New Spirit of St. Louis®
EGGS PRIZE®

Teacher Guide

This curricular unit was designed to accompany a $10 million aerospace competition, the Ansari X PRIZE. The module allows students to experience the same process that the actual Ansari X PRIZE teams undertook and, in many cases, are still pursuing. Although the science content is focused on applications related to rocketry and human space flight, project conceptualization, design, testing, and implementation are critical science process skills. It is important that students are allowed to complete this process and the thinking and analysis that are inherent to it.

The unit begins with some background information on the Ansari X PRIZE mission and the New Spirit of St. Louis® EGGS PRIZE® challenge. Students will then launch a rocket they construct using their own background knowledge. This will allow you to observe what students *do* and *do not* already know about rocketry, and motivates students to learn more. Students will then work in Design Groups to discuss their first attempt at launching rockets. They will assume expert roles and, in Expert Groups, will each gain specific knowledge about one of the variables related to successful rocket launching and the safe return of a fragile payload (in this case, a raw egg). They will bring this information back to their Design Group to help put together a newly designed rocket with payload. After additional testing, the groups will launch in the New Spirit of St. Louis® EGGS PRIZE® Competition to see if they can accomplish the goal of two consecutive launches to 30 meters with an intact, safe payload.

This activity parallels the work of a project design team in that each member is an expert on one part of the mission and that team members must share expertise to reach a mutual goal. Cooperative learning will assist in this expertise-building process. Your role becomes that of a facilitator of learning, rather than the source of knowledge. The Expert Group activities can be completed with your supervision, but do not require instruction. Encourage students to ask questions and find answers for themselves through the process. Your close supervision is required during the test launches. To facilitate classroom management, you might want to schedule launches on one specific day of the week or when a majority of teams is ready to test their variable. You may want to recruit the assistance of other adults to assist.

Safety is a major issue in this curriculum. Be certain that you study the Safety Rules with your students and monitor strict safety regulations during all launches. Use the Safety Check List each time you build or launch. Specific information is included in this unit. To assist you in aligning this unit to your state and local curriculum frameworks, a list of national standards addressed is included. Following the experiences provided in this curriculum, your students should have an understanding of the process of mission design and implementation; content knowledge of rockets and Newton's Three Laws of Motion; and an appreciation for the power of working together to solve a problem.

The X PRIZE Foundation wishes you many safe and successful launches!

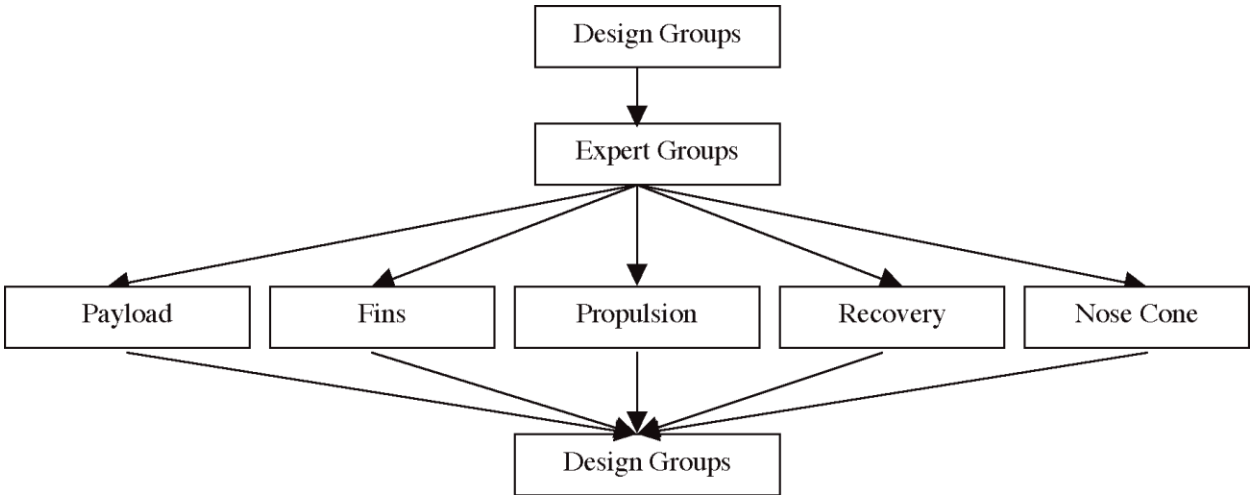
How to Teach This Unit

The New Spirit of St. Louis® EGGS PRIZE® Curriculum Module is built using a learning cycle that incorporates the cooperative learning model. A learning cycle is a framework around which curriculum is built. The learning cycle for the New Spirit of St. Louis® EGGS PRIZE® module includes the three phases of Exploration, Concept Invention, and Application. The cooperative learning model known as the "jigsaw" is found within the Concept Development and Application phases.

