Reece’s class was investigating the principles of flight. His teacher showed the class how to make gliders out of strips of paper and straws as the picture below shows. The students made their gliders with different size rings of paper on each end of the straw. Reece noticed that some of the gliders flew far, some not very far, and some nose-dived. Reece decided to investigate how the circumference of the paper rings affected the distance that the gliders flew. He made 5 different gliders all with the front ring 2 cm wide and 10 cm in circumference. The back ring on the gliders measured 10, 15, 20, 25 and 30 cm in circumference. He flew each glider three times and recorded the flight distance for each flight, and then found the mean flight distance for each glider.

11. Independent Variable? (1 point) __________________________

12. Dependent Variable? (1 point) __________________________

13. Write a testable question that could be the basis of Reece’s scientific investigation. (1 point)

__________________________________________________________________________________________________________

14. Write a hypothesis for the testable question you wrote above. (1 point)

__________________________________________________________________________________________________________

15. To make a fair experiment, Reece kept several factors constant during the experiment. List one factor he should keep the same. (1 point)

__________________________________________________________________________________________________________
Below is the data Reece collected during his investigation.

<table>
<thead>
<tr>
<th>Distance Gliders Flew (cm)</th>
<th>Circumference of Back Glider Ring (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Trial 1</td>
<td>168</td>
</tr>
<tr>
<td>Trial 2</td>
<td>165</td>
</tr>
<tr>
<td>Trial 3</td>
<td>229</td>
</tr>
<tr>
<td>Mean</td>
<td>187</td>
</tr>
</tbody>
</table>

16-19. Use the data from the table above to construct an appropriate graph on the grid below. (4 points total) Be sure to provide:
- an appropriate title (1 point)
- a label for each axis with appropriate units (1 point)
- an appropriate number scale and category labels (1 point)
- correctly plotted data (1 point)

20. Use the data table and graph to write a conclusion for the experiment. (1 point)
DIRECTIONS: Read the paragraph below and answer the following questions about Reece’s investigation.

Reece’s class was investigating the principles of flight. His teacher showed the class how to make gliders out of strips of paper and straws as the picture below shows. The students made their gliders with different size rings of paper on the front and back. Reece noticed that some of the gliders flew far, some not very far, and some nose-dived. Reece decided to investigate how the circumference of the paper rings affected the distance that the gliders flew. He made 5 different gliders all with the front ring 2 cm wide and 10 cm in circumference. The back ring on the gliders measured 10, 15, 20, 25 and 30 cm. He flew each glider three times and recorded the flight distance for each flight, and then found the mean flight distance for each glider.

IN.1.A.5,6,7.b-Identify and describe the importance of the independent variable, dependent variable, control of constants, and multiple trials of the design of a valid experiment.

11. Independent Variable? (1 point) **circumference of the glider’s back paper ring**
   *(Any part of this phrase that indicates what is being changed in the experiment is acceptable.)*

IN.1.A.5,6,7.b-Identify and describe the importance of the independent variable, dependent variable, control of constants, and multiple trials of the design of a valid experiment.

12. Dependent Variable? (1 point) **Flight distance of the glider**
   *(Any part of this phrase that indicates what will potentially change as a result of changing the independent variable and/or what is being measured in the experiment is acceptable.)*
13. Write a testable question that could be the basis of Reece’s scientific investigation. (1 point)

   Any question that shows the affect of the independent variable on the dependent variable is acceptable.

   **Examples**

   How does the circumference of the paper ring on the back of the glider affect how far it flies?

   Will a glider with a bigger (smaller) back ring go farther?

   Does the size of the glider’s paper ring make a difference in how far it flies?

   Does the size of the glider’s paper ring affect its flight distance?

   What effect will different size paper rings on the back of the glider have on the distance the glider flies?

   If the circumference of the back ring on a paper glider is increased will it affect the distance the glider travels?

   Will changing the circumference of the back ring of the glider cause it to travel a greater distance?

14. Write a hypothesis for the testable question you wrote above. (1 point)

   Any hypothesis that shows the affect of the independent variable on the dependant variable is acceptable. The hypothesis must answer the testable question. The hypothesis can be incorrect. The hypothesis should be an If/then statement.

   **Examples**

   If the circumference of the paper ring on the glider is larger, then glider will go farther (not as far).
If the front ring is smaller than the back ring, then the glider will (will not) go farther.

