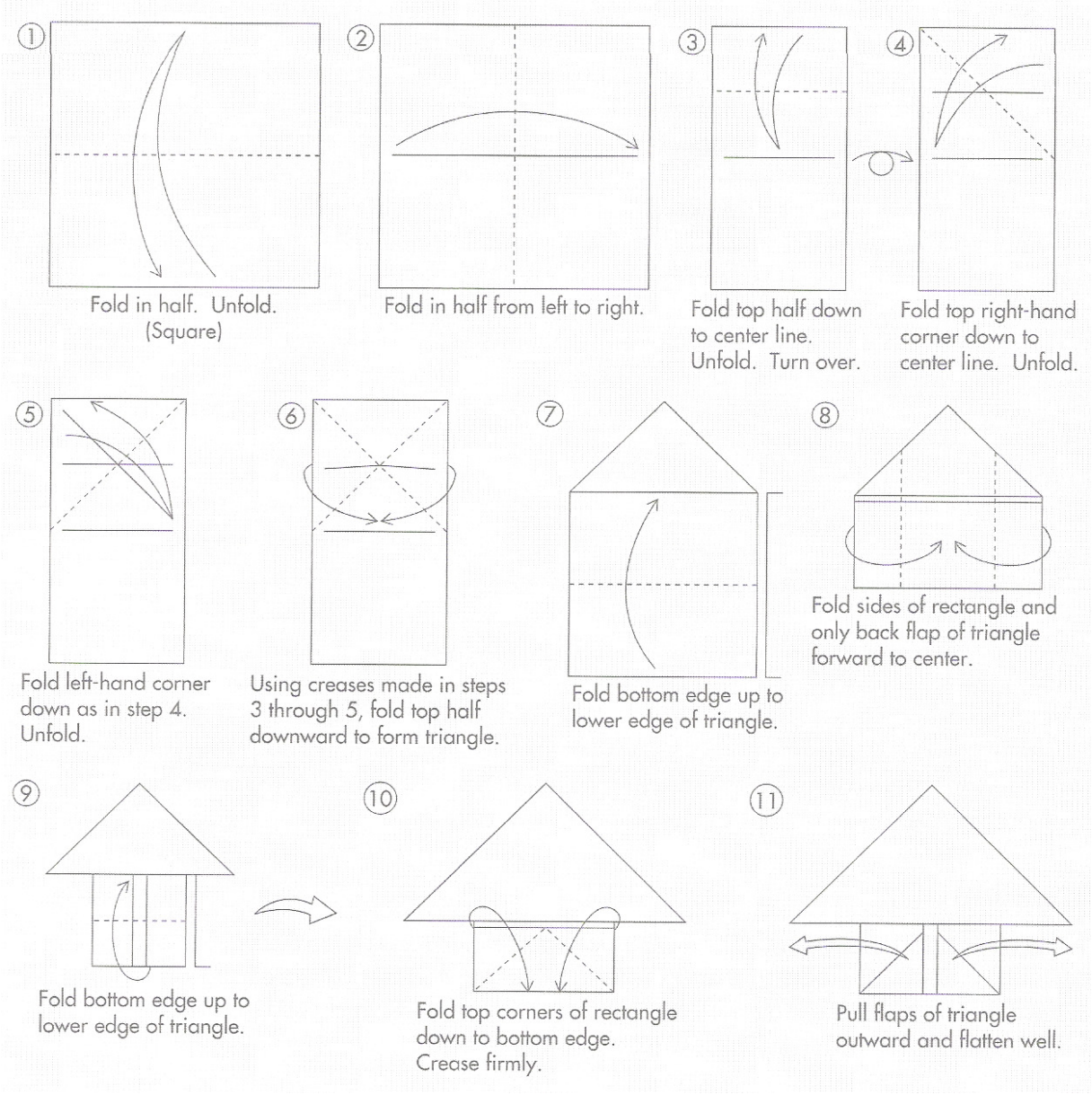
## Comparing Two Means

# [9]Jumping Frogs

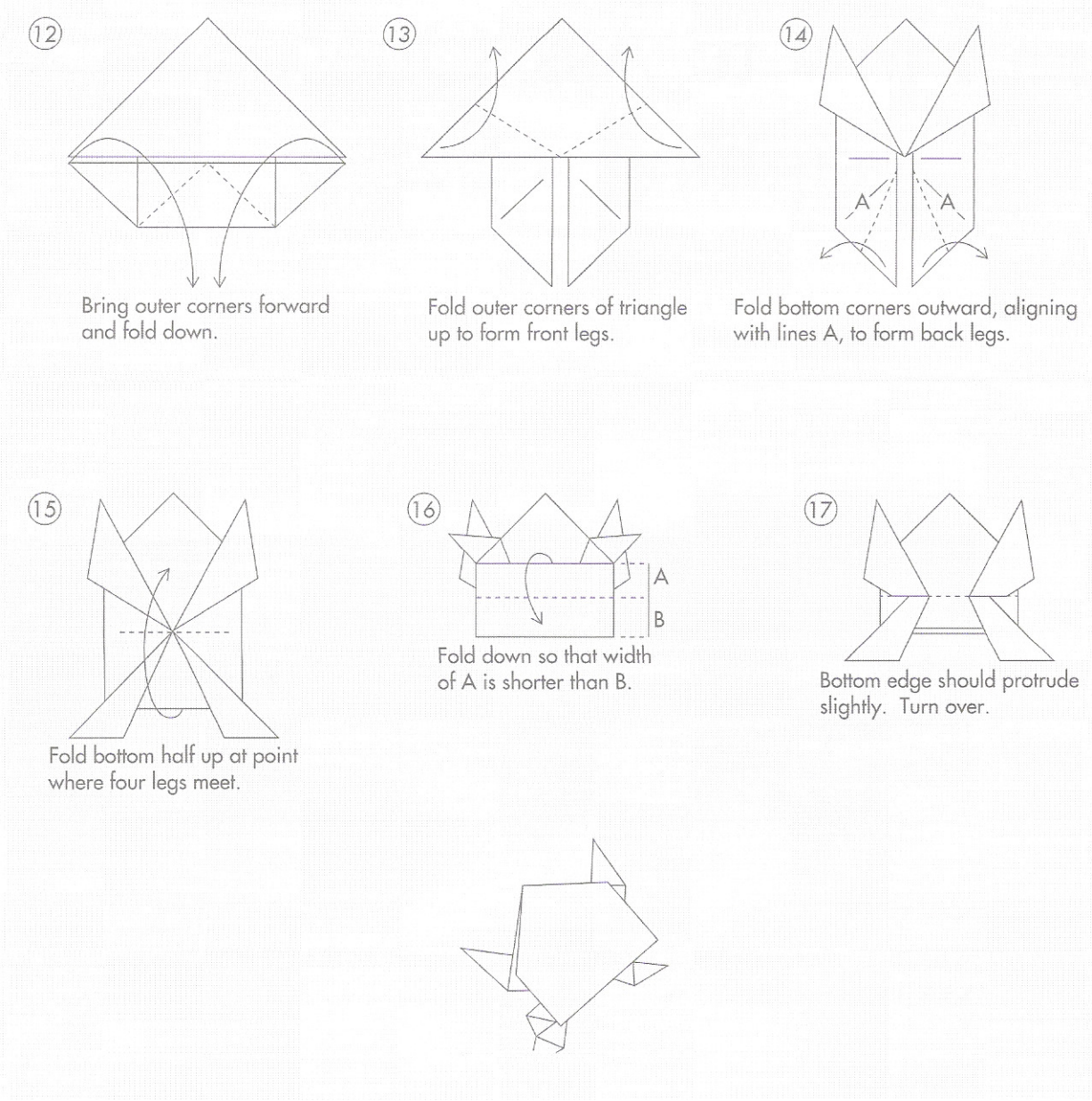
In this lab, you will be creating 2 origami jumping frogs made from different sizes of the same type of paper and determining if there is any difference between the distances each frog can jump.

