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# *Agnes Pflumm and the Stonecreek Science Fair*

**STANDARDS**: NGSS Science and Engineering Practices / Cross-Cutting Concepts for grades 4-8

**TIME FRAME**: 2-4 weeks (or whatever you decide)

**MATERIALS**: Preferably a classroom set of *Agnes Pflumm and the Stonecreek Science Fair*. Many if not most schools have funded the class sets with grants or with literacy resources.

**OBJECTIVES**: (1) To make the science research process less painful (and even appealing!) to students (and thus, their parents and teachers).

(2) To teach science content through the powerful medium of storytelling.

(3) To promote literacy, critical thinking, problem solving (both independent and cooperative), anti-procrastination skills, and a LOVE for science. **(Note: Many 4-6th grade teachers use my books as part of their language arts curriculum, too.)**

(4) To create an atmosphere where metrics and accurate measurement are both absorbed *and* put into practice.

(4) Very importantly, to teach the **NGSS Standards** in an integrated STEAM approach to teaching and learning.

**PREPARATION**:

(1) **Actively engage students in a series of fun, reliable-data-producing experiments which teach the concepts of independent and dependent variables, hypothesis, constants, control, and repeated trials.** (I use paper whirligigs, an idea adapted from *Science Scope*. By changing variables such as weight, wing fold direction, and wing length, students clearly see the relationship between cause and effect and the importance of constants and a control. See lesson: ***The Amazing Paper Whirligig and THE SECRET OF THE RAP (at the end of these lessons).***

**This is also the perfect time to reinforce the importance of lab safety.** First, I put students in groups, and ask them to write down a list of 10 LAB SAFETY RULES that they think would be important. Then, I look around the room and find a student who would be in direct violation of these rules (long hair hanging down, open-toed shoes, shirt tails out, dangling jewelry, etc). I bring each one up to the front and ask the class to guess what lab rule he or she is. Then, we collectively come up with a list of safety rules for a science lab.

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## AN IMPORTANT NOTE ABOUT GRAPHING

If you have already reviewed data graphing skills, give your students time to figure out how to set up graphs for data from classroom experiments *BEFORE* showing them how. Ask them to take out graph paper and pencil, draw the x and y axes, label the axes with the independent and dependent variables, and then set the scale for the data. Walk around and check their progress.

THIS DIAGNOSTIC ASSESSMENT IS VERY IMPORTANT FOR IDENTIFYING AREAS OF EXISTING MISUNDERSTANDING. AVOID LETTING THEM LET COMPUTER SOFTWARE DO THEIR THINKING FOR THEM WHEN GRAPHING DATA.

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Here's one of my favorite activities: It's called the BURRITO BOOK (learned many years ago at a conference). It's the perfect way to make a little notebook for a lab report. If you use legal sized paper – *Voila!* You have a sketchbook!

## HOW TO MAKE THE BURRITO BOOK

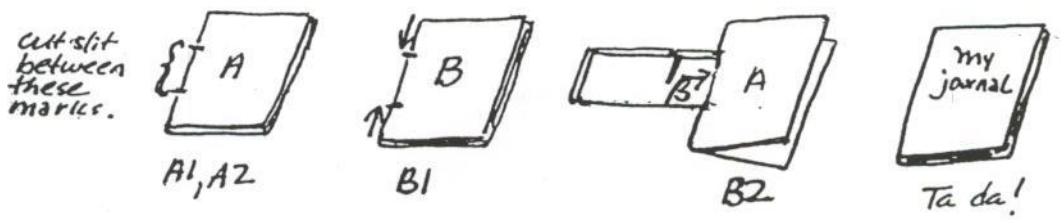
**Supplies:** 3 sheets of 8 ½ x 11 letter sized paper (for lab reports) OR 8 ½ x 14 legal sized paper (for sketchbooks), metric rulers, scissors, pencil or pen

**A 1** Fold 1 sheet of paper in half "Hamburger" style.

**A 2** Measure in **4 cm from each end of the fold** and make a pencil mark at these points; then cut a slit BETWEEN these marks. This will be part of your **cover.** (***NOTE:*** If using legal sized paper, make your pencil marks **5 cm** from each end of the fold.)

