Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**What is Science? – Case Study**

**The Last Flight of TWA 800** (rev. 10/02/09)

**On the evening of July 17th, 1996, shortly after sunset, but while the sky was still light, Trans World Airlines (TWA) Flight 800 took off from New York City’s John F. Kennedy International Airport on its way to Leonardo da Vinci International Airport in Rome, Italy, via Charles de Gaulle International Airport in Paris, France. On board were the Captain, three flight engineers, 14 flight attendants, and 212 passengers.**

**At approximately 8:31pm EDT, the Boeing 747-131, just eleven minutes into its flight and having reached an altitude of 13,700 feet, suddenly exploded in mid-air. Under the glow of the fireball, sections of the plane were seen to have tumbled into the Atlantic Ocean, about 8 miles south of East Moriches, Long Island, N.Y. None of the 230 people on board survived the crash.**

You and your team have been assigned as independent research investigators to investigate this disaster.

1. Upon meeting and discussing this event, you and your team decide to state the
 specific problem you are trying to solve as a question. Write this in the box below.

2. On the reverse side of this page use Table 1 to begin a list of data or information
 you feel your team will need in order to determine the cause of this disaster.
 Also, list as many sources of information as you can that might provide you this
 data. For each data set please include a source, or sources, for this data.

Page 2 – Table 1

|  |  |
| --- | --- |
| DATA/INFORMATION NEEDED | SOURCE(S) OF THIS DATA |
|  |  |

Page 3 – Table 2

3. As your list of Data/Information Needed grew in Table 1, did you begin to think of
 some hypotheses that might be used to answer your question in #1 above? If so, in
 Table 2 below, begin a list of hypotheses that relate to your original question and
 opposite each hypothesis list the data or data source that you would use to test this
 hypothesis.

|  |  |
| --- | --- |
| HYPOTHESES | SOURCE(S) OF DATA TO BE USED TO TEST EACH HYPOTHESIS |
|  |  |

Page 4

4. Now read the following summary of the data that was gathered during the first
 month following the crash of TWA 800.

**DATA GATHERED – FIRST MONTH AFTER THE CRASH**

**Additional history of plane that day:** On the day of the crash, the airplane departed Athens, Greece, as TWA Flight 881, and arrived at the gate at JFK about 4:38 EDT. Upon arrival at JFK, there was a crew change, and the aircraft was refueled. In charge of the flight this evening was Captain Steven Snyder, an experienced veteran of more than 6,000 flying hours.

**Statements from eye witnesses of the crash:** 1. At 8:31:50 EDT, the captain of an Eastwind Airlines Boeing 737 first reported to Boston Air
 Traffic Control that he “saw an explosion out there”, adding “ahead of us here…about 16,000 feet
 or something like that, it just went down into the water.”

 2. All told, there were 736 witness accounts. Of these, 670 witnesses reported seeing something that
 probably related to the accident, and almost 250 reported hearing something that was likely
 related to the accident. 239 reported hearing something variously described as an “explosion,
 boom, rumble, or thunder” mostly along the south shore of Long Island at 9 – 12 miles slant line
 distance. 258 accounts were characterized as “streak of light” witnesses (“an object moving in the
 sky”…variously described as a “point of light, fireworks, a flare, a shooting star” or something
 similar). Of these 258 witnesses, 63 reported that they observed a streak of light moving upward in
 the sky to the point where a large fireball appeared (38 reported that the streak was ascending
 vertically or nearly so, 18 indicated that the streak originated from the surface of the earth, and 7
 reported it originated at the horizon). 599 witnesses reported a fireball and of these, 264 reported
 seeing the fireball originate, 200 reported seeing the fireball split in two, and 217 reported
 observing the fireball hit the surface of the water, or disappear below the horizon. 210 witnesses
 reported seeing both a fireball and a streak of light.

