Answer Key

Lab #1 Key: Physical Geographers and the Scientific Method

Problem-Solving Module #1: Physical Geography and Anthropogenic Factors

1. Physical geography is the study of Earth's physical systems, the processes that govern those systems, and how people interact with Earth's systems. Physical geography explores how Earth's natural physical landscapes have changed in the past and how they may change in the future.

2. Spatial relationships are important in physical and human geography because they provide insight into understanding cultural and physical phenomena.

3. Answers will vary. Expect comments related to humans modifying the physical landscape in terms of agricultural activities, resource extraction, road building, and urban expansion.

4. Anthropogenic is anything made or caused by people.

5. Answers will vary. Expect to see places cities such as Karachi, Mumbai, Calcutta, Bangkok, Singapore, and Hong Kong.

6. Combustion engines are made by people, and these engines emit nitrogen oxide pollution. This pollution collects in Earth's lower atmosphere and is presented in Figure 1–1 as visible dark patches near major urban areas, as well as linear paths along major ocean shipping lanes.

7. The linear nature of the nitrogen oxide concentrations is due to the combustion engines propelling ships in narrow shipping lanes. More information is located here: http://earthobservatory.nasa.gov/IOTD/view.php?id=80375

8. In the year 2000, Dubai's coastline had no man-made islands. By 2012, several artificial archipelagos existed off the coast. The large Palm Jebel Ali and the smaller Palm Jumeirah are most obvious. To the northeast is another artificial archipelago called The World. There are also other, less-symmetrical islands off Dubai's coast in the 2012 images that did not exist in the 2000 image. On land, significant urban expansion is seen extending back from the coast in the 2012 photo.

Problem-Solving Module #2: The Scientific Method

1.

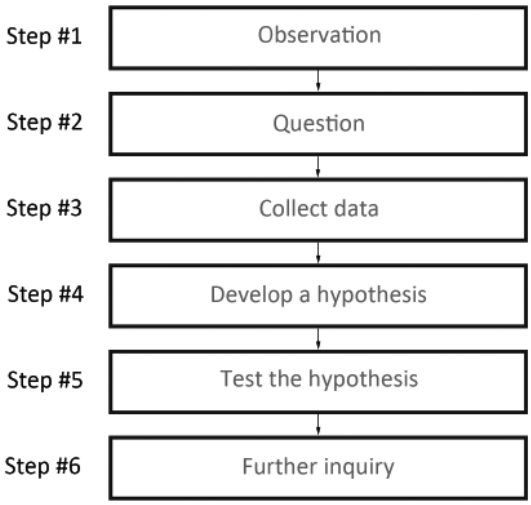

FIGURE 2–1

2. Suggested answer: Local fishing communities are probably better informed about the size of the Aral Sea compared to government officials in Moscow, so expect most students (but not all) to adopt the hypothesis that the Aral Sea is shrinking.

3. A scientist needs to collect data about the size of the Aral Sea. Data could include satellite pictures, coastline snapshots, and data about the Aral Sea's surface area, depth, and volume.

4. Suggested answers: The size of the Aral Sea shrank between the 1960s to the late twentieth century.
   - The images and data support my hypothesis that the Aral Sea shrank from the 1960s to the late twentieth century, or…
   - The images and data do not support my hypothesis that the Aral Sea shrank from the 1960s to the late twentieth century.

5. Answers will be open-ended, but they should include speculation about new questions, new ideas, and additional data collection. Answers may include:
   - How much of the Aral Sea has disappeared since the 1960s?
   - How has the Aral Sea's water composition changed since the 1960s?
   - What are the impacts since the 1960s on local communities surrounding the Aral Sea?
   - Are there any mitigation and/or recovery efforts happening in the area?

Problem-Solving Module #3: Spatial Scale

1 .

FIGURE 3–1

2. Smaller

3. Smaller

4. Large; small

5. Large scale

6. Small scale

Problem-Solving Module #4: Temporal Scale

1.

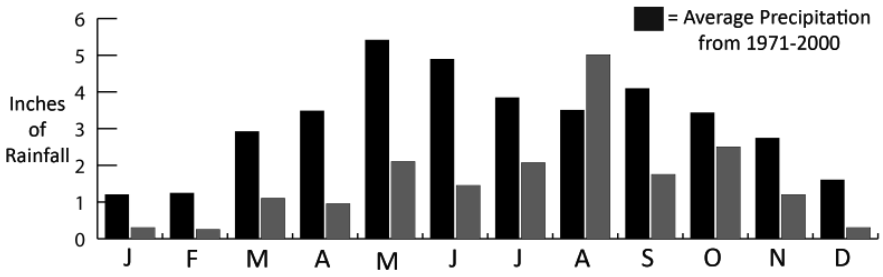

FIGURE 4–1

2. The hypothesis is not supported because there is more than average rainfall.

3. The hypothesis is supported because with the exception of one month, precipitation is consistently below average.

4. Suggested answers:
   - Temporal scale is the window of time used to examine phenomena.
   - Without considering a temporal scale when conducting a study, a researcher's hypothesis may be incorrectly supported, or incorrectly not supported.
   - Examining only August's data to test the hypothesis is a poor window of time selection because a drought is defined as an *extended* period of time with less-than-average precipitation. A single month is an inadequate window of time to accurately assess the veracity of the hypothesis.