**B 1** To make the **inside pages**, fold the remaining two sheets of paper in another "Hamburger" fold, and again measure and mark **4 cm** from each end of the fold (5 cm for legal sized paper). This time, cut UP TO these two marks from each end.

**B 2** Finally, fold these inside pages into a lengthwise "Hotdog" fold, and slide them into the center cover slit until their slits are lined up with the center opening. Unfold the pages, and you have a Burrito Book!



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***NOW, BACK TO YOUR LESSON PLANS:***

(3) Read *Agnes Pflumm* yourself, and practice your voices (especially that of Mrs. Melrose). Practice the Science Rap on pages 20-24. Any instrumental rap music with a good beat will work. Be sure to familiarize yourself with the topics listed in the ***FYI*** section (pp. 128-129) in case you want to structure your own set of lesson plans.)

(4) Now you're ready for Agnes! LET THE FUN BEGIN!

**(NOTE: At certain points in these lessons, I propose taking a DETOUR to concentrate on specific skill building exercises.)**

***THREE DAYS BEFORE*****.....**

Begin wearing button or name tag that says **"WHO IS AGNES PFLUMM????"** but don't give anything away. Ask students to bring a folder with pockets and notebook paper to class. (or make these up ahead of time, depending on your resources). This will become their Science Fair Planners.

***DAY 1*****.....**

**Read** aloud chapters 1-5, then close the book with a flourish. They will protest and beg for more. Resist and begin copying homework questions on the board.

**HOMEWORK (HW)**: Answer questions from Chapters 1-2 in folders. Good composition and grammar are musts!

***DAY2*****.....**

**Go over** HW questions. (Draw names to be sure everyone gets a turn eventually.)
**Read** chapter 6 aloud. Don't forget to practice the Science Rap at home first! Don't be shy!
**Distribute books!** Your students will go bonkers! Mine sure did.

**HW**: Match the parts of the **Science and Engineering Practices** with the verses in the Science Rap.

***DETOUR # 1: THE SCIENCE RAP LIVE!***

Teachers around the country have really had fun letting their students practice and perform the SCIENCE RAP as part of their first inquiry units. Some teachers have been asked to have their students perform the SCIENCE RAP for PTO meetings. Some enterprising teachers have teamed with their school's music teachers to guide entire grade levels of students through group performances (with original music and choreography!) of the SCIENCE RAP.

***DAY 3*****.....**

**Read** chapter 7-8 aloud, then in class go over questions from this section of the book.
**HW:** Write your own answers to the above questions in their journal. Read chapters 9-12.

***DAY 4*****.....**

**Divide class** into cooperative dialogue groups to discuss q.1-4, Chapters 8-9. Have each group chose a spokesperson to share their group's opinions with the class. Students will have

a *lot* to say about how much help parents should really give
**HW:** Answer q.1-3, Chapter 10 in journal.

***DETOUR #1***

GETTING THE IDEA!!!! If you have the technology available to you, go to my website www.agnespflumm.com, and the link *No Fear Science Fair Projects.* There you will find ideas, background information, and lots more!

If you can't go online in your classroom, try to compile a list of interesting project ideas from any number of excellent resources available. Distribute 2 timetables per student for this year's school and local science fairs (One for the student to put in their Science Fair Planner and the other to be sent home to parents.) Allow class time for students to paste this schedule of due dates into the front cover of their Science Fair Planner. Then have them write the dates for each assignment due (for example – 3 possible ideas for your project; bibliography of sources; background information, etc. (Note: The links on my website will help you greatly with planning your fair.) *BE SURE YOU HAVE CHECKED YOUR SCHOOL CALENDAR AND HAD THE DATE, TIME, ETC. APPROVED. IF YOU WILL BE USING YOUR SCHOOL'S AUDITORIUM, GYMNASIUM, OR CAFETERIA, COORDINATION AND COMMUNICATION ARE ESSENTIAL!*

**HW**: Read chapters 13-15.

***DAY 5-6*****.....**

**Discuss** THE MEETING. If you do have internet access in your classroom, be sure to bookmark the science project sites (You'll find them on my website!) ahead of time. If you can enlist the help of your media specialist, this is also a great time to team teach research skills - from using the *Reader's Guide to Periodical Literature* to learning how to properly cite sources.
**Though using the book form of this guide may seem "old fashioned" these days, it will provide invaluable hands- on experience with fact finding.**

**Encourage students** to make their projects as original as possible and to avoid "cookbook" projects that have been done to death.**Teach** students how to prepare a bibliography for different types of resources.

