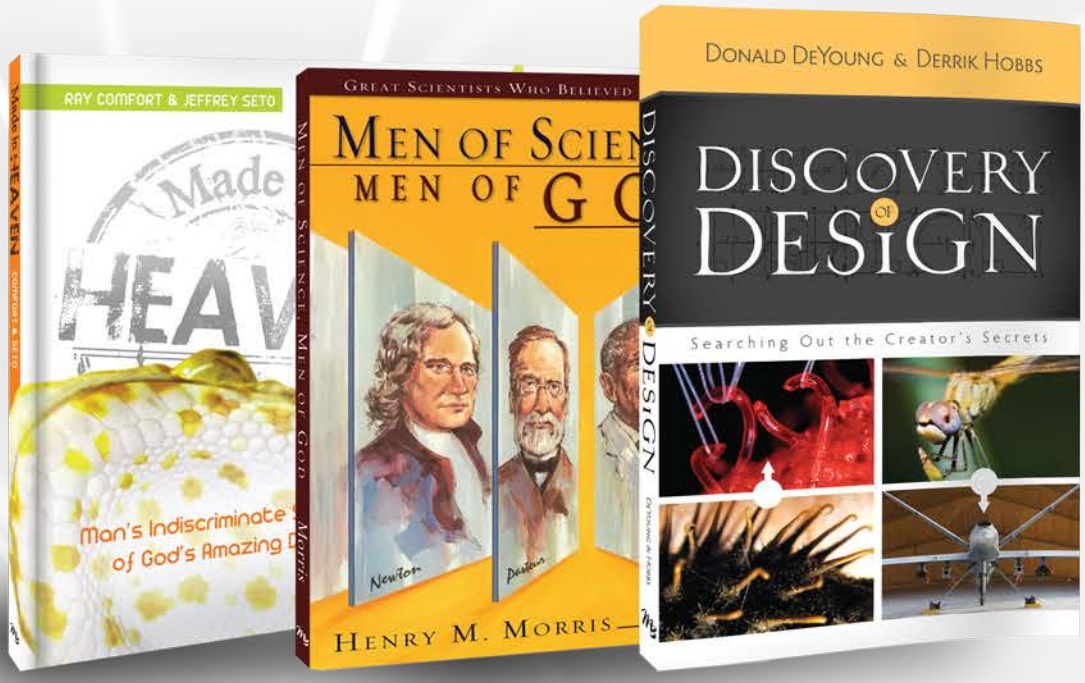
7th–9th Grade

Applied Science

- Answer Keys
- Weekly Lesson Schedule
- Worksheets
- Quizzes & Tests

APPLIED ENGINEERING

Studies of God's Design in Nature



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Applied Engineering: Studies of God's Design in Nature

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Author Bios:
Jeff Seto has worked as an aerospace engineer in experimental research and development for over 20 years; holds a B. Eng in aerospace and an electrical engineering diploma in avionics.

Ray Comfort is a best-selling author of more than 70 books, and the president of Living Waters ministry.

Dr. Henry Morris is known as the father of modern Creation science, the founder of Institute for Creation Research (ICR) and the author of many well-known apologetic books.

Don DeYoung is Chairman of the Science and Mathematics Department, Grace College, Winona Lake, Indiana.

Derrik Hobbs has an active interest in creation studies, including business models based on principles and processes found in nature.

Using This Teacher Guide

Features: The suggested weekly schedule enclosed has easy-to-manage lessons that guide the reading, worksheets, and all assessments. The pages of this guide are perforated and three-hole punched so materials are easy to tear out, hand out, grade, and store. Teachers are encouraged to adjust the schedule and materials needed in order to best work within their unique educational program.

Lesson Scheduling: Students are instructed to read the pages in their book and then complete the corresponding section provided by the teacher. Assessments that may include worksheets, activities, quizzes, and tests are given at regular intervals with space to record each grade. Space is provided on the weekly schedule for assignment dates, and flexibility in scheduling is encouraged. Teachers may adapt the scheduled days per each unique student situation. As the student completes each assignment, this can be marked with an "X" in the box.

	**Approximately 30 to 45 minutes per lesson, four days a week**
	**Includes answer keys for worksheets, quizzes, and tests**
	**Worksheets for each section**
	**Quizzes and tests are included to help reinforce learning and provide assessment opportunities.**
	**Designed for grades 7 to 9 in a one-year course to earn 1 science credit**
	**Applied Learning Activities**

Course Objectives: Students completing this course will

- Evaluate how things like batteries, human organ repair, microlenses, automotive engineering, paint, and even credit card security all have links to natural designs
- Review how design in nature reveals the fingerprint of our Creator
- Discover how the glow of a cat's eyes innovates road reflectors
- Investigate the naturally sticky inspirations for Velcro® and barbed wire, as well as how a fly's ear, the lizard's foot, the moth's eye, and other natural examples are inspiring improvements and new technologies in our lives
- Study the life of the "forgotten" inventor, Joseph Henry, whose exploration of electricity set the standard for later innovators
- Identify how the exploration of practical intelligent design in nature offers a new paradigm for science inquiry.

Course Description

This *Applied Engineering: Studies of God's Design in Nature* teacher guide contains materials for use with *Made in Heaven, Men of Science, Men of God*, and *Discovery of Design*. From the frontiers of scientific discovery, researchers are now taking design elements from the natural world and creating extraordinary breakthroughs that benefit our health, our quality of life, and our ability to communicate, and even help us work more efficiently. An exciting look at cutting-edge scientific advances, the course highlights incredible examples that include innovations like solar panels in space unfurled using technology gleaned from beech tree leaves, and optic research rooted in the photonic properties of opal gemstones.

Science continually borrows from God's creation, yet refuses to give God the glory. Engineers and inventors have long examined God's creation to understand and copy complex, proven mechanics of design in the science known as biomimicry. Much of this inspiration is increasingly drawn from amazing aspects of nature in search of wisdom and insight. We are surrounded daily by scientific advancements that have become everyday items, simply because man is copying from God's incredible creation.

