SEPA
SOCIETY OF ELEMENTARY PRESIDENTIAL AWARDEES

ITEEA
National Harbor
Washington DC • March 2-4, 2016

Teaching Technology and Engineering STEM Showcase

Best Practice: Using Origami As A STEM Tool

Best Practice Description: Track and model the Frog's Life Cycle including its methods of movement at different stages of development. Use creative designs with origami folds to model the frogs' statute and movement.

Objectives:
By the end of our STEM project, we will be able to:
- Describe the frog as a living thing.
- Develop an array of models to explain the frogs' unique and diverse life cycle.
- Explain what origami is and its origin.
- Demonstrate the art of origami by folding paper to create models of frogs.
- Use origami models to construct explanations as to how some frogs move.
- Use various forms of technology to record data on the model frogs' movement.
- Design and construct an investigation using origami figures to model the frog and to collect data on the various movements of jumping frogs (height, distance, stability).

STEM Activities:

Part I *(Pre-activities)*
- Review the life cycle of the frog
- Compare the frog to other amphibians

Part II *(Pre-activities)*
- Review the art of origami via Internet, use of projector or printed instructions.
- Apply knowledge of geometric terms to construct sample frog figures.

Part III
- Conduct a project to test and determine the best attributes of the designed frogs.
- Test sample figures to illustrate/replicate various movements of jumping frogs.
- Modify the design based on data collected to increase the origami frogs' ability in jumping height, distance and stability.

Part IV Assessments (Extensions)

S - • Collaboratively develop or revise an origami model based on evidence that shows the relationship among variables for repeated frog jumps.

T - • Record folding process of models via digital camera (still shots or video)
Use the shots to publish on school webpage or newsletter
Use technology to collect/record and manipulate data for the project

E - • Describe the folding process using geometric terms that apply to select origami frog models

M - • Solve math problems related to the project; e.g. elapsed time, geometric shapes, or lines of symmetry, etc.

Using Origami As A STEM Tool ~ Standards

CONNECTING TO THE STANDARDS ~ **NGSS: 1) Life Science and 2) Engineering, Technology, and Applications of Science**

Standard 3-LS1. Inheritance and Variation of Traits: Life Cycles and Traits

Performance Expectations:
3-LS1-1. Develop models to describe that organisms have unique and diverse life cycles but all have in common birth, growth, reproduction, death.

Science and Engineering Practices
Developing and Using Models; Analyzing and Interpreting Data; Constructing Explanations and Designing Solutions

Disciplinary Core Ideas:
LS1.B: Growth and Development of Organisms
LS3.A: Inheritance of Traits
LS3.B: Variation of Traits

Crosscutting Concepts
Patterns; Cause and Effect

Standard 4-LS1. From Molecules to Organisms: Structures and Processes

Performance Expectations:
4-LS1-1. Construct an argument that plants and *animals* have internal and external structures that function to support survival, growth, behavior and reproduction.

Science and Engineering Practices:
Asking Questions and Defining Problems; Developing and Using Models; Planning and Carrying out Investigations

Disciplinary Core Idea:
4-LS1D. Information Processing

Crosscutting Concepts:
Cause and Effect; Systems and Systems Models

Standard: MS-ETS1. Engineering Design

Performance Expectation:
MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Science and Engineering Practices:
Asking Questions and Defining Problems; Developing and Using Models; Analyzing and Interpreting Data; Engaging in Argument from Evidence

Disciplinary Core Idea:
ETS1.A. Defining and Delimiting Engineering Problems
ETS1.B. Developing Possible Solutions
ETS.1.C. Optimizing the Design Solution

Crosscutting Concepts:
Influence of Science, Engineering, and Technology on Society and the Natural World

Standard: 3-5-ETS1 Engineering Design

Performance Expectations:
3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.

3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

Science and Engineering Practices:
Asking Questions and Defining Problems; Planning and Carrying Out Investigations; Constructing Explanations and Designing Solutions

Disciplinary Core Idea:
ETS1.A. Defining and Delimiting Engineering Problems
ETS1.B. Developing Possible Solutions
ETS.1.C. Optimizing the Design Solution

Crosscutting Concepts:
Influence of Science, Engineering, and Technology on Society and the Natural World

Common Core State Standards Connections:
ELA/Literacy: RI.3.1; RI.3.2; RI.3.3; W.3.2; SL.3.4 - Mathematics: MP.2; MP.4; 4.G.A.3; 5N.F.B.7; 4.N.F.A.2