***DETOUR # 2:***

**NOW'S THE TIME TO DISCUSS PLAGIARISM, WHAT IT IS AND WHY IT'S CHEATING. (See my web site for links to this subject.)**

**Later in the week**, give a **25 point quiz** over library research techniques, writing bibliographies, and facts about plagiarism.

***DAY 7*****.....**

**Discuss** questions from Chapters 14-15, giving notes on those in Chapter 15.
Students will clearly see how important it is to be precise in science as well as to make their procedure repeatable. In what ways did the *Anything Goes* group violate the Scientific Method?

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**HW:** Give students a cake recipe and ask them to make a list of at least 10 variables that might be changed.

***DAY 8*****.....**

**Compare** student answers on homework assignment and show how a separate experiment could be made from each variable changed.

**In class**: Students read chapters 16-21, then make a list of the problems each of the characters encountered in the initial phases of the project. Collect their journals for a "spot check" just to make sure they're keeping up with it.

***DETOUR # 3 : THE METRIC MOMENT….BROUGHT TO YOU BY AGNES PFLUMM***

It was no accident that I had character Andy Crotts do an science fair project on Metric Measurment. Early on in the teaching of the inquiry process, you must stop to assess your students' (and your!) comfort level and proficiency with the metric system. Here's a step by step plan which I have used with great success:

1. Go to page 108, ***TEST YOUR METRIC I.Q !*****,** which Andy has to bribe his classmates to take.

2. Enlarge the test roughly 125% (It should about the size of half a sheet of copy paper).

3. Paste 2 copies of the enlarged version of the Metric Test on 1 sheet of paper to serve as your master. Make copies equal to half the number of your students. (This saves paper!)

4. **Announce to your students that today will be the first of many METRIC MOMENTS**. Begin by explaining to them that in spite of the fact that the entire field of science and technology (from medicine to astrophysics) is done in metrics, the United States has stubbornly hung on to its English System of measurement, based on such "trustworthy" standards as the length of an English king's foot! In fact, we are the only civilized, progressive nation on the planet that still resists measuring our car trips in kilometers, our newborns in kilograms, and our sodas in liters.

   To be "fluent" in science, one must master metrics and be completely comfortable using it. However, because we in America have been raised with the English System of Measurement, we must first be able to readily go from English to Metrics in our heads. How else are we to travel the world, where we must read a map, go to a market, or take the proper amount of medicine – ALL IN METRICS!

5. Announce that today's **METRIC MOMENT** will involve your students taking a PRE-TEST to determine their **fluency in METRICS**. Assure them that the scores will NOT count against their averages but will only be used as a reference point against which to compare improvement later. **Also tell them not to be embarrassed if at this point, they score quite poorly.** Administer Andy's Metric I.Q. test, and then have students take out a red pen. Read out the answers. With each question worth 7 points, have them figure their Metric I.Q.

(their test score) and write it on the top of the test. Then, collect the papers and write the scores (minus student names, of course!) on the board. Have the class calculate their AVERAGE METRIC I.Q. on (write the date).

5. Over the next week, plan many METRIC MOMENTS and activities. DO create a **METRIC LEARNING CENTER**! Stage a school-wide METRIC OLYMPICS. Events can include estimation games for mass, length, volume, temperature, and (for older students), density.

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6. **After your METRICS unit, re-administer Andy's test, and you and your students will be proud and amazed at the improvement in their METRIC IQ!**

**DAY 9.....**

**Read** chapter 22 aloud. Discuss annoying, intrusive, and well-meaning parents. **Allow students to share** their own stories on this subject.
**Then read** chapter 23 aloud and demonstrate the proper way to shake hands and introduce one's self (NO DEAD FISH HAND SHAKES!) Have students practice on each other.

**HW**: Read chapters 24-26. Have students make a list of possible problems they might expect to encounter with their own projects.