The Exploration phase of this module culminates in the original launch of the trial rocket, an unmodified bottle, by the Design Groups. In this phase, students will be building upon their prior knowledge and testing the validity of that knowledge. This phase gives you an opportunity to examine the background knowledge and experiences your students bring to this unit.

The Concept Development phase involves the students in Expert Group work. After the initial launch, the Design Group assigns members to become experts on the individual rocket variables. These experts work with members of the other groups likewise assigned to the Expert Groups. Each group focuses on a deep understanding of one critical variable of the rocket construction and launch. You will find these in the Expert Group activities of this module.

For the Application phase, the original Design Groups reconvene to apply new understandings to construct a second rocket for the final competitive launch. Once the group members have attained expertise in an Expert Group, they each bring back to the Design Groups their individual expertise



The Expert Group work is designed for five groups. However, if your class configuration does not accommodate that number, feel free to assign the activities to the appropriate number of groups. If you wish to use four Expert Groups, consider combining the Payload and Nose Cone groups, or the Recovery and Payload groups. Another option is to complete the Propulsion activities as a class and then have students work in the remaining four Expert Groups.

Because various groups will be working on different things simultaneously, you will need to have some way to keep track of the work both of the groups and of individual students. A daily log of group

activities kept by each Design Group and Expert Group is one strategy. Periodic student evaluation of the members of the group is another.

You may also want to allow time for the Project Design Group to meet every few days for members to touch base with each other on what they are learning in their Expert Groups. It will be critical for the Payload and Nose Cone Expert Groups to confer with each other, as well, perhaps, as some combinations of the other groups. You may want to set up an appointment calendar for Expert Groups to schedule time to meet with closely aligned groups when interaction is necessary. Some groups may have a variable design they want to test on an actual rocket. In order to avoid having to launch test rockets every day, you may want to assign scheduled test days. The assistance of an additional adult (i.e. parent, teacher's aide) will help you to facilitate this process.

Your classroom should have the flexibility to accommodate student activity. If you have access to an outdoor area and/or large open area such as a hallway, gymnasium or multipurpose room, the students can use that for their testing prior to the actual rocket launch.

Assessment will occur throughout the process. Journals are a critical part of students thinking through the process of designing, building, and evaluating the rocket. They assist the student to focus on his or her thinking and show growth and learning over time. You may wish to have students do journal entries as often as every day. To help the students focus their thoughts, you may ask a question addressing a specific skill the students are developing, a design they are creating, a problem they are solving, how the groups are interacting, or some specific content they are learning. Because students will be in different places in their learning from day to day, you are the best judge of the types of questions that should be addressed in the journals.

Some journal prompt examples include:

a) Describe the design you used for your nose cone and why you used that specific design. Support your design with specific data.
b) What new thing did you learn today in your expert group?
c) What problem are you working to solve today? How did you do it or what are you thinking about to this point?
d) Describe your group interactions today. How could you improve them for tomorrow? What specifically can you do?

The final assessment will be the success of the final competitive launch and the student's evaluation of the efforts made to accomplish it.

If you complete this unit, you will have addressed all of the standards indicated within the lessons, plus certain Science Education Teaching Standards found in the National Science Education Standards. These teaching standards related to planning inquiry-based instruction, guiding and facilitating learning, using ongoing assessment, providing appropriate learning environments, and developing communities of science learners.

Learning Experiences - Sample Time Line

The following is a suggested time line for the learning experiences within this module, based on time used during pilot testing. Days in this sequence represent 42-minute class periods. When teaching with an inquiry approach, it is difficult to be constrained by a rigid time schedule. Additionally, since these activities require time outside, weather can be a factor in scheduling. Several "sponge" activities are included for use in various parts of the learning cycle. The information presented here is to be used as a guide to assist teacher planning.

