**Science Research Paper Outline Example: Background information**

**Introduction**

**Science Experiment Topic:** The recent experiment was about how well paper airplanes fly. The effect of crumpling the paper for the airplane was tested, to see the effect a crumpled surface would have on how far it flew.

**Related researched topics/terms:** During the research I discovered information about aerodynamics, Bernoulli’s principle, and lift.

**An explanation of the link between the topics:** In my experiment, the airplane that had the smoothest wings went the furthest. This is related to drag, a concept from my research.

**A preview of the 3 body paragraphs:** In this research paper, I will be reviewing the concepts of aerodynamics, including Bernoulli’s principle and lift.

**Body Paragraph 1**

**The first important idea from the research is presented:** The science of how air moves around objects like paper airplanes is called aerodynamics.

**Fact 1 about the idea, with citation:** Aero is from the latin for air, and dynamics refers to the movement of the air. In the experiment, how the plane moved through the air affected how far it flew. (Harper, 2003.) As indicated by Harper (2003), this word is from 1837, when scientists first started studying flying machines like hot air balloons.

**Fact 2 about the idea, with citation:** In general, aerodynamics is can work in two ways as a fluid moves around an object. Turbulent flow is occurs at high speeds and with rough or irregular objects. It is difficult to predict, and can have major effects on airspeed. Laminar flow is when air moves smoothly around an object. This usually occurs when air is moving slowly, or the object is very smooth. Laminar flow is easy to predict, and can result in higher airspeeds. (Encylopedia.com, 2002, Paragraph 7.)

**Fact 3 about the idea, with citation:**  Another concept in aerodynamics is the idea of viscosity. This is a way of measuring how thick the fluid moving around an object is. This is basically caused by friction within the fluid. Even with a thin, non-viscous fluid like air, viscosity can have an effect on airplanes. As it says on Encyclopedia.com, “near a solid surface—for example, the wing of an airplane—viscosity becomes a factor because air tends to stick to that surface” (Paragraph 5).

**Body Paragraph 2**

**The second important idea from the research is presented:** In paper airplanes, most airflow is laminar. In these cases, the flight of the plane can be explained by Bernoulli’s principle.

**Fact 1 about the idea, with citation:** This principle is critical for understanding why the experiment had the observed results. As in Encylopedia.com (2002) says, “Named after the Swiss mathematician and physicist Daniel Bernoulli (1700-1782), this proposition goes to the heart of that which makes an airplane fly.” (Paragraph 8)

**Fact 2 about the idea, with citation:** Bernoulli observed that as velocity of a fluid increases, the force of pressure decreases (Encylopedia.com, 2002, Paragraph 9). If a plane moving through air has air flowing over different parts of the plane at different rates, then different parts of the plane would be affected by different amounts of air pressure.

**Fact 3 about the idea, with citation:**  For an airplane wing, as air moves over the bottom of the wing and the top, the air over the top must move faster because of the wing’s curve. The faster moving air has less pressure than the slower air beneath the wing, so the stronger pressure from below pushes up on the wing. This is basically what make a plane fly, which “would prove crucial to the design of aircraft in the twentieth century, as engineers learned how to use currents of faster and slower air for keeping an airplane aloft” (Encyclopedia.com, 2002, paragraph 12).

**Body Paragraph 3**

**The third important idea from the research is presented:** Lift is the force that pushes something up in opposition to the pull of gravity, or as NASA states it: “Lift is the [force](http://www.grc.nasa.gov/WWW/k-12/airplane/forces.html) that directly opposes the [weight](http://www.grc.nasa.gov/WWW/k-12/airplane/weight1.html) of an airplane and holds the airplane in the air.”

**Fact 1 about the idea, with citation:** As a fluid moves around an object, it is forced to change the direction it is moving in. This change in direction is also a change in velocity, a type of acceleration. Since the fluid is accelerating, a force is produced. Because the turning of the fluid’s flow causes a force, the equal and opposite reaction is the same amount of force working on the object, which in this case is an airplane (NASA, 2013, paragraphs 2 and 3).

**Fact 2 about the idea, with citation:** Lift is related to the difference in speed between the fluid and the object (NASA, 20013, Paragraph 5). As this difference increases, so does lift. This is why at high speeds, there is enough lift to push airplanes that weigh tons into the air in opposition to gravity.

**Fact 3 about the idea, with citation:** Since lift depends on speed, anything that can slow an object down can reduce lift. For objects, one such force is drag. Friction of the fluid with a rough object surface creates this slowing force (Encyclopedia.com, 2002, paragraph 13). This is why the paper airplane with the roughest most crumpled surface flew the shortest distance. Drag reduced lift, and gravity pulled the airplane down before much distance had been covered.

**Conclusion**

**Science Experiment Topic:** The experiment was about the relationship between the wrinkles in a paper airplane’s surface and how far it can fly.

**Related researched topics/terms:** Research revealed that the science of how objects can fly is called aerodynamics. Ideas such as Bernoulli’s principle can explain why lift occurs that can push an airplane up against the pull of gravity.