Procedure:

1. Fold each 8 x 8 paper according to the instructions below. Try it out first with a scrap piece of paper. Then follow the instructions for a 6 x 6 piece of paper.




[9] This activity has been adapted from the *Jumping Frog Activity* from Activity-Based Statistics, Scheaffer, Watkins, Witmer, Gnadadesikan. Key Curriculum Press, 2004.




2. As a class, we will decide on a sample size of frog jumps with which everyone will be comfortable. *n*=_____. What else do we need to do?

3. Open a new document on your handheld and add a Lists & Spreadsheet. Enter the data into the lists, **smfrog** and **lgfrog**.

4. Add a Calculator page and calculate One-Variable Statistics and select 2 lists. X1 list will be **smfrog** and X2 List will be **lgfrog**.

**State $\bar{x}$ and $s$ for each size frog.**

5. Adding 2 Data & Statistics pages, create a histogram for each size frog. Make sure the scales are the same, set bin width = 2.

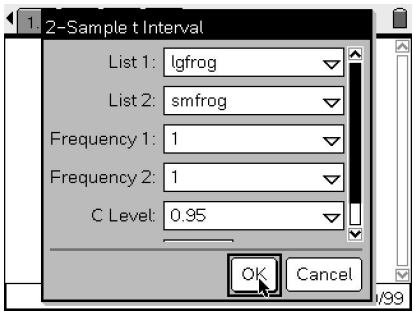
**Describe and compare each histogram.**

6. For each size of frog, create a 95% confidence interval for the mean distance jumped using your handheld, press (menu) 5: Statistics, 6: Confidence Interval, 2: t-interval. Use **data** in the first dialogue box and select **smfrog**. Press (enter) and run through the t-interval again, selecting **lgfrog** in the first dialogue box.

**Draw the two confidence intervals on the two charts on the board.**

**Make a few statements about these confidence intervals.**

7. Now we will create a confidence interval for the difference in mean distances for the two frog sizes and draw this on the third chart. Using your handheld, add another calculator page and press (menu), *Statistics*, *Confidence Interval*, *2 sample t interval*. Select **Data**, (tab) to OK and on the next dialogue box, enter:




**State your confidence interval for the difference in mean differences for the two frogs.**

**Does your confidence interval show that there is a significance difference between the jumping distances of the two sizes of frogs? Explain how you know.**

**Draw your confidence interval on the board on the third graph.**

**How does your confidence interval compare to the other students' intervals?**

**Based on the class intervals, state whether you believe if there is or is not a significant difference between the mean distances in jumps between the two sizes of frogs. Support your answer.**

8. Enter the class means in two different lists in the Nspire, **clgfrog** and **csmfrog**.

**Using the class data, perform a test to determine if there is a significant difference between the mean jump distances for the different frog sizes. Make sure to follow the inference toolbox! Include a sketch of the histograms.**

9. Verify your results above by performing a 2-sample *t* test on the calculator under the stat tests menu.

**Explain how this experiment could be carried out using a matched pairs design.**

10. In your spreadsheet, name column C, **difference** and calculate the difference between the **lgfrog** and **smfrog**.

11. Graph **difference** on a Data & Statistics page.

**Describe your histogram.**

12. Calculate a *t*-interval for **difference**.

**State the interval. Based on your interval, is there a significant difference? Support your answer!**

**How would your significance test procedure change?**

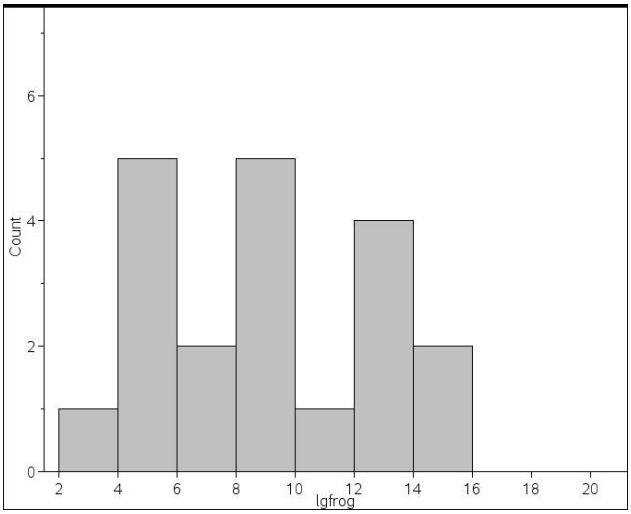
**Discuss why the matched pairs design may be preferred for this experiment.**