There is nothing in science that can ever prove that God does not exist and therefore, no way that science can disprove the possibility of miracles or of true creation. Science cannot either prove or disprove such things, and so a scientist can decide for himself whether he will believe them. The observed facts and data of science can support him in this choice or otherwise, but they can never compel it. It is completely wrong for people to assume — as they often do — that a true scientist cannot simultaneously be a true man of God, believing in God as Creator and Savior and believing the Bible as God's revelation. Dr. Henry Morris presents 101 biographies which include Christian testimonies of scientists who believed in the Bible and in a personal Creator God . . . scientists who were pioneers and "founding fathers" of modern scientific disciplines.

Note: Answers to the Digging Deeper portions of the worksheets can be found in the back of the *Discovery of Design* text used for this course.

Research Paper

Before the end of this course, a student is required to write a research paper on an inventor from *Men of Science, Men of God*. One can begin reading the book and exploring the inventors in anticipation of this paper.

First Semester Suggested Daily Schedule

Date	Day	Assignment	Due Date	✓	Grade
		First Semester–First Quarter			
Week 1	Day 1	Introduction & Ch 1: Microorganisms: Bacteria-Micro-motor Read Pages 8–13, 188 (the appropriate answer section) *Discovery of Design* • (DoD) Discovery of Design: Intro & Worksheet 1 • Pages 16–17 Teacher Guide • (TG)			
	Day 2	Ch 1: Bacteria-Battery • Read Pages 14–15, 189 • (DoD) Discovery of Design: Worksheet 2 • Page 18 • (TG)			
	Day 3	Ch 1: Biofilm-Bacteria Control • Read Pages 16–17, 189 • (DoD) Discovery of Design: Worksheet 3 • Page 19 • (TG)			
	Day 4	Ch 1: Diatom-Nanotechnology • Read Pages 18–19, 190 • (DoD) Discovery of Design: Worksheet 4 • Page 20 • (TG)			
	Day 5				
Week 2	Day 6	Ch 1: Protien-Solar Cells • Read Pages 20–21, 190 • (DoD) Discovery of Design: Worksheet 5 • Page 21 • (TG)			
	Day 7	Ch 2: The Insect World: Ants-Airlines Read Pages 23–25, 191 • (DoD) Discovery of Design: Intro & Worksheet 1 • Pages 22–23 • (TG)			
	Day 8	Ch 2: Asian Beetle-Paper Whitener Read Pages 26–27, 191 • (DoD) Discovery of Design: Worksheet 2 • Page 24 • (TG)			
	Day 9				
	Day 10				
Week 3	Day 11	Ch 2: Bombardier Beetle-Gas Turbine Engine Read Pages 28–29, 191 • (DoD) Discovery of Design: Worksheet 3 • Page 25 • (TG)			
	Day 12	Ch 2: Butterfly-Cosmetics • Read Pages 30–31, 192 • (DoD) Discovery of Design: Worksheet 4 • Page 26 • (TG)			
	Day 13	Ch 2: Dragonfly-Surveillance • Read Pages 32–33, 192 • (DoD) Discovery of Design: Worksheet 5 • Page 27 • (TG)			
	Day 14	Ch 2: Firefly-Light Stick • Read Pages 34–35, 193 • (DoD) Discovery of Design: Worksheet 6 • Page 28 • (TG)			
	Day 15				
Week 4	Day 16	Ch 2: Fly-Hearing Aid • Read Pages 36–37, 193 • (DoD) Discovery of Design: Worksheet 7 • Page 29 • (TG)			
	Day 17	Ch 2: Honey Bee-Surveillance • Read Pages 38–39, 194 • (DoD) Discovery of Design: Worksheet 8 • Page 30 • (TG)			
	Day 18	Ch 2: Insect Hearing-Atomic Force Microscope Read Pages 40–41, 194 • (DoD) Discovery of Design: Worksheet 9 • Page 31 • (TG)			
	Day 19	Ch 2: Insects-Robotics • Read Pages 42–43, 195 • (DoD) Discovery of Design: Worksheet 10 • Page 32 • (TG)			
	Day 20				

Date	Day	Assignment	Due Date	✓	Grade
Week 5	Day 21	Ch 2: Namib Beetle-Water Collector Read Pages 44–45, 195 • (DoD) Discovery of Design: Worksheet 11 • Page 33 • (TG)			
	Day 22	Ch 2: Spider Silk-Fiber Optics • Read Pages 46–47, 196 • (DoD) Discovery of Design: Worksheet 12 • Page 34 • (TG)			
	Day 23	Ch 2: Termite Mound-Ventilation Read Pages 48–49, 196 • (DoD) Discovery of Design: Worksheet 13 • Page 35 • (TG)			
	Day 24	Ch 2: Timber Beetle Larva • Read Pages 50–51, 196 • (DoD) Discovery of Design: Worksheet 14 • Page 36 • (TG)			
	Day 25				
Week 6	Day 26	Ch 2: Wasp-Paper • Read Pages 52–53, 197 • (DoD) Discovery of Design: Worksheet 15 • Page 37 • (TG)			
	Day 27	Ch 2: Water Strider-Water Repellent Read Pages 54–55, 197 • (DoD) Discovery of Design: Worksheet 16 • Page 38 • (TG)			
	Day 28	**Discovery of Design: Ch.1–2 Quiz 1** • Pages 191–192 • (TG)			
	Day 29	Ch 3: Flight: Bat-Sonar Systems Read Pages 57–59, 198 • (DoD) Discovery of Design: Worksheet 1 • Page 39 • (TG)			
	Day 30				
Week 7	Day 31	Ch 3: Bird Flight-Aircraft • Read Pages 60–61, 198 • (DoD) Discovery of Design: Worksheet 2 • Page 40 • (TG)			
	Day 32	Ch 3: Flying Reptile-Delta Wing Aircraft Read Pages 62–63, 199 • (DoD) Discovery of Design: Worksheet 3 • Page 41 • (TG)			
	Day 33	Ch 3: Kingfisher- Bullet Train • Read Pages 64–65, 199 • (DoD) Discovery of Design: Worksheet 4 • Page 42 • (TG)			
	Day 34	Ch 3: Owl Wing-Noise Reduction Read Pages 66–67, 200 • (DoD) Discovery of Design: Worksheet 5 • Page 43 • (TG)			
	Day 35				
Week 8	Day 36	Ch 3: Swift-Aircraft Wings • Read Pages 68–69, 200 • (DoD) Discovery of Design: Worksheet 6 • Page 44 • (TG)			
	Day 37	Ch 3: Toucan Beak-Shock Absorber Read Pages 70–71, 201 • (DoD) Discovery of Design: Worksheet 7 • Page 45 • (TG)			
	Day 38	Ch 4: Underwater Life: Boxfish-Automobile Design Read Pages 73–75, 201 • (DoD) Discovery of Design: Worksheet 1 • Page 47 • (TG)			
	Day 39	Ch 4: Brittlestar-Microlens • Read Pages 76–77, 202 • (DoD) Discovery of Design: Worksheet 2 • Page 48 • (TG)			
	Day 40				