**Cockpit voice recorder (CVR):**
 1. There was nothing unusual on the CVR tape until 8:29:15 when the Captain stated: “Look at that
 crazy fuel flow indicator there on number four…see that?” Boston Air Traffic Control Center
 cleared TWA 800 to climb to and maintain 15,000 feet at 8:30:15, followed by the Captain
 ordering “climb thrust” and acknowledging the ATC clearance in the next few seconds. At 8:30:35
 the Flight Engineer said “power’s set”. At 8:30:42 the Cockpit Area Microphone recorded a
 mechanical movement in the cockpit, followed by an unintelligible word at 8:31:03, followed by
 sound similar to “recording tape damage” at 8:31:05. The tape suddenly ended at 8:31:12. Sound
 spectrum analysis revealed that during the last second of recording there were two unusual events
 on the Captain’s microphone channel where a brief 400 Hertz sound was recorded. (The aircraft’s
 AC power system normally operates at 400 HZ line frequency.) Other background electrical noise
 normally recorded on that channel ceased during the two transient events, 0.73 and 0.68 seconds
 before the end of the tape. The other CVR channels recorded normally. The last event on the CVR
 tape occurred on all channels, and involved a very short, loud noise lasting 0.117 seconds before
 the tape ended. The CVR tape ended with power failure at 8:31:12, which was the same time as the
 last radar transponder return was received from the aircraft.

Page 5

 2. Analysis of CVR: The loud, transient noise at the end of Flight 800’s CVR tape was compared to
 similar noises on the recorders of two 747’s that were destroyed by bombs in the forward cargo
 compartment, Pan Am 103 and Air India 182. It was also compared to the event on the tape of
 United 811, a 747-100 which suffered an explosive decompression due to failure of the forward
 cargo compartment, and with the explosion recorded on the CVR tape of a Philippine Airlines 737
 which had suffered a fuel/air mixture explosion in its center wing tank on the ground. The
 bombed aircraft tapes showed a very rapid rise in noise level, brief duration, and a very rapid
 decline in the noise of the explosion. In the case of the other three aircraft, including TWA 800,
 the rate of the rise of the noise was more gradual, the duration of peak noise longer, and the
 decline of the noise was more gradual.

**Radar records at time of crash:** 1. Radar records indicated three commercial airliners and a P-3 Orion anti-submarine aircraft were in
 the vicinity at the time of the explosion of TWA Flight 800. None was close enough to TWA 800
 to have instigated a collision.

 2. Radar also indicated that there were numerous private, commercial, and government boats in the
 area at the time of the crash. Interestingly all were accounted for except one, which moved off to
 the east and was never identified.

 **Military Operations in the Area:**  Officials denied that military exercises or assets were offshore except for three submarines and a
 P-3 Orion anti-submarine aircraft. Yet an early media report cited the United States Coast Guard
 as reporting that a military "pyrotechnic exercise" was taking place off the Long Island coast when
 Flight 800 suddenly exploded. FBI witness reports corroborate that early report:

5. Based on the data accumulated in the first month after the crash, which
 hypothesis does your team think is the most logical explanation for what happened
 to TWA 800: (a) Missile, (b) Bomb, (c) Mechanical Failure, or (d) Other?

 Please record tour choice below and present a brief accounting of the evidence your
 team feels is most compelling for this choice and your reasoning for this choice.

Page 6

6. Since this investigation concerns a historical event, do you feel that it is feasible to
 conduct a direct experiment to replicate the explosion and crash? Please explain
 your answer.

7. Since the extinction of the dinosaurs was also a historical event, what would
 scientists investigating that event do in a similar fashion to what you have done
 with the investigation of the crash of TWA 800?

8. Based on your answers to the previous three questions (#’s 5 – 7), what would have
 to happen in order for you to reconsider, or even change, the hypothesis your team
 chose as the answer to question #5?

Page 7

9. A famous religious figure, frequently seen on TV, is quoted in the newspapers as
 saying: “I have proof that the TWA air disaster was caused by God as punishment
 for the decay of Americans’ morals, which, in turn, is promoted by legislation
 recently passed by the United States Congress.”

 Would you, or would you not, include his “proof” in your investigation?
 Please include your reasoning for your answer.

10. How do you personally feel about the following statement?

 *“Science is only capable of explaining natural events by looking for natural
 causes. It does not address the supernatural or paranormal primarily because it
 has never been able to develop the means to measure or observe the
 supernatural or paranormal.”*