The larger (smaller) the back ring circumference of the glider is, the farther it will fly.

The size (circumference) of the paper ring will not affect how far it flies.

When the glider has a smaller front ring, it will go the farthest.

The larger the back paper ring, the greater the distance flown.

If the circumference of the back ring on the glider is increased, then the glider will go farther (not as far).

If the circumference of the back ring of the glider is increased, then the glider will travel a greater (shorter) distance.

IN.1.A.5,6,7.c-Design and conduct a valid experiment.

15. To make a fair experiment, Reece kept several factors constant during the experiment. List one factor he should keep the same: (1 point)

Same size and type of straw
Same type of paper
Similar sizes of tape
2 cm wide strips of paper for each glider
Same height of launch (throw)
Same person throwing the glider with the same force
Same measuring tool and unit of measure (cm)
Place the glider is thrown from
Angle of launch

Below is the data Reece collected during his investigation.

<table>
<thead>
<tr>
<th>Distance Gliders Flew with varying Back Ring Circumference</th>
<th>Circumference of Back Glider Ring (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance Gliders flew (cm)</td>
<td>10</td>
</tr>
<tr>
<td>Trial 1</td>
<td>168</td>
</tr>
<tr>
<td>Trial 2</td>
<td>165</td>
</tr>
<tr>
<td>Trial 3</td>
<td>229</td>
</tr>
<tr>
<td>Mean</td>
<td>187</td>
</tr>
</tbody>
</table>
IN.1.D.5,6,7.a—Communicate the procedures and results of investigations and explanations through oral presentations, drawings and maps, data tables (allowing for the recording and analysis of data relevant to the experiment, such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities), graphs (bar, single line, pictographs), equations and writings.

16-19. Use the data from the table above to construct an appropriate graph on the grid below.

(4 points total) Be sure to provide:
- an appropriate title (1 point)
- a label for each axis with appropriate units (1 point)
- an appropriate number scale and category labels (1 point)
- correctly plotted data (1 point)

*Assess the graph that would be most appropriate for your grade level.

(Bar Graph Example)

Distance Gliders Flew with varying Back Ring Circumference

Circumference of Back Paper Ring on Glider (cm)
16-19. Use the data from the table on the previous page to construct an appropriate graph on the grid below.

(4 points total) Be sure to provide:
- an appropriate title (1 point)
- a label for each axis with appropriate units (1 point)
- an appropriate number scale and category labels (1 point)
- correctly plotted data (1 point)

(Line Graph Example)

**Distance Gliders Flew with varying Back Ring Circumference**

```
<table>
<thead>
<tr>
<th>Circumference of Back Paper Ring on Glider (cm)</th>
<th>Distance Glider Flew (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>100</td>
</tr>
<tr>
<td>15</td>
<td>200</td>
</tr>
<tr>
<td>20</td>
<td>300</td>
</tr>
<tr>
<td>25</td>
<td>350</td>
</tr>
<tr>
<td>30</td>
<td>400</td>
</tr>
</tbody>
</table>
```

![Graph Example]
16-19. Use the data from the table on the previous page to construct an appropriate graph on the grid below.

(4 points total) Be sure to provide:
- an appropriate title (1 point)
- a label for each axis with appropriate units (1 point)
- an appropriate number scale and category labels (1 point)
- correctly plotted data (1 point)

**Distance Gliders Flew with varying Back Ring Circumference**

![Graph](image-url)
16-19. Use the data from the table on the previous page to construct an appropriate graph on the grid below.

(4 points total) Be sure to provide:
- an appropriate title (1 point)
- a label for each axis with appropriate units (1 point)
- an appropriate number scale and category labels (1 point)
- correctly plotted data (1 point)

(Scatter Plot using all data points Example)
A line of best fit in this graph could be accepted also.

**Distance Gliders Flew with varying Back Ring Circumference**

![Graph of distance gliders flown with varying back ring circumference]
IN.1.C.5,6,7.a-Use quantitative and qualitative data as support for reasonable explanations (conclusions)

20. Use the data table and graph to write a conclusion for the experiment. (1 point)

Any conclusion that shows how the independent variable affects the dependent variable is acceptable.

Examples

The glider with the larger back ring went the farthest.

The glider went the farthest when the front ring was smaller than the back ring.

The larger the circumference of the back glider ring, the farther the glider will fly.

When the circumference of the back ring on a paper glider was increased the glider flew farther.