Lab #2 Key: Globes and Maps

Problem-Solving Module #1: The Globe, Latitude, and Longitude

1. North Atlantic Ocean
2. South Pacific Ocean
3. India
4. New Zealand
5. Africa
6. 35° N, 140° E
7. 23° S, 43° W
8. 48° N, 2° E
9. 42° N, 88° W
10. 40° N, 116° E
11. a. Havana, Cuba
12. d. Sao Paulo, Brazil
13. c. Kuala Lumpur, Malaysia
14. East
15. East
16. Western
17. Northern
18. 1665 km, because 15° × 111 km = 1665 km
19. 9990 km, because 90° × 111 km = 9990 km
20. 19,980 km, because 180° × 111 km = 19,980 km
21. The person traveling along the 30° N line of latitude travels more kilometers. When traveling along the 30° N line of latitude, 96 kilometers exist between each meridian. When traveling along the 60° N line of latitude, only 56 kilometers exist between each meridian.
22. 30° N, 165° E
23. 15° N, 150° E
24. 15° N, 60° W
25. 30° S, 60° W
26. 11, 340, because 105° × 108 = 11,340 kilometers

27. 4,995, because 45° × 111 = 4,995 kilometers

28. Southern and western hemispheres

29. 90°

Problem-Solving Module #2: Map Elements

1. 39° 00′

2. 38° 52′ 30″

3. 7.5″

4. 120° 00′

5. 119° 52′ 30″

6. 7.5″

7. South Lake Tahoe Quadrangle, California-Nevada, 7.5 Minute Series

8. 119° 55′

9. 119° 57′ 30″

10. 38° 55′

11. 38° 57′ 30″

12. Bar scale and representative fraction scale

13. 24,000

14. 24,000

15. Roads

16. State route

17. 4WD and/or FS passenger route

18. FS passenger route

19. U.S. route

20. "Contours are imaginary lines that join points of equal elevation on the surface of the land above or below a reference surface, such as mean sea level."

21. "Contours make it possible to measure the height of mountains, depths of the ocean bottom, and steepness of slopes."

22. County or equivalent and federally administered park and/or national forest system land

23. State or territorial

24. Intermittent

Problem-Solving Module #3: Contour Lines

1. 40 feet

2. 9,560 feet

3. Downhill

4. 2,000

5. Northeast

6. 1.89 miles, because 10,000/5,280 = 1.89

7. None, because there are no contour lines

8. Ellipse G is a steep slope. It has many narrowly spaced contour lines within a small area. Ellipse F is a flat expanse of land. It has no contour lines within the same-sized ellipse as G.

Problem-Solving Module #4: A Complete USGS Topo

1. 28° 07′ 30″ N

2. 28° 00′ N

3. 1:24,000

4. 5 feet

5. Lake Ariana

6. 125 feet

7. Hickory Road

8. State route

9. Interstate route

10. De Castro Road

Lab #3 Key: Google Earth, Topographic Maps, and Remote Sensing

Problem-Solving Module #1: Google Earth and Topographic Maps

1. Rio Grande National Forest
2. The national forest boundary is demarcated by a thick red line.
3. It disappears because it becomes completely transparent.
4. Sand Creek
5. Cold Creek
6. Lower, because Google Earth flew out of the mountains, down a valley, and onto a plane that is lower than markers C and D
7. 7,854 feet
8. 10,948 feet
9. 3,094 feet, because 10,948 – 7,854 = 3,094
10. About 5.5 miles
11. The solid blue line turns into a dashed blue line, indicating that the river becomes intermittent.
12. 12,440 feet
13. 7,800 feet
14. 200 feet
15. About 6,633 feet
16. 200 feet
17. 325 feet
18. Center-pivot irrigation circles
19. 10/22/2011
20. 2,341 m (7,681 ft in default settings)
21. 2,341 m (or 12,648 ft in default settings)
22. 8/18/2011
23. 9/5/1998
24. Center pivot circle is bright green on 10/22/2005 and pale tan on 8/30/2006. The SE quadrant of the 8/30/2006 image also has very little if any agricultural growth.
25. Sand dunes

Problem-Solving Module #2: Google Earth and Digital Elevation Models (DEM)

1. Any three of the following answers:
   - Modeling of coastal processes
   - Ecosystems management
   - Habitat research
   - Coastal and marine spatial planning
   - Community hazard mitigation and preparedness
2. Marker A is on dry land that is near or below sea level.
3. 0 feet
4. 6 feet
5. Uphill
6. Marker C is located in shallow water, while marker D is on dry land near or below sea level.
7. 12 feet
8. Homes
9. Marker E is located in deep water.
10. Marker F is located in shallow water.
11. Downhill
12. 153 feet
13. According to the key, location G is on "Dry land above sea level," while location D is on "Dry land near or below sea level." According to the elevation indicator, location G is 153 feet above sea level, while location D is 0 feet above sea level. For these two reasons, location D is more likely to flood than location G.
14. 4 feet
15. 30 feet
16. According to the key, location J is on "Dry land above sea level," while location I is on "Dry land near or below sea level." According to the elevation indicator, location J is 30 feet above sea level, while location I is 4 feet above sea level. For these two reasons, location I is more likely to flood than location J.