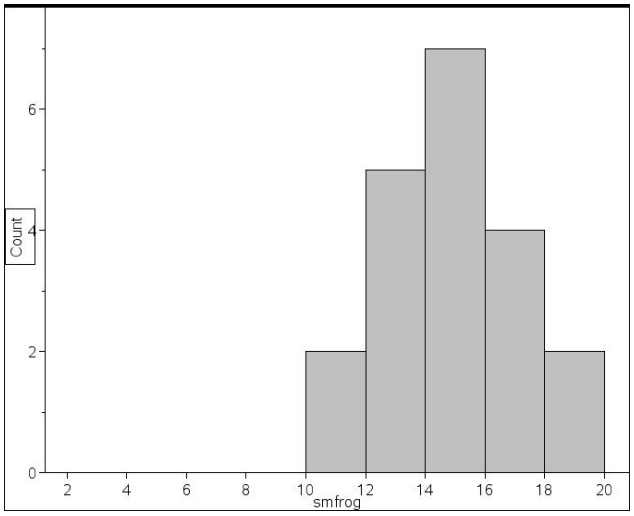
Here are the nspire screens for a ***sample*** student data.

**TEACHER NOTE:** The data was ***randomly*** generated and **should not** be accepted as the answer for this activity. Each student should have three lists in their spreadsheet and graphs of each. The students may choose to calculate all intervals and statistics on 1 calculator sheet. Several calculator pages have been used to show the individual calculations.

| | A smfrog | B lgfrog | C differences | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| ◆ | | | =lgfrog−smfrog | | | | | |
| 1 | 15.1 | 13.6 | -1.55 | | | | | |
| 2 | 18.8 | 3.29 | -15.6 | | | | | |
| 3 | 14.7 | 11.9 | -2.81 | | | | | |
| 4 | 13.5 | 4.5 | -9.03 | | | | | |
| 5 | 17.9 | 12.9 | -4.93 | | | | | |
| 6 | 13.5 | 9.98 | -3.48 | | | | | |
| 7 | 15.1 | 5.23 | -9.83 | | | | | |
| 8 | 14.9 | 14.7 | -0.181 | | | | | |
| 9 | 11.9 | 12. | 0.129 | | | | | |
| 10 | 12.4 | 12.7 | 0.321 | | | | | |
| 11 | 11.4 | 4.9 | -6.5 | | | | | |
| 12 | 13.9 | 14.7 | 0.75 | | | | | |
| 13 | 14.2 | 8.67 | -5.55 | | | | | |
| 14 | 14.1 | 9.1 | -4.99 | | | | | |
| 15 | 19.1 | 4.97 | -14.1 | | | | | |
| 16 | 16.7 | 9.13 | -7.56 | | | | | |
| 17 | 12.8 | 6.77 | -6.04 | | | | | |

*C* **differences:=lgfrog−smfrog**




OneVar 2,*lgfrog,smfrog*: *stat.results*

| | | |
|---|---|---|
| "Title" | "One−Variable Statistics" | "_____" |
| "$\bar{x}$" | 8.94 | 14.9 |
| "$\Sigma x$" | 179. | 298. |
| "$\Sigma x^2$" | 1.86E3 | 4.53E3 |
| "$s_x := s_{n-1x}$" | 3.71 | 2.15 |
| "$\sigma_x := \sigma_{nx}$" | 3.62 | 2.1 |
| "n" | 20. | 20. |
| "MinX" | 3.29 | 11.4 |
| "$Q_1X$" | 5.1 | 13.5 |
| "MedianX" | 8.89 | 14.8 |
| "$Q_3X$" | 12.4 | 16.3 |
| "MaxX" | 14.7 | 19.1 |
| "$SSX := \Sigma(x-\bar{x})^2$" | 262. | 88. |

