

TOP SECRET  
X - PROJECT  
**3X5**

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V-5-B





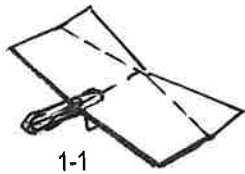
J-5-A

TOP SECRET  
X - PROJECT  
3X5

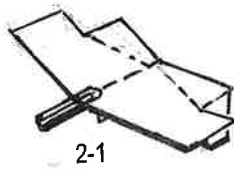


### 3X5 INDEX CARD MODELS - BASIC DESIGNS

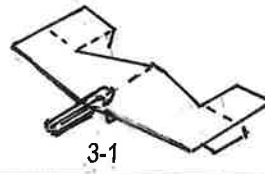
A wide variety of simple flying models - gliders, catapult, rubber/capacitor powered - can be quickly built from colorful 3x5 index cards, tape, paper clips, and for some, a stir stick or soda straw - using straight-line cuts, easy bends, limited taping and adjustable paper clips for balance. Sketch labels identify the sketch, card(s) used and stir sticks/soda straws-if any (example "18 (sketch) - 1 (card) - S (stick or straw)"..



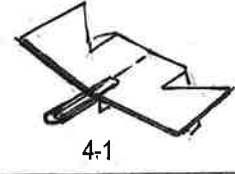
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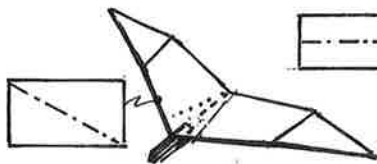
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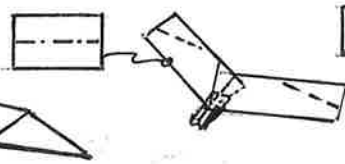
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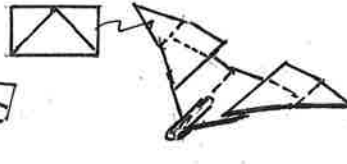
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5-1



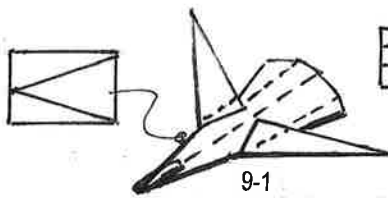
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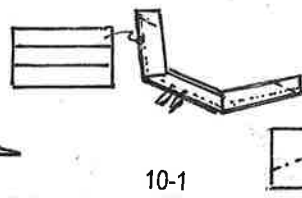
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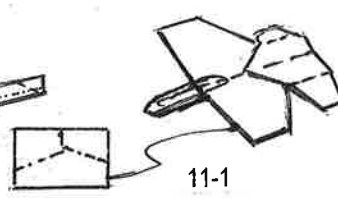
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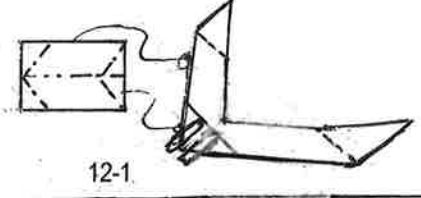
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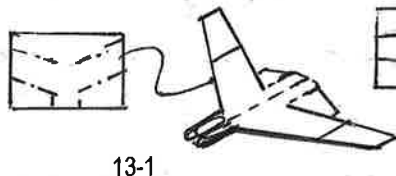
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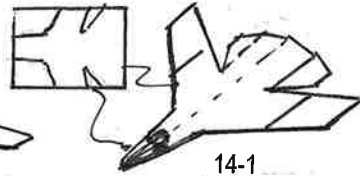
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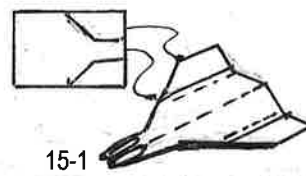
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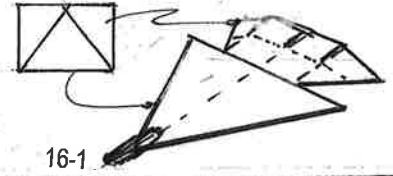
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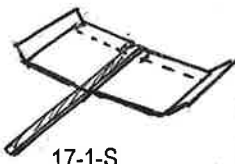
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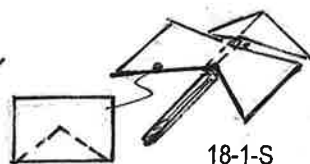
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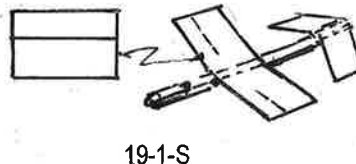
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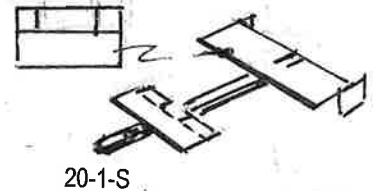
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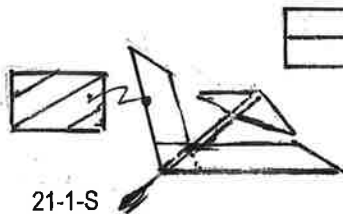
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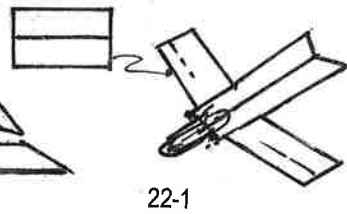
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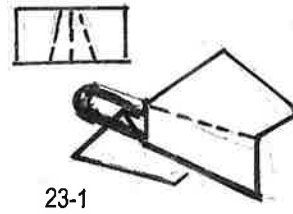
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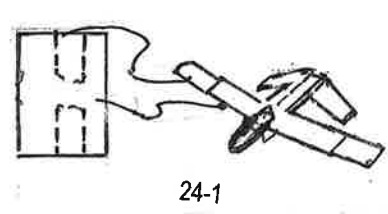
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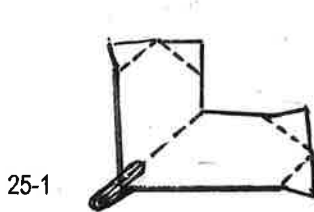
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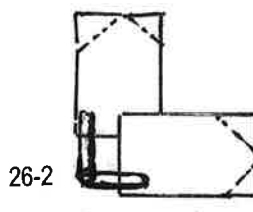
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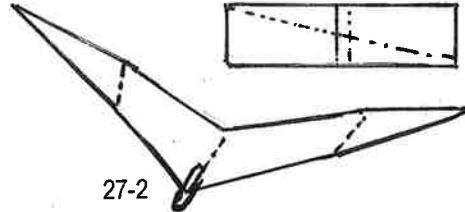
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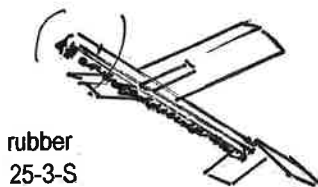
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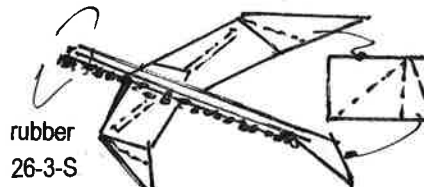
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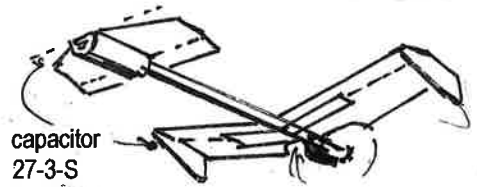
27-2