Problem-Solving Module #3: Google Earth and Light Detection and Ranging (LiDAR)

1. Shadow
2. Sunlight
3. The time of day is a.m. because the eastern side of the slope is bathed in sunlight while the western side of the slope is bathed in shadow.

4. It disappears and was replaced by a blank white area.

5. It rebuilds itself and becomes visible again.

6. Sunlight

7. The time of day is p.m. because the western side of the slope is bathed in sunlight while the eastern side of the slope is bathed in shadow.

8. This is a reservoir. Marker C is positioned on a dam. Students may call this a lake.

9. 449 feet

10. 372 feet

11. About 77 feet high, because 449 – 372 = 77 feet

12. No

13. Yes

14. This LiDAR image sees through trees to the ground.

Problem-Solving Module #4: Google Earth and Radio Detection and Ranging (Radar)

1. It's experiencing heavy rainfall, and we know this because it is has a 55–60 dBZ value (red).

2. It's experiencing no rainfall, and we know this because there is no radar signal.

3. It lessened, and we know this because the dBZ value over Macon is now 35–40 instead of 55–60 dBZ.

4. East

5. It is beginning to rain in Augusta, and we know this because it has increasing dBZ values with each successive radar image. Students might say that the weather is "getting worse."

6. It is beginning to clear in Atlanta, and we know this because it has decreasing dBZ values with each successive radar image. Students might say that the weather is "getting better."

7. It is beginning to clear in Athens, and we know this because it has decreasing dBZ values with each successive radar image. Students might say that the weather is "getting better."

Lab #4 Key: Atmospheric Composition, Layers, and Pressure

Problem-Solving Module #1: Atmospheric Composition

1.

Permanent Atmospheric Gas	Percent of Atmosphere	Total Mass (kg) (Scientific Notation)	Total Mass (kg) (Nonscientific Notation)
Nitrogen (N_2)	78%	4.4×10^{15}	4,400,000,000,000,000
Oxygen (0_2)	21%	1.2×10^{15}	1,200,000,000,000,000
Argon (Ar)	1%	5.6×10^{13}	56,000,000,000,000

TABLE 1–1

2. 4%

3. They decrease.

4.

Element	Atomic Mass Number (protons + neutrons)	Atmospheric Gas Formula	Atmospheric Gas Mass
N	14	N_2	28
O	16	O_2	32
Ar	40	Ar	40
H	1	H_2O	18

TABLE 1–3

5. Suggested answers:
   - Air with a large percentage of water vapor has less mass than air with a small percentage of water vapor.
   - Air with a large percentage of water vapor has more mass than air with a small percentage of water vapor.

6. Two samples of air need to be collected. One sample should contain a large percentage of water vapor while the other should contain no water vapor.

7.

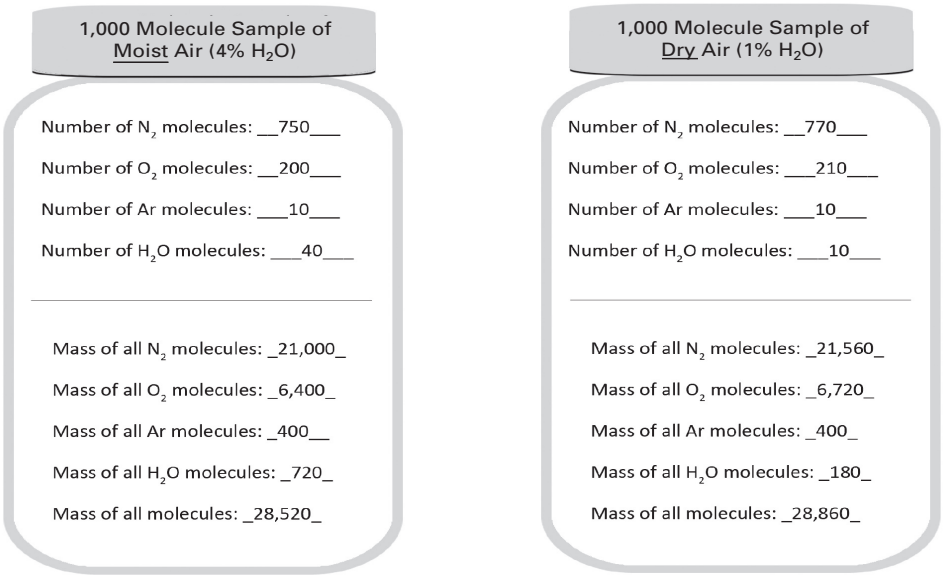

FIGURE 1–1