References and Support Credits for Origami activities: University of Wisconsin Sea Grant Institute
Crease, Crease, Crease Video produced by Patricia Cooper, TILT Team Member, NOVA http://youtu.be/yubFN15wuc0

Teaching Technology and Engineering STEM Showcase

USING AN INTEGRATED PROCESS APPROACH AND LITERACY TO PROMOTE STEM INSTRUCTIONAL PRACTICES

This instructional tool is designed to showcase the integration of STEM education in all classrooms, and in particular, elementary classrooms. It will foster deepening one's understanding of the relatedness of science, technology, engineering and mathematics; and will demonstrate the use of science trade books as an entity to promote literacy and highlight the present day and historical contributions of scientists and inventors from all cultural groups. This project will provide examples of teacher and student work.

~ ESSENTIAL QUESTIONS ~

What are the STEM processes; how are the processes related; and how do the instructional practices of STEM impact personal and social perspectives in our society?

STEM PROCESSES

SCIENCE PRACTICES	TECHNOLOGICAL DESIGN	ENGINEERING DESIGN	MATHEMATICS PRACTICES
Ask questions and define problems. Develop and use models. Plan and carry out investigations. Analyze and interpret data. Use mathematics and computational thinking. Construct explanations and design solutions. Engage in argument from evidence. Obtain, evaluate, and communicate information.	Identify the problem. Define the problem. Generate ideas for possible solutions. Select the best solution. Model the solution. Evaluate the solution. Refine the solution as needed. Communicate the solution.	Ask a question. Imagine an idea or solution. Plan Create a product. Improve on the product. *Continue the cycle.*	Make sense of problems and persevere in solving them. Reason abstractly and quantitatively. Construct viable arguments and critique the reasoning of others. Model with mathematics. Use appropriate tools strategically. Attend to precision. Look for and make use of structure. Look for and express regularity in repeated reasoning.

~ MULTI-DISCIPLINARY CURRICULAR COMPONENTS ~

How are core curricular standards addressed through the teaching and learning of STEM concepts?

Discipline	Standard	Concept	Challenge
Science	Life Science Science/Engineer Practices Crosscutting Concepts	Life Cycles and Animal Structures and Processes Human endeavors	Design & construct model Origami frogs Read: B. Taylor, Frogs & Snakes
Technology	Design World	Communication technology & engineering	Use Communication and Audio-visual Technologies to showcase origami model
Engineering	Drafting and Design	Engineering design	Construct origami frogs
Mathematics	Measurement & Data	Measurement & Data Geometry	Fold appropriate geometric shapes to form origami design
Reading	Informational Text	Key Ideas and Details	Read: Smithsonian Nat. Ranger
Social Studies	Literacy/World History	Historical Research	Research the art of origami
Art	Visual Arts	Portraying an image Applying media processes	Design/draw pictorial representation of frogs

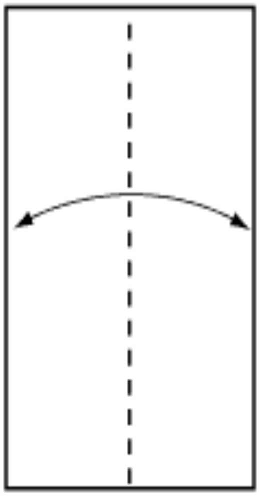
References: Next Generation Science Standards (http://www.nextgenscience.org) 2013
International Society for Technology in Education (http://www.iste.org/STANDARDS) 2012
McREL: Engineering Education (http://www2.mcrel.org/compendium/SubjectTopics.asp?SubjectID=28)
Engineering is Elementary (http://www.eie.org/overview/engineering-design-process)
Mathematics Common Core Standards (http://www.corestandards.org/math)

How to Make an Origami Jumping Frog

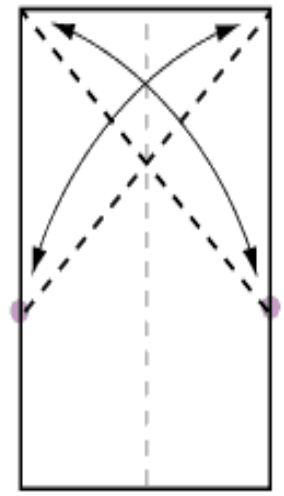
Adapted from: Origami Jumping Frog Instruction Origami-fun.com

Crease, Crease, Crease Video produced by Patricia Cooper, TILT Team Member, NOVA http://youtu.be/yubFN15wuc0