rubber  
25-3-S



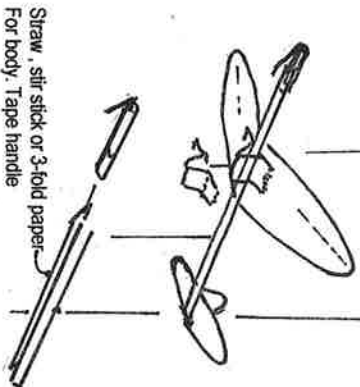
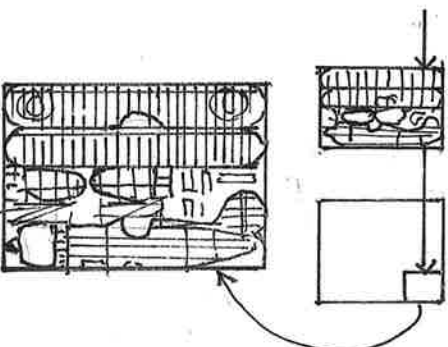
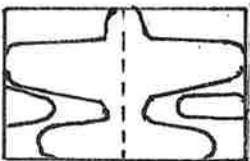
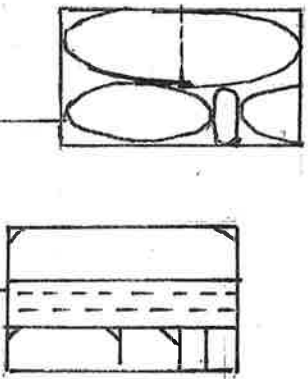
rubber  
26-3-S



capacitor  
27-3-S

### 3x5 INDEX CARD MODEL - DESIGN VARIETY

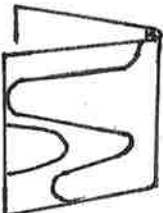
The 3x5 format lends itself to a very wide variety of designs. For example, the basic designs as shown on the previous exhibit represent simple shapes and geometry. However, more traditional model shapes can easily be rendered. Good examples would be traditional hand-launched and catapult glider designs, stick rubber designs, or even powered free-flight competition models..



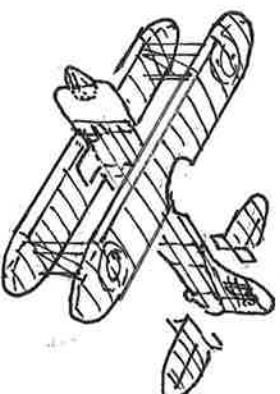
Straw, stir stick or 3-fold paper  
For body. Tape handle



Sketch design on 3x5 card.  
Cut out parts. Assemble  
Paper clip on nose.  
Bend for catapult if desired.



Sketch design on to 3x5 card  
Including all parts, tabs, etc  
Cut, fold, trim symmetrical parts  
Cut other parts  
Gluestick tape body sides/tabs  
Fold crease wing dihedral/camber  
Clay or toothpick for nose weight  
Fly. Enjoy. Repeat.