Date	Day	Assignment	Due Date	✓	Grade
Week 9	Day 41	Ch 4: Cuttlefish-Camouflage • Read Pages 78–79, 202 • (DoD) Discovery of Design: Worksheet 3 • Page 49 • (TG)			
	Day 42	Ch 4: Elephant Nose Fish-Electric Sensor Read Pages 80–81, 203 • (DoD) Discovery of Design: Worksheet 4 • Page 50 • (TG)			
	Day 43	Ch 4: Fish Motion-Ship Propulsion Read Pages 82–83, 203 • (DoD) Discovery of Design: Worksheet 5 • Page 51 • (TG)			
	Day 44	Ch 4: Lobster Eye-Telescope Lens Read Pages 84–85, 204 • (DoD) Discovery of Design: Worksheet 6 • Page 52 • (TG)			
	Day 45				
First Semester–Second Quarter					
Week 1	Day 46	Ch 4: Mussels-Adhesive • Read Pages 86–87, 204 • (DoD) Discovery of Design: Worksheet 7 • Page 53 • (TG)			
	Day 47	Ch 4: Octopus-Robotics • Read Pages 88–89, 205 • (DoD) Discovery of Design: Worksheet 8 • Page 54 • (TG)			
	Day 48	Ch 4: Seashell-Construction Material Read Pages 90–91, 205 • (DoD) Discovery of Design: Worksheet 9 • Page 55 • (TG)			
	Day 49	Ch 4: Sea Slug-Chemicals • Read Pages 92–93, 206 • (DoD) Discovery of Design: Worksheet 10 • Page 56 • (TG)			
	Day 50				
Week 2	Day 51	Ch 4: Sea Sponge-Fiber Optics-Chemicals Read Pages 94–95, 206 • (DoD) Discovery of Design: Worksheet 11 • Page 57 • (TG)			
	Day 52	Ch 4: Whale-Submarine • Read Pages 96–97, 206 • (DoD) Discovery of Design: Worksheet 12 • Page 58 • (TG)			
	Day 53	**Discovery of Design: Ch. 3–4 Quiz 2** • Pages 195–198 • (TG)			
	Day 54	Ch 5: Land Animals: Ankylosaurus-Fiberglass Read Pages 99–101, 207 • (DoD) Discovery of Design: Worksheet 1 • Page 59 • (TG)			
	Day 55				
Week 3	Day 56	Ch 5: Antler-Organ Repair • Read Pages 102–103, 207 • (DoD) Discovery of Design: Worksheet 2 • Page 60 • (TG)			
	Day 57	Ch 5: Dog Paw-Shoe Soles • Read Pages 104–105, 208 • (DoD) Discovery of Design: Worksheet 3 • Page 61 • (TG)			
	Day 58	Ch 5: Gecko-Adhesive • Read Pages 106–107, 208 • (DoD) Discovery of Design: Worksheet 4 • Page 62 • (TG)			
	Day 59	Ch 5: Giraffe-Antigravity Spacesuit Read Pages 108–109, 208 • (DoD) Discovery of Design: Worksheet 5 • Page 63 • (TG)			
	Day 60				

Date	Day	Assignment	Due Date	✓	Grade
Week 4	Day 61	Ch 5: Horse Bone-Construction Read Pages 110–111, 209 • (DoD) Discovery of Design: Worksheet 6 • Page 64 • (TG)			
	Day 62	Ch 5: Penguin Eye-Sunglasses Read Pages 112–113, 209 • (DoD) Discovery of Design: Worksheet 7 • Page 65 • (TG)			
	Day 63	Ch 5: Tree Frog-Automobile Tires Read Pages 114–115, 210 • (DoD) Discovery of Design: Worksheet 8 • Page 66 • (TG)			
	Day 64	Ch 6: People: Body Odor-Insect Repellent Read Pages 117–119, 210 • (DoD) Discovery of Design: Worksheet 1 • Page 67 • (TG)			
	Day 65				
Week 5	Day 66	Ch 6: DNA-Computer Memory Read Pages 120–121, 210 • (DoD) Discovery of Design: Worksheet 2 • Page 68 • (TG)			
	Day 67	Ch 6: DNA-Eardrum-Earphone Read Pages 122–123, 211 • (DoD) Discovery of Design: Worksheet 3 • Page 69 • (TG)			
	Day 68	Ch 6: Eye Iris-Identification • Read Pages 124–125, 211 • (DoD) Discovery of Design: Worksheet 4 • Page 70 • (TG)			
	Day 69	Ch 6: Fibrin-Elastic • Read Pages 126–127, 212 • (DoD) Discovery of Design: Worksheet 5 • Page 71 • (TG)			
	Day 70				
Week 6	Day 71	Ch 6: Fingerprint-Prosthetic Hand Read Pages 128–129, 212 • (DoD) Discovery of Design: Worksheet 6 • Page 72 • (TG)			
	Day 72	Ch 6: Leg Bone-Eiffel Tower • Read Pages 130–131, 213 • (DoD) Discovery of Design: Worksheet 7 • Page 73 • (TG)			
	Day 73	Ch 6: Muscles-Robotics • Read Pages 132–133, 213 • (DoD) Discovery of Design: Worksheet 8 • Page 74 • (TG)			
	Day 74	Ch 6: Saliva-Healing • Read Pages 134–135, 214 • (DoD) Discovery of Design: Worksheet 9 • Page 75 • (TG)			
	Day 75				
Week 7	Day 76	Ch 6: Skin-Self-repairing Plastic Read Pages 136–137, 214 • (DoD) Discovery of Design: Worksheet 10 • Page 76 • (TG)			
	Day 77	Ch 6: Tooth Enamel-Armor Coating Read Pages 138-139, 214 • (DoD) Discovery of Design: Worksheet 11 • Page 77 • (TG)			
	Day 78	Ch 6: Vernix-Skin Cream • Read Pages 140-141, 215 • (DoD) Discovery of Design: Worksheet 12 • Page 78 • (TG)			
	Day 79	**Discovery of Design: Ch. 5–6 Quiz 3** • Pages 199–202 • (TG)			
	Day 80				