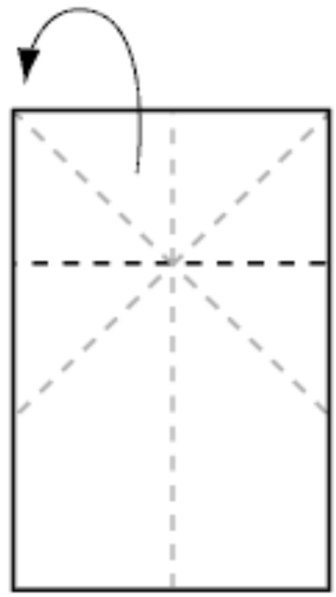
The Origami Jumping Frog is really easy to make... To make the frog jump to its best potential, use paper that's a bit thicker. You will need to use rectangular paper for this model.



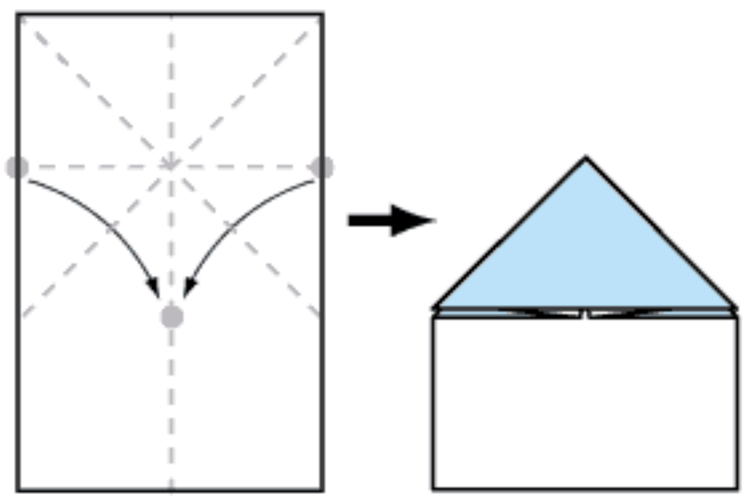
1.Start with a rectangular sheet of paper, white side up. Fold it in half, and open out again.



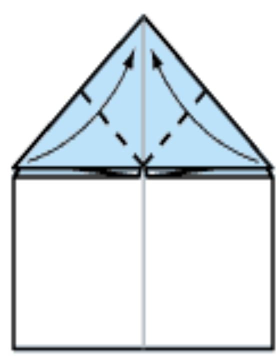
2. Fold both top corners to the opposite edge of the paper then unfold. Your creases should look like this.



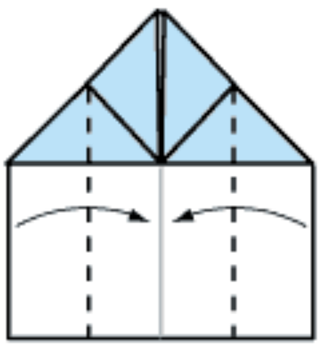
3. Where the diagonal creases meet in the middle, fold the paper backwards, crease well and open.



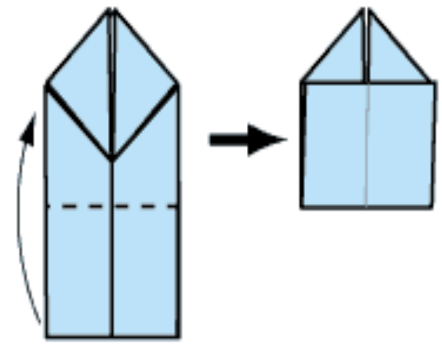
4. Hold the paper at the sides, bring these points down to the centerline, then flatten. The creases should do most of the work here!



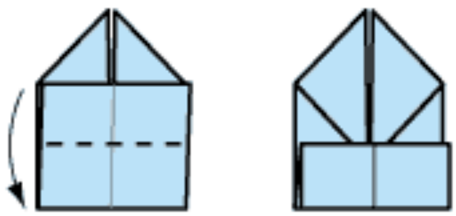
5. Fold the uppermost triangles up to the top point.



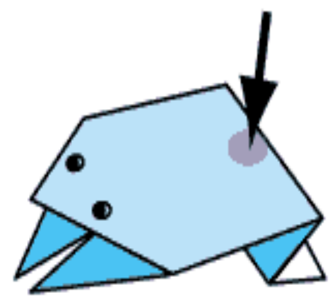
6. Fold sides in to the center line.



7. Fold bottom of model upwards so the end sits in the center of the top diamond.



8. Now fold the same part downwards, in half.



Turn over, your Jumping Frog is finished! To make him jump, press down on his back as shown.

page 2a.