***DETOUR # 3*.....**

Provide a handout on what the project display board should look like. Bring out some old projects (if you have some) to show students. Introduce the ready-made Tri-board as by far most effective way to display your data.
**HW:** Finish reading the book! Give one week to finish questions on these chapters.

***DAY 10....***

**Go to** *Permission to Act Out in Class* (p. 132) Ahead of class, decide which scenes you want your students to act out and put those scene's numbers in a jar as many times as there are students in the scene. Have each student draw a number to determine which group and scene they will be in. Have them begin improvising immediately. Tell them they're going to be acting them out tomorrow or the next day for a 25 point quiz grade.

***THE WEEK BEFORE YOUR SCHOOL FAIR...***

Have each student **defend his or her project** to you and the rest of the class. Have them greet you confidently, make direct eye contact, point frequently to their data and/or materials as you ask them as many specific questions as possible. **Be sure to ask them what they would do differently if they were to do their projects again**.

Remind students to jot down all the questions and/or suggestions the judge asked about their projects. These notes will help them be even better prepared for their next judging experience and also allow them to make important improvements in their projects if they are going on to the next level of competition.

***NOTES:*** You should use *Agnes Pflumm and the Stonecreek Science Fair* as it best fits *your* curriculum. In the appendix, you will find instructions for performing scenes through creative drama. Also, feel free to add more questions to the list in the appendix.

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# *THE AMAZING PAPER WHIRLIGIG*

**How can a simple paper whirligig be used to teach virtually every aspect of the experimental process?**

It's easy! Just have students cut out and fold the whirligig and then design experiments with only 1 independent variable at a time being changed.

**SAMPLE EXPERIMENTS:**

1. How does the wing fold direction affect the spin direction (clockwise or counterclockwise) of the paper whirligig when dropped?

2. How does adding mass in the form of paperclips affect the fall time of the paper whirligig?

3. How does the length of the wings affect the fall time?
   - All 3 experiments have only 1 **independent** and 1 **dependent variable**.
   - All 3 experiments have a set of **constant**s which must stay the same for all trials.
   - Experiments 2 and 3 must have a **control helicopter** to which the independent variable does not apply.

**Tips:**

- For experiments 2 and 3, be sure to practice with 3 timekeepers to make sure the start and stop times are synchronized.

- Avoid dropping the whirligigs in a draft as from a fan or air conditioner.

- Do not allow students to stand on a chair. The teacher should be the one dropping the whirligig and all students collecting data in tables, which have been made before the experimental trials are begun.

- Do at least 3 trials for each change in the independent variable in *any* experiment you do.

# *The Secret of the RAP!*

**IN THE VERSES OF AGNES PFLUMM'S SCIENCE RAP LIE THE SECRETS OF A NO-FEAR SCIENCE FAIR PROJECT. LET'S TRY IT WITH EXPERIMENT # 2 ABOVE!**

**I. ASK A QUESTION: WHAT IS THE EFFECT OF the number of paperclips ON the fall time of the paper whirligig? (Notice that in questions written in "WHAT IS THE EFFECT OF" manner, what follows the word "OF" is always the INDEPENDENT VARIABLE and that what follows the word "ON" is always the DEPENDENT VARIABLE.)**

**A. INDEPENDENT VARIABLE: THE NUMBER OF**

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PAPERCLIPS

B. DEPENDENT VARIABLE: FALL TIME (SECS)

C. EXPERIMENTAL CONSTANTS:

1. Same whirligig
2. Same method of dropping, etc
3. You list some more constants for 3-5.
4.
5.

D. CONTROL – those trials in which the whirligig is dropped with NO paperclips (Notice that in the CONTROL trials, the INDEPENDENT VARIABLE is taken OUT of the experiment. Having CONTROL trials is the ONLY way to determine if your independent variable is really having an EFFECT on your dependent variable -the results). This is one of the most important concepts you'll need to learn about doing a CONTROLLED EXPERIMENT like this one.

## II. FIND OUT MORE (BACKGROUND INFORMATION)

NOTE: In your background information, you must be sure to read up on gravity and falling bodies, the effects of air resistance on a falling body, Galileo's demonstration from the Leaning Tower of Pisa, and the concept of terminal velocity. Only then will you truly grasp the kind of data you will get from doing this experiment.