Date	Day	Assignment	Due Date	✓	Grade
Week 8	Day 81	Ch 7: Vegetation: Beech Leaf-Space Antenna Read Pages 143–145, 215 • (DoD) Discovery of Design: Worksheet 1 • Page 79 • (TG)			
	Day 82	Ch 7: Chemicals-Medicine • Read Pages 146–149, 216 • (DoD) Discovery of Design: Worksheet 2 • Page 80 • (TG)			
	Day 83	Ch 7: Cocklebur-Velcro • Read Pages 150–151, 216 • (DoD) Discovery of Design: Worksheet 3 • Page 81 • (TG)			
	Day 84	Ch 7: Fava Bean-Valve • Read Pages 152–153, 217 • (DoD) Discovery of Design: Worksheet 4 • Page 82 • (TG)			
	Day 85				
Week 9	Day 86	Ch 7: Fescue Grass-Herbicide Read Pages 154–155, 217 • (DoD) Discovery of Design: Worksheet 5 • Page 83 • (TG)			
	Day 87	Ch 7: Lotus Flower-Surface Cleaner Read Pages 156–157, 217 • (DoD) Discovery of Design: Worksheet 6 • Page 84 • (TG)			
	Day 88	Ch 7: Osage Orange-Barbed Wire Read Pages 158–159, 218 • (DoD) Discovery of Design: Worksheet 7 • Page 85 • (TG)			
	Day 89	Ch 7: Pine Cone-Smart Clothes Read Pages 160–161, 218 • (DoD) Discovery of Design: Worksheet 8 • Page 86 • (TG)			
	Day 90				
		Mid-Term Grade			

Date	Day	Assignment	Due Date	✓	Grade
		Second Semester–Third Quarter			
Week 1	Day 91	Ch 7: Rubber Tree-Automobile Tires Read Pages 162–163, 219 • (DoD) Discovery of Design: Worksheet 9 • Page 87 • (TG)			
	Day 92	Ch 7: Skunk Cabbage-Thermostat Read Pages 164–165, 219 • (DoD) Discovery of Design: Worksheet 10 • Page 88 • (TG)			
	Day 93	Ch 7: Spinach-Solar Cell • Read Pages 166–167, 220 • (DoD) Discovery of Design: Worksheet 11 • Page 89 • (TG)			
	Day 94	Ch 7: Venus Flytrap-Food Packaging Read Pages 168–169, 220 • (DoD) Discovery of Design: Worksheet 12 • Page 90 • (TG))			
	Day 95				
Week 2	Day 96	Ch 7: Water Lily-Construction • Read Pages 170–171, 221 • (DoD) Discovery of Design: Worksheet 13 • Page 91 • (TG)			
	Day 97	Ch 7: Wild Wheat-Humidity Sensor Read Pages 172–173, 221 • (DoD) Discovery of Design: Worksheet 14 • Page 92 • (TG)			
	Day 98	Ch 8: Nonliving Objects: Buckyballs-Micro Ball Bearings Read Pages 175–177, 221 • (DoD) Discovery of Design: Worksheet 1 • Page 93 • (TG)			
	Day 99	Ch 8: Nanoparticles-Water Purifier Read Pages 178–179, 222 • (DoD) Discovery of Design: Worksheet 2 • Page 94 • (TG)			
	Day 100				
Week 3	Day 101	Ch 8: Opal-Photonic Device Read Pages 180–181, 222 • (DoD) Discovery of Design: Worksheet 3 • Page 95 • (TG)			
	Day 102	Ch 8: Pulsar-Time Standard • Read Pages 182–183, 223 • (DoD) Discovery of Design: Worksheet 4 • Page 96 • (TG)			
	Day 103	Ch 8: Water Flow-Impeller & Conclusion Read Pages 184–187, 223 • (DoD) Discovery of Design: Worksheet 5 • Page 97 • (TG)			
	Day 104	**Discovery of Design: Ch. 7–8 Quiz 4** • Pages 203–206 • (TG)			
	Day 105				
Week 4	Day 106	**Discovery of Design: Ch. 1–8 Test** • Pages 207–210 • (TG)			
	Day 107	Forward & Intro • Read Pages 1–7 • *Made in Heaven* • (MiH) Made in Heaven: Worksheet 1 • Page 101 • (TG)			
	Day 108	Ch 1: Swim Like a Fish • Read Pages 8–9 • (MiH) Made in Heaven: Worksheet 1 • Page 103–104 • (TG)			
	Day 109	Introduction: • Read Pages 5–10 • *Men of Science, Men of God* • (MOS)			
	Day 110				