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tInterval *smfrog*,1,0.95: *stat.results*

| | |
|---|---|
| "Title" | "t Interval" |
| "CLower" | 13.9 |
| "CUpper" | 15.9 |
| "x̄" | 14.9 |
| "ME" | 1.01 |
| "df" | 19. |
| "sx := sn-1x" | 2.15 |
| "n" | 20. |

tInterval *lgfrog*,1,0.95: *stat.results*

| | |
|---|---|
| "Title" | "t Interval" |
| "CLower" | 7.2 |
| "CUpper" | 10.7 |
| "x̄" | 8.94 |
| "ME" | 1.74 |
| "df" | 19. |
| "sx := sn-1x" | 3.71 |
| "n" | 20. |

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tInterval_2Samp *lgfrog,smfrog*,1,1,0.95,0: *stat.results*

| | |
|---|---|
| "Title" | "2−Sample t Interval" |
| "CLower" | -7.93 |
| "CUpper" | -4.01 |
| "x̄Diff" | -5.97 |
| "ME" | 1.96 |
| "df" | 30.5 |
| "x̄1" | 8.94 |
| "x̄2" | 14.9 |
| "sx1" | 3.71 |
| "sx2" | 2.15 |
| "n1" | 20. |
| "n2" | 20. |

tTest_2Samp *lgfrog,smfrog*,1,1,0,0: *stat.results*

| | |
|---|---|
| "Title" | "2−Sample t Test" |
| "Alternate Hyp" | "μ1 ≠ μ2" |
| "t" | -6.22 |
| "PVal" | 7.16E-7 |
| "df" | 30.5 |
| "x̄1" | 8.94 |
| "x̄2" | 14.9 |
| "sx1" | 3.71 |
| "sx2" | 2.15 |

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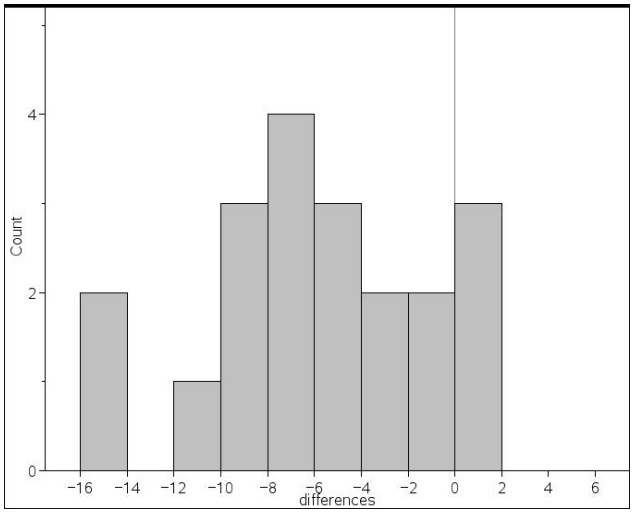


OneVar *differences*,1: *stat.results*

| | |
|---|---|
| "Title" | "One−Variable Statistics" |
| "x̄" | -5.97 |
| "Σx" | -119. |
| "Σx²" | 1.13E3 |
| "sx := sn-1x" | 4.71 |
| "σx := σnx" | 4.59 |
| "n" | 20. |
| "MinX" | -15.6 |
| "Q1X" | -9.36 |
| "MedianX" | -5.79 |
| "Q3X" | -2.18 |
| "MaxX" | 0.75 |
| "SSX := Σ(x−x̄)²" | 421. |

tInterval *differences*,1,0.95: *stat.results*

| | |
|---|---|
| "Title" | "t Interval" |
| "CLower" | -8.17 |
| "CUpper" | -3.76 |
| "x̄" | -5.97 |
| "ME" | 2.2 |
| "df" | 19. |
| "sx := sn-1x" | 4.71 |
| "n" | 20. |

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