## III. MAKE A GUESS ABOUT WHAT'S IN STORE (HYPOTHESIS)

Ex. I believe that adding paper clips will (You fill what you think will happen ) the fall time of the whirligig. (Hint: Do you think it will INCREASE, DECREASE, or HAVE NO EFFECT on the fall time?)

## IV. GATHER YOUR STUFF ( This is your MATERIALS LIST)

1. 1 paper whirligig (see template below)

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2. **3 students who have practiced so that they can synchronize their start and stop times with stopwatches.**
3. **1 teacher to stand on a stool and drop the paper whirligig for all trials.**

## V. GET ORGANIZED (PROCEDURE STEPS)

1. **All students need to set up and draw data tables like that below. Copy a table on the board as well (or on an overhead transparency). Students should have calculators ready to compute averages.**

2. **Bring students timers up to the front of the classroom so they can clearly hear and see when the whirligig is dropped and when it hits the ground. Practice dropping the whirligig several times with the cues "DROP!" to begin timing and "STOP!" to end timing the instant the whirligig hits the ground. Appoint a student helper to pick up the whirligig so the teacher doesn't have to get up and down off the stool.**

3. **Bring another student helper up to the board or overhead projector to enter data. There will be three times given for each drop. Have the data writer at the board write all three times down (to nearest 1/100$^{th}$) of a second, and then require students to calculate the average time for each trial. This number will be entered as the time for Trial 1 for each change in the number of paperclips. [Note, in the case of one student missing the start or stop, just go with two times to average for a trial]. Repeat procedure for trials 2-3. Ask students to calculate the average fall time to the nearest 1/10$^{th}$ of a second for each change in the independent variable.**

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## VI. SOLID DATA WILL BE YOUR PRIZE!

### A. YOU MUST DO REPEATED TRIALS (at least 3)

### B. Record your results in a DATA TABLE

**Example**

Effect of Adding Paperclips on Whirligig Fall Time

**Fall Time (seconds)**

| Number of paperclips | Trial 1 | Trial 2 | Trial 3 | Average |
|---|---|---|---|---|
| 0 | | | | |
| 2 | | | | |
| 4 | | | | |
| 6 | | | | |
| 8 | | | | |

### C. GRAPH your data and look for relationships between the variables. Be sure to always put the independent variable on the X axis. NOTE: In general, only the AVERAGE results are shown on your final graph.

NOTE: SOMETIMES YOU WON'T SEE ANY RELATIONSHIP BETWEEN YOUR VARIABLES AT ALL. DOES THAT MEAN YOUR PROJECT'S A FLOP?

2. UNEXPECTED THINGS HAPPEN ALL THE TIME IN SCIENCE, THAT'S WHAT MAKES IT SO COOL! The following were all discovered by accident: penicillin, Post-it notes, soda water, Velcro, and silly putty.

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**VII. CONCLUSIONS (the following 5 questions must be addressed in this section):**

**A. Was my hypothesis confirmed?**

**B. What DID happen? (Here cite your exact data, noting the changes in the dependent variable with each change of the independent variable.)**

**C. What were some possible sources of error?**

**D. What would you do differently if you were to do this experiment again?**

**E. What other questions related to this project did you think of that might make good experiment?**

**For example, in our whirligig experiment, you might want to investigate how the length of the wings affects the fall time. REMEMBER, YOU CAN ONLY CHANGE ONE VARIABLE AT A TIME FOR A GIVEN EXPERIMENT. OTHERWISE YOU WON'T KNOW WHAT CAUSED THE RESULTS YOU OBSERVED.**

**NOW GO BACK TO THE RAP AND SEE HOW VERSES 4-11 MATCH UP TO THE STEPS YOU MUST TAKE WHILE GATHERING AND ANALYZING YOUR DATA. LEARN THE RAP. DO THE SCIENCE, AND HAVE FUN!**