Date	Day	Assignment	Due Date	✓	Grade
Week 5	Day 111	Ch 1: Swim Like a Fish Made in Heaven: Worksheet 2 • Pages 105–106 • (TG)			
	Day 112	Ch 2: Body Armor of the Future • Read Pages 10-11 • (MiH) Made in Heaven: Worksheet 1 • Pages 107–108 • (TG)			
	Day 113	Ch 3: Stronger than Kevlar • Read Pages 12-13 • (MiH) Made in Heaven: Worksheet 1 • Pages 109–110 • (TG)			
	Day 114	Ch 1: • Read Pages 11–13 • (MOS)			
	Day 115				
Week 6	Day 116	Ch 4: Pinecone Fashion... • Read Pages 14–15 • (MiH) Made in Heaven: Worksheet 1 • Pages 111-112 • (TG)			
	Day 117	Ch 4: Pinecone Fashion Coming Soon to a Mall Near You Made in Heaven: Worksheet 2 • Pages 113–114 • (TG)			
	Day 118	Ch 5: Cleaning Like a Lotis Leaf • Read Pages 16-17 • (MiH) Made in Heaven: Worksheet 1 • Pages 115–116 • (TG)			
	Day 119	Ch 2: • Read Pages 15–17 • (MOS)			
	Day 120				
Week 7	Day 121	Ch 6: Robosquid and Jet Propulsion Read Pages 18–19 • (MiH) Made in Heaven: Worksheet 1 • Pages 117–118 • (TG)			
	Day 122	Ch 7: Mantis Shrimp Eye... • Read Pages 20–21 • (MiH) Made in Heaven: Worksheet 1 • Pages 119–120 • (TG)			
	Day 123	Ch 7: Mantis Shrimp Eye Improves Next Wave of... Made in Heaven: Worksheet 2 • Pages 121–122 • (TG)			
	Day 124	Ch 3: • Read Pages 19–30 • (MOS)			
	Day 125				
Week 8	Day 126	Ch 8: Butterflies Prevent... • Read Pages 22–23 • (MiH) Made in Heaven: Worksheet 1 • Pages 123–124 • (TG)			
	Day 127	**Made in Heaven: Ch. 1–8 Quiz 1** • Pages 211–214 • (TG)			
	Day 128	Ch 9: Human Eye • Read Pages 24-25 • (MiH) Made in Heaven: Worksheet 1 • Pages 125–126 • (TG)			
	Day 129	Ch 4: • Read Pages 31–41 • (MOS)			
	Day 130				
Week 9	Day 131	Ch 9: Human Eye — A Better Camera Lens Made in Heaven: Worksheet 2 • Pages 127–128 • (TG)			
	Day 132	Ch 10: Computer Virus Software... • Read Pages 26–27 • (MiH) Made in Heaven: Worksheet 1 • Pages 129–130 • (TG)			
	Day 133	Ch 10: Computer Virus Software... Made in Heaven: Worksheet 2 • Pages 131–132 • (TG)			
	Day 134	Ch 5: • Read Pages 43–59 • (MOS)			
	Day 135				

Date	Day	Assignment	Due Date	✓	Grade
		Second Semester–Fourth Quarter			
Week 1	Day 136	Ch 11: The Human Brain... • Read Pages 28–29 • (MiH) Made in Heaven: Worksheet 1 • Page 133–134 • (TG)			
	Day 137	Ch 11: The Human Brain Inspires Faster Computer Chips Made in Heaven: Worksheet 2 • Pages 135–136 • (TG)			
	Day 138	Ch 12: Anti-Lasers Learn from... • Read Pages 30-31 • (MiH) Made in Heaven: Worksheet 1 • Pages 137–138 • (TG)			
	Day 139	Ch 6: • Read Pages 61–78 • (MOS)			
	Day 140				
Week 2	Day 141	Ch 13: Decoding the Bombard... • Read Pages 32–33 • (MiH) Made in Heaven: Worksheet 1 • Pages 139-140 • (TG)			
	Day 142	Ch 13: Decoding the Bombard Beetle Made in Heaven: Worksheet 2 • Pages 141–142 • (TG)			
	Day 143	Ch 14: Mosquitos Studied for... • Read Pages 34–35 • (MiH) Made in Heaven: Worksheet 1 • Pages 143–144 • (TG)			
	Day 144	Ch 7: • Read Pages 79–90 • (MOS)			
	Day 145				
Week 3	Day 146	Ch 15: Listen Like a Fly on a Wall • Read Pages 36–37 • (MiH) Made in Heaven: Worksheet 1 • Pages 145–146 • (TG)			
	Day 147	Ch 15: Listen Like a Fly on a Wall Made in Heaven: Worksheet 2 • Pages 147–148 • (TG)			
	Day 148	Ch 16: Healing Power of the Body... • Read Pages 38-39 • (MiH) Made in Heaven: Worksheet 1 • Pages 149–150 • (TG)			
	Day 149	Ch 8: • Read Pages 91–94 • (MOS)			
	Day 150				
Week 4	Day 151	**Made in Heaven: Ch. 9–16 Quiz 2** • Pages 215–218 • (TG)			
	Day 152	Ch 17: Humans Give Robotic... • Read Pages 40–41 • (MiH) Made in Heaven: Worksheet 1 • Pages 151–152 • (TG)			
	Day 153	Ch 18: Mussels with Strong... • Read Pages 42–43 • (MiH) Made in Heaven: Worksheet 1 • Pages 153–154 • (TG)			
	Day 154	Research Report • (MOS) • Worksheet 1 • Pages 155 • (TG)			
	Day 155				
Week 5	Day 156	Ch 19: Velcro® Imagined in the... • Read Pages 44–45 • (MiH) Made in Heaven: Worksheet 1 • Pages 157–158 • (TG)			
	Day 157	Ch 20: Wasp Nests and... • Read Pages 46–47 • (MiH) Made in Heaven: Worksheet 1 • Pages 159–160 • (TG)			
	Day 158	Ch 21: Cats Eyes That Saves Lives • Read Pages 48–49 • (MiH) Made in Heaven: Worksheet 1 • Pages 161–162 • (TG)			
	Day 159	Ch 22: Gecko Feet Help Robots... Read Pages 50–51 • (MiH) Made in Heaven: Worksheet 1 • Pages 163–164 • (TG)			
	Day 160				