Day(s)	Learning Experience	Group[#]	Phase of Learning Cycle[@]
1	Introduction: Ansari X PRIZE, New Spirit of St. Louis® EGGS PRIZE®	I or W	E
2	Set up teams; share information	D	E
3	Create team logo; start team filing system	D	E
S[%]	Research the Ansari X PRIZE on the Internet	I or D	E
E[%]	Risk Assessment	W	E
4	Safety	W	E
5	Altitude Tracking	W	E
E%	Advanced Altitude Tracking		E
E[%]	You Get What You Pay For	D	
6	First Launch Preparation	W	E
7 - 8	First Launches	W	E
S[%]	Rocket Visionaries	I or W	E
9	Design Group Team Journal Entries; divide into Expert Groups	D	E
10 - 12	Expert Group Experiences		
	Payload Protection	E	C
	Fins	E	C
	Propulsion	E	C
	Recovery	E	C
	Nose Cone	E	C
13	Prepare Expert Group Report	E	C
14	Expert Group Presentations	E	
15 -21	Work in Design Groups		
	Plan	D	A
	Construct		
	Trial Launches	D	A
	Review / Rebuild	D	A
23	New Spirit of St. Louis® EGGS PRIZE® Competition	D	A

24	Design Group Team Journal Entries; Award Ceremony	D	A
S%	Careers	I	A
S%	Physical Science Content	I	A

# I=Individual
D=Design Group
E=Expert Group
W=Whole Class

@ A=Application
C=Concept Invention
E=Exploration

% E=Extension Activities for Advanced Classwork
S="Sponge" (Alternative) Activities for Altered Schedules

Estimated Site Costs

Although many of the consumable items used in the New Spirit of St. Louis® EGGS PRIZE® curriculum can be donated or may be borrowed, the following items may need to be purchased. Prices will vary, and this chart is intended only to aid the teacher in planning. These items are needed regardless of the total number of students participating.

Item	Cost per Item ($)	Average Cost Per Site ($)
Launch pad (we suggest two!)	100	200
Air pump or air compressor	50	50
Leaf blower	30	30
Low temperature hot glue guns (4)	5	20
Hair dryer	10	10
Orange pylons (4)	5	20
PVC pipe (1 ½ ” x 10’)	5	5
PVC pipe (1”x 10’)	4	4
Saw for PVC pipe	9	9
Rubber mallet	5	5
Tent stakes	5	5
Total		*$358*

The following items will probably be available in middle/junior/senior high school science classrooms, but may not be available in all elementary classrooms. It may be simple to borrow these items when needed. Prices are estimates based on popular science supply catalogs.

Item	Cost per Item ($)	Average Cost per Site ($)
Funnel (~95 mm opening; short stem, 15 mm diameter bottom opening)	5.00	10.00
Goggles (average 10)	3.40	34.00
Graduated cylinders (100 ml) (2)	2.15	4.30
Hole punch (3)	4.75	14.25
Markers/paints/decals…	2.00 – 10.00	10.00
Meter Sticks (4)	2.25	10.00
Rope (10 meters)	2.00	2.00
Rulers (metric pkg. 10)	7.10	7.10
Scissors (minimum of 5)	2.95	14.75
Spring Scale	5.75	5.75
1-2 ounce fishing sinkers or small washers	2.00	2.00
Stopwatches (3)	4.00	12.00
Total		*$126.15*

Approved Consumable Materials List

This is the list of approved consumable materials for use in constructing the New Spirit of St. Louis® EGGS PRIZE® rocket.

- 2-liter plastic bottles, undamaged
- balloons
- bubble wrap
- cardboard, corrugated
- clay
- construction paper
- cotton balls
- cups- paper, styrofoam
- decorative decals
- dental floss
- egg cartons
- eggs
- fishing line
- foam board (1/8 inch)
- hot glue sticks (low-temp only)
- lawn & garden or trash bags
- markers or felt-tipped pens
- ping-pong balls
- plastic grocery bags
- plastic wrap
- popsicle sticks
- rubber bands
- sandpaper
- straws
- string- cotton or nylon
- styrofoam packing "peanuts"
- tagboard (oak tag or posterboard)
- tape- cellophane, duct, masking, strapping
- thread
- tubes- paper towel, toilet paper, wrapping paper
- typing paper
- water
- white glue

Non-Consumable Materials List

This is the list of approved non-consumable materials for use during construction and testing of the New Spirit of St. Louis® EGGS PRIZE® rockets.

- air pump or tank
- graduated cylinders
- hole punch
- launch pad
- launching test mechanism (2-liter bottle with PVC pipe, vacuum with blower, leaf
- blower)
- long stick
- low-temperature glue guns
- meter sticks
- rope (30 meters)
- ruler
- safety goggles for all appropriate participants
- scissors
- small washers or 1-2 ounce fishing sinkers
- spring scale
- stop watches
- tape measure
- tennis balls