**An explanation of the link between the topics:** From the research, it is clear that the reason that “crumpled paper” paper airplanes fell the fastest was because the friction of the air over the wrinkles produced drag.

**A review of the 3 body paragraphs:** It has been shown in the research that the science of aerodynamics explains how differences in pressure on an airplane’s surface (like its wing) can cause an upward force called lift, but that this lift depends on speed. Since friction with the air on a plane can cause drag that causes lower speed, drag can reduce lift. This is why paper airplanes with rougher surfaces go slower and fall faster.

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Science Class

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The Aerodynamics of Paper Planes

The recent experiment this paper is based on was about how well paper airplanes fly. The effect of crumpling the paper for the airplane was tested, to see the effect a crumpled surface would have on how far it flew. During the research information was discovered about aerodynamics, Bernoulli’s principle, and lift. In the experiment, the airplane that had the smoothest wings went the furthest. This is related to drag, a concept from the research. In this research paper, I will be explaining the concepts of aerodynamics, including the already mentioned Bernoulli’s principle and lift.

The science of how air moves around objects like paper airplanes is called aerodynamics. Aero is from the Latin for air, and dynamics refers to the movement of the air. In the experiment, how the plane moved through the air affected how far it flew. (Harper, 2003.) As indicated by Harper (2003), this word is from 1837, when scientists first started studying flying machines like hot air balloons. In general, aerodynamics is can work in two ways as a fluid moves around an object. Turbulent flow is occurs at high speeds and with rough or irregular objects. It is difficult to predict, and can have major effects on airspeed. Laminar flow is when air moves smoothly around an object. This usually occurs when air is moving slowly, or the object is very smooth. Laminar flow is easy to predict, and can result in higher airspeeds. (Encylopedia.com, 2002, Paragraph 7.) Another concept in aerodynamics is the idea of viscosity. This is a way of measuring how thick the fluid moving around an object is. This is basically caused by friction within the fluid. Even with a thin, non-viscous fluid like air, viscosity can have an effect on airplanes. As it says on Encyclopedia.com, “near a solid surface—for example, the wing of an airplane—viscosity becomes a factor because air tends to stick to that surface” (Paragraph 5).

In paper airplanes, most airflow is laminar. In these cases, the flight of the plane can be explained by Bernoulli’s principle. This principle is critical for understanding why the experiment had the observed results. As in Encylopedia.com (2002) says, “Named after the Swiss mathematician and physicist Daniel Bernoulli (1700-1782), this proposition goes to the heart of that which makes an airplane fly.” (Paragraph 8) Bernoulli observed that as velocity of a fluid increases, the force of pressure decreases (Encylopedia.com, 2002, Paragraph 9). If a plane moving through air has air flowing over different parts of the plane at different rates, then different parts of the plane would be affected by different amounts of air pressure. For an airplane wing, as air moves over the bottom of the wing and the top, the air over the top must move faster because of the wing’s curve. The faster moving air has less pressure than the slower air beneath the wing, so the stronger pressure from below pushes up on the wing. This is basically what make a plane fly, which “would prove crucial to the design of aircraft in the twentieth century, as engineers learned how to use currents of faster and slower air for keeping an airplane aloft” (Encyclopedia.com, 2002, paragraph 12).

Lift is the force that pushes something up in opposition to the pull of gravity, or as NASA states it: “Lift is the [force](http://www.grc.nasa.gov/WWW/k-12/airplane/forces.html) that directly opposes the [weight](http://www.grc.nasa.gov/WWW/k-12/airplane/weight1.html) of an airplane and holds the airplane in the air.” As a fluid moves around an object, it is forced to change the direction it is moving in. This change in direction is also a change in velocity, a type of acceleration. Since the fluid is accelerating, a force is produced. Because the turning of the fluid’s flow causes a force, the equal and opposite reaction is the same amount of force working on the object, which in this case is an airplane (NASA, 2013, paragraphs 2 and 3). Lift is related to the difference in speed between the fluid and the object (NASA, 20013, Paragraph 5). As this difference increases, so does lift. This is why at high speeds, there is enough lift to push airplanes that weigh tons into the air in opposition to gravity. Since lift depends on speed, anything that can slow an object down can reduce lift. For objects, one such force is drag. Friction of the fluid with a rough object surface creates this slowing force (Encyclopedia.com, 2002, paragraph 13). This is why the paper airplane with the roughest most crumpled surface flew the shortest distance. Drag reduced lift, and gravity pulled the airplane down before much distance had been covered.

The experiment was about the relationship between the wrinkles in a paper airplane’s surface and how far it can fly. The research revealed that the science of how objects can fly is called aerodynamics. Ideas such as Bernoulli’s principle can explain why lift occurs that can push an airplane up against the pull of gravity. From the research, it is clear that the reason that “crumpled paper” paper airplanes fell the fastest was because the friction of the air over the wrinkles produced drag. It has been shown in the research that the science of aerodynamics explains how differences in pressure on an airplane’s surface (like its wing) can cause an upward force called lift, but that this lift depends on speed. Since friction with the air on a plane can cause drag that causes lower speed, drag can reduce lift. This is why paper airplanes with rougher surfaces go slower and fall faster.

References

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