Date	Day	Assignment	Due Date	✓	Grade
Week 6	Day 161	Ch 22: Gecko Feet Help Robots Go Vertical Made in Heaven: Worksheet 2 • Pages 165–166 • (TG)			
	Day 162	Ch 23-24: Why Fish.../Fins are... • Read Pages 52–55 • (MiH) Made in Heaven: Worksheet 1 • Page 167–168 • (TG)			
	Day 163	**Made in Heaven: Ch. 17–24 Quiz 3** • Pages 219–220 • (TG)			
	Day 164	Ch 25: Termites and.... • Read Pages 56–57 • (MiH) Made in Heaven: Worksheet 1 • Pages 169–170 • (TG)			
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Week 7	Day 166	Ch 25: Termites and Air-Conditioned Buildings Made in Heaven: Worksheet 2 • Pages 171–172 • (TG)			
	Day 167	Ch 26: Broken Bones, Healing,... • Read Pages 58–59 • (MiH) Made in Heaven: Worksheet 1 • Pages 173–174 • (TG)			
	Day 168	Ch 27: Wipers, Eyes, and... • Read Pages 60–61 • (MiH) Made in Heaven: Worksheet 1 • Pages 175–176 • (TG)			
	Day 169	Ch 27: Wipers, Eyes, and Controversy Made in Heaven: Worksheet 2 • Pages 177–178 • (TG)			
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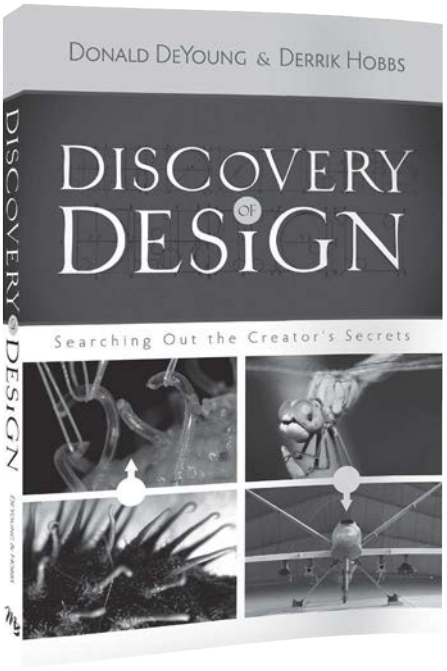
Week 8	Day 171	Ch 28: Kingfishers Break Sonic... • Read Pages 62–63 • (MiH) Made in Heaven: Worksheet 1 • Pages 179–180 • (TG)			
	Day 172	Ch 29: Worms at the Center... • Read Pages 64–65 • (MiH) Made in Heaven: Worksheet 1 • Pages 181–182 • (TG)			
	Day 173	Ch 30: Moth's Eye Inspires New... • Read Pages 66–67 • (MiH) Made in Heaven: Worksheet 1 • Pages 183–184 • (TG)			
	Day 174	Ch 31: The Astonishing Leaf... • Read Pages 68–69 • (MiH) Made in Heaven: Worksheet 1 • Pages 185–186 • (TG)			
	Day 175				
Week 9	Day 176	Ch 32: Mathematics, Sunflowers... • Read Pages 70–71 • (MiH) Made in Heaven: Worksheet 1 • Pages 187–188 • (TG)			
	Day 177	Conclusion • Read Pages 72–78 • (MiH)			
	Day 178	**Made in Heaven: Ch. 25–32 Quiz 4** • Pages 221–224 • (TG)			
	Day 179	**Made in Heaven: Ch. 1–32 Test** • Pages 225–226 • (TG)			
	Day 180				
		Final Grade			



Applied Engineering Worksheets

for Use with

Discovery of Design

Introduction

1. What is the name of the science where designs are developed from designs in nature?

2. What are the two distinct explanations for the many successful ideas derived from studying nature?

3. What is the major flaw in crediting evolution for the successful design features found in nature?

4. What is the historic definition of science?

5. What are two reasons the Creator deliberately included all the useful design features in our world?

Bacteria > Micro-motor

1. What was the year of Leeuwenhoek's discovery of "small living creatures in rain water"?

2. How do many microscopic life forms propel themselves through liquids?

3. How many of these motors would fit along a one-inch length?

4. What are the three main parts of these "motors"?

5. Describe how myxobacteria move.

Digging Deeper

6. What is the precise meaning of the words *micro* and *nano*?

7. How does the speed of an electric fan compare with the 100,000-rpm rate of the molecular motor?

8. What are the chemical properties of silly string?

Bacteria > Battery

1. Why is *Rhodoferax ferrireducens* of special interest to scientists?

2. What is the efficiency rate for production of electric energy by *Rhodoferax ferrireducens*?

3. What are bacterial batteries?

4. What is the technological challenge toward making bacterial batteries a realistic option for energy-starved areas?

5. How much sugar would it take to power a 60-watt lightbulb for a number of hours using bacterial batteries?

Digging Deeper

6. What actually is a battery?

7. Why are most energy-conversion processes inefficient?

8. How many electrons pass through a standard 60-watt light bulb in one second?

Biofilm > Bacteria Control

1. What are biofilms?

2. How do members of biofilms communicate with one another?

3. What is the ability of biofilms to affect their surroundings by hundreds of chemical compounds called?

4. What is an example of biofilms helping to block invading foreign bacteria?

5. Studies are being done to determine if biofilms can control corrosion in what fuel-related equipment?

Digging Deeper

6. Estimate the number of bacteria on your hands.

7. Where might one find freshwater biofilms?

8. What are some unusual locations of biofilms?

Diatom > Nanotechnology

1. What are diatoms?

2. Where are diatoms found?

3. Why are scientists, who are interested in nanotechnology, looking at diatoms?

4. What two chemical substances are used to harden diatom components for use as microscopic mechanical gears?

5. What does the author mean by "designer diatoms"?

Digging Deeper

6. Are diatoms plants or animals?

7. What is the mineral name for glass?

8. Diatomaceous earth is a powdered form of diatom fossils. What are some of its uses?

Protein > Solar Cells

1. How do plants capture energy from the sun?

2. Which is more efficient at capturing energy from the sun – plants or silicon solar cells?

3. What part of plants have scientists succeeded in using to create small solar cells?

4. What happens when light shines on the plant-based proteins on an electricity-conducting glass surface?

5. What is one advantage for protein solar energy cells mentioned in the book?

Digging Deeper

6. How is electric current measured?

7. How is it possible that wind power, water power, and fossil fuels are all forms of solar energy?

8. Can you name three non-solar forms of energy?

Applied Engineering Worksheets

for Use with

Made in Heaven

Become an inventor!

You have completed enough coursework to have learned how many of today's most cutting-edge innovations are inspired by God's designs in nature. As you begin the remainder of this course, you will enjoy doing simple experiments and learn information on the science behind many of these innovations.

Now here is your challenge! Take steps to become an inventor:

1. Start an invention notebook, where you will detail your thoughts, and brainstorm ideas and do rough sketches.

2. Choose something related to nature that you find interesting.

3. Develop an idea for an improvement, innovation, or invention related to this natural design or feature of nature.

4. At the beginning, try to record as many of your thoughts as possible – even if they seem impractical. Try to list at least 8 to 10 ideas.