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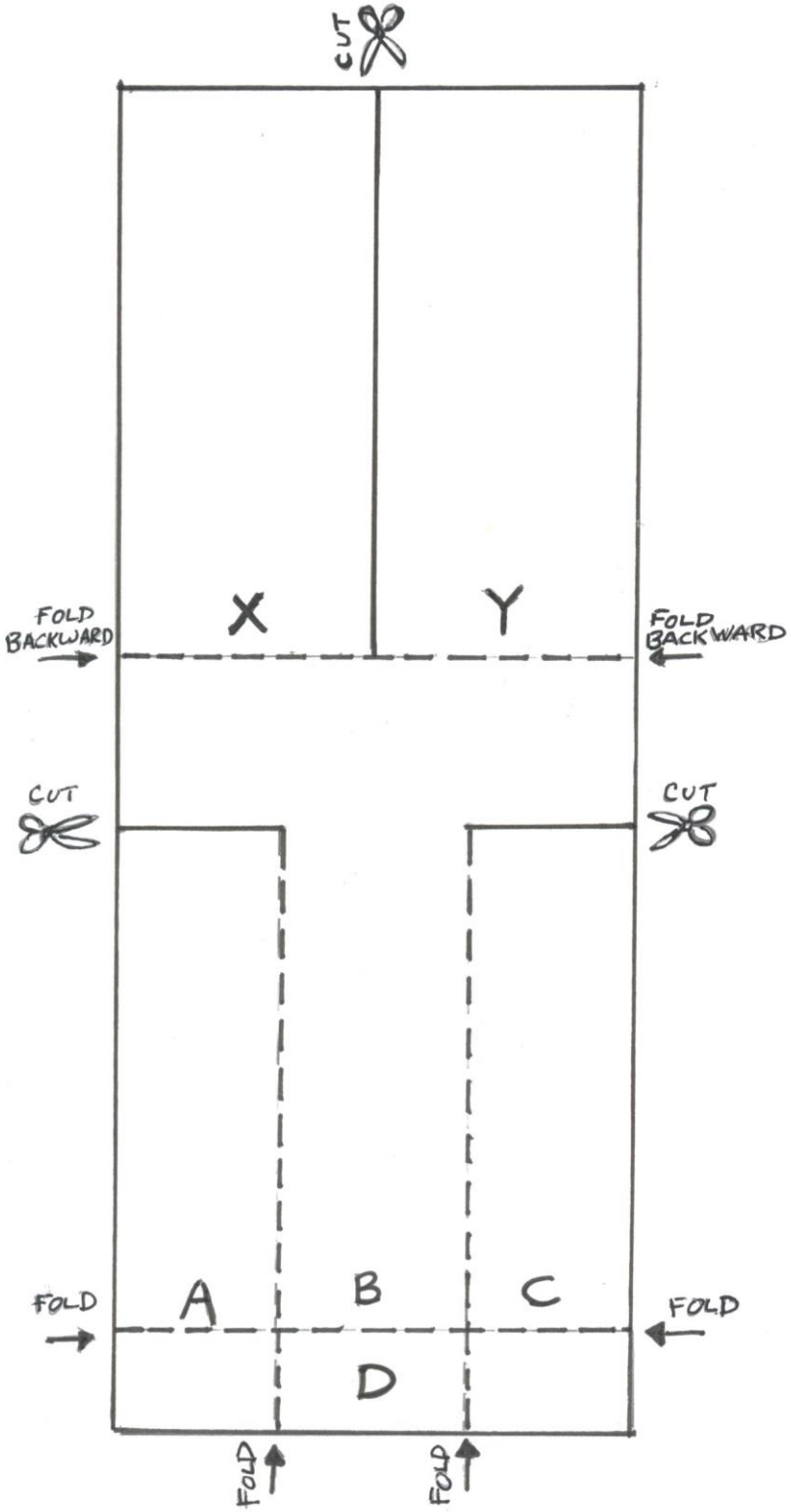
*TEMPLATE AND INSTRUCTIONS FOR MAKING THE PAPER WHIRLIGIG*




1. CUT out around the PERIMETER of the whirligig template, along the SOLID outside lines.
2. Now, CUT along the 3 SOLID INTERIOR lines, being CAREFUL to STOP when you reach a broken line.
3. FOLD along the broken lines: section C BEHIND section B, section A BEHIND section B, and section C BEHIND section B.
4. Complete the whirligig by FOLDING blade X in one direction along the BROKEN LINE, and blade Y in the OPPOSITE direction.