5. Next, look at your ideas, and see which ones are really needed and can be a practical help. This is where you narrow it down from the improbable to the practical. Try to list at least three of the most practical ideas. If needed, you can do simple drawings where you try to determine whether an idea is doable or not.

6. From these three ideas, choose the one you feel is most viable or able to be done. This is your proposed invention!

7. Now imagine what it would take for your idea to become a workable invention.

8. Create a plan for how you could possibly test out your idea in terms of making it an invention.

9. List three to five reasons for why your invention is needed.

10. Then present either a project notebook with a two-page presentation of your idea and your thoughts, or you can create a simple display on a poster.

Concepts and Definitions

The following information will lay a critical foundation for related Applied Learning activities. It is important that you read and understand this information so the Applied Learning opportunities can demonstrate and clarify important scientific concepts in action.

Fluid dynamics may sound like a science that is limited to fluid or water. But did you know that any object that moves through air or in water experiences the same aerodynamic effects and follows identical principles? It's true. Fluid does not mean liquids; rather any medium such as oil, air, gas, and various liquids that are subject to motion are classified as a "fluid." The only difference is the speed in which an object will travel.

This is due to different fluid densities. Density is defined as the mass (weight) per unit volume. As an example, if you had a gallon of water and a gallon of air, the gallon of water would be heavier. The density of water (62.4 lbs/ft^3) is much greater than the density of air (.08 lbs/ft^3).

The science of fluid dynamics is comprehensive and we will not be able to cover all that it entails. Rather, we will focus on the articles from the book *Made in Heaven* that are subject to the laws of fluid dynamics and the following characteristics of fluid flow over an object, which are covered in the book.

Boundary Layer

This is the thin layer that is adjacent to the surface of an object that is unaffected by either laminar or turbulent flow.

Laminar Flow

All fluid flow that moves over an object that takes on the appearance of smooth flow, parallel to the objects surface. Laminar flow contributes to speed, or flow, of an object. This is the opposite effect of turbulent flow.

Turbulent Flow

Turbulent flow is all fluid flow that moves in a rough/erratic flow pattern. This is the opposite effect of laminar flow.

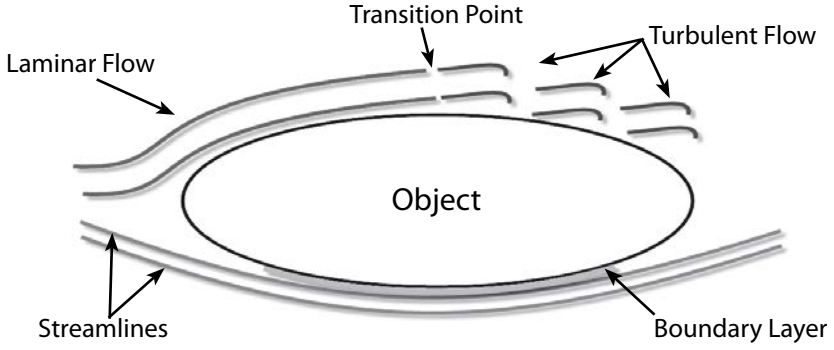
Transition Point

This is the location where the fluid flow transitions from laminar to turbulent flow.

Streamlines

This is a trace or an outline of the flow pattern around an object that defines the flow characteristics around the object.

Drag



Drag is exactly what it sounds like. Drag slows down and is a hindrance in the flow of fluid.

Q: Which flow type would you expect to exhibit drag?

A: If you said turbulent, then you are correct.

Rough flow = drag, and drag is caused by the shape of the object.

Applied Learning

The following activity or experiment illustrates important concepts for this portion of the coursework. Please make note of the scientific aspects of the activity as well as the specific areas of focus. These should reinforce important concepts and definitions that you have learned as you apply them.

Science

Fluid dynamics

Definition/Focus

Focusing on laminar and turbulent flow

Smooth flow is based on the shape of an object

Parts Lists

- Hand
- Large container of water, such as a pool or bathtub

Experiment

In the bathtub or a swimming pool, try to push the water with your hand in the following configurations:

1. An open palm with the fingers tightly pressed together
2. An open palm with your fingers spread apart (as far as you can)
3. Your hand balled up in a fist
4. With the edge of your hand (like a karate chop)

☑ Take Away

Note the difference in resistance felt by forming different shapes with your hand in the water. Different shapes exhibit different resistances. Fish are created with a shape that minimizes drag.




Questions:

1. Which shape moved the fastest in water?

2. Why do you think objects of that shape move faster?

3. Can you think of other types of shapes that move with speed?

4. What other examples in God's creation can you think of that might follow this principle?

Answer Keys

Introduction

1. Biomimicry
2. Millions of years of supposed evolutionary change developed these innovations; valuable, practical designs have been with since the beginning of time
3. Patterns and information are conserved with the passing of generations, but the DNA blueprint does not increase in complexity or gain new information.
4. The historic definition of science is the search for knowledge and truth about the physical world, wherever this may lead.
5. Design examples show us how to properly care for nature and maintain its health; the other purpose was for the benefit of living things, and also that ideas could be discovered and utilized for the welfare of mankind.

Chapter 1 – Worksheet 1

1. 1657
2. Using molecular motors
3. 10 million
4. flagellus, central shaft of protein, electrochemical reactions
5. This organism has hundreds of tiny nozzles covering its outer surface. It manufactures a slime that shoots from these nozzles, much like silly string. As a result, the bacterium recoils in the opposite direction using the principle of jet propulsion.
6. The prefixes micro and nano come from Greek roots meaning, respectively, "small" and "dwarf." Technically, micro stands for one millionth, or 10^{-6}. The, thickness of a sheet of paper is about 4000 micro-inches. A nano is defined as one billionth, or 10^{-9}. In one inch there are one million micro-inches, and one billion nano-inches.
7. Typical speed for a household electric fan is 1500 rpm. This is 60 times slower than the speed of the bacteria flagellum.
8. Silly string was first introduced as a child's toy in 1972. A liquid polymer in a pressurized aerosol container quickly turns solid when exposed to air. Polymers are compounds with long chains of chemically bonded molecules. One container can produce silly string hundreds of feet long.

Chapter 1 – Worksheet 2

1. This tiny microbe produces electrical current using simple sugars as its fuel source.
2. 80%
3. Energy-producing microorganisms
4. To combine the electric output from a large number of these bacteria to produce a practical level of current.
5. One cup
6. A battery is a chemical cell useful for storing electrical energy. Energy storage is a challenge for technology, and research continues on batteries with high efficiency and capacity.
7. When fuel is burned in a car to produce motion, much of the resulting heat energy is unused. This heat radiates outward from the engine and water coolant, and also leaves with the hot exhaust gases. The second law of thermodynamics describes such inevitable losses in every energy transfer process.
8. A light bulb, whether in a flashlight or reading lamp, has an electric current of about one ampere. This amounts to over six million-trillion electrons (actually 6.25×10^{18}) passing through the bulb filament each second. These electrons move through the filament at a snail's pace, somewhat similar to a large crowd passing through a narrow gate.

Chapter 1 – Worksheet 3

1. Large organized communities of bacteria
2. By releasing chemicals
3. Signal blocking
4. Protecting animals like dogs and cattle from cholera infection, or biofilms added to paint to prevent barnacles from attaching to the surface of boats

5. to use biofilms to control corrosion in oil and gas pipelines
6. Living bacteria are everywhere in large numbers, and there may well be millions on each of our hands. Most are harmless "resident bacteria," but hand washing is a good practice to prevent the spread of less friendly bacteria. Many bacteria reproduce and multiply in less than a single hour.
7. A layer of biofilm often coats rocks in streams, making their surfaces slippery. Also, biofilms sometimes cover the surface of stagnant ponds.
8. Colorful biofilms are found on the surface of hot, acidic pools in Yellowstone National Park, as well as on glaciers. In homes, biofilm colonies may grow in the corners of shower stalls.

Chapter 1 – Worksheet 4

1. Diatoms are microscopic, single-celled algae.
2. They are found in the sea, freshwater lakes, and soil.
3. They are looking for ready-components.
4. Magnesium oxide MgO; and titanium oxide TiO.
5. These are diatoms that researchers hope to encourage growth into new and useful shapes.
6. Diatoms have been variously classified as plants, animals, or something in between. They share biochemical features of both plants and animals, including photosynthesis and mobility.
7. Glass consists of the chemical compound silicon dioxide, SiO_2. The mineral name is quartz or silica.
8. This common chalk-like material serves as a filter for liquids and an abrasive. Its absorbent property is also useful as a component in kitty litter. In addition, diatomaceous earth serves as a stabilizer in explosives, as a mechanical insecticide, and as a medium for potted plants.

Chapter 1 – Worksheet 5

1. Photosynthesis
2. Plants
3. Photosynthetic proteins
4. The lights causes a faint current of electricity to pass thru adjacent layers and by putting multiple layers in series, the plant-based protein generates a useful electrical current.
5. The ability for it to repair itself when damage occurs because plants are self-healing.
6. Current is the flow of electrons through a conductor, measured in amperes. A typical light bulb may use one amp of current. The current produced by a single spinach protein is on the order of a billionth of an ampere, or one nanoamp (10^{-9} amp).
7. Solar heating of portions of the earth causes breezes to blow. Wind then results as air moves to even out temperature and pressure differences. The sun also causes water to evaporate from lakes. This water later condenses and flows back downhill, where it may be harnessed by generators for hydroelectricity. Fossil fuels include coal, oil, and natural gas. It is thought that these fuels largely formed from earlier plants that captured sunlight by photosynthesis. The vegetation later was buried and compressed by pressure and heat. Fossil fuels are thus solar energy stored up from the past.
8. Nuclear energy is available from elements inside the earth, and geothermal energy comes from underground magma. Tidal movement, caused by the moon's gravity, is also tapped as an energy source.

Chapter 2 Introduction– Worksheet 1

1. Undiscovered creatures or insects in tropical rain forest regions.
2. Insect
3. Invertebrates
4. Locusts
5. Any of the following: ants, beetles, flies, spiders, centipedes

Chapter 2 – Worksheet 1

1. Swarming
2. Countless interactions between nearby ants

Made in Heaven Worksheet Answer Keys

Chapter One

1. Number 4, the edge of your hand
2. The hand in this orientation simulates a wedge shape, which slices through the water. The other shapes have a larger frontal area, which cause more drag.
3. All shapes with rounded ends
4. Dolphins, squid, birds

Chapter Two

1. The corrugations and the popsicle sticks ran parallel with each other and provided no rigidity in the other direction.
2. Gluing down the second set of popsicle sticks 90 degrees to the corrugations provided the increase in strength.
3. There would still be additional strength added, as long as the second set of popsicle sticks do not run parallel with the cardboard corrugations.

Chapter Three

1. Able to break thread and paper, unable to break the remaining materials
2. Thread should have been the easiest
3. Fishing line, you were probably unable to break.
4. metal, wood, plastic

Chapter Four

1. Yes, after drying, the paper's shape changed and became wrinkled, resulting in the paper contracting.
2. Yes, the sponge did also shrink in size, but did not significantly change its shape as compared to the paper.
3. No, they did not. The sponge took more time to dry because of the larger size and the fact that it absorbed more water than the piece of paper.

Chapter Five

1. It would make no difference.
2. No, the only way is to physically glue it down.

Chapter Six

1. The only way is to make the air intake end stiffer to prevent it from moving all around. One method is to add tape around it a number of times to increase the thickness.
2. Less air in the balloon means less pressure, which will result in the balloon moving more slowly.
3. The farther away you stand, the more difficult it will be to hit the target. The closer you are, the better chance you have of directing the balloon through your friend's arms.

Chapter Seven

1. Violet, indigo, blue, green, yellow, orange, red
2. The rainbow will shift and/or disappear.

Chapter Eight

1. 360 degrees
2. A peak and trough
3. Since the peak of one wave will occur at the trough of the other wave, the net result is that they would cancel each other out in their entirety and result in a flat line.

Chapter Nine

1. Will be dependent on your camera, but your eyes will have a larger field of view than your camera. Some cameras have what is called a panoramic view setting which will provide you with a field of view far wider.

Chapter Ten

1. 27
2. Will vary from individual to individual
3. 4 x 4 x 4 x 4 = 1024
4. Thousands every day, which are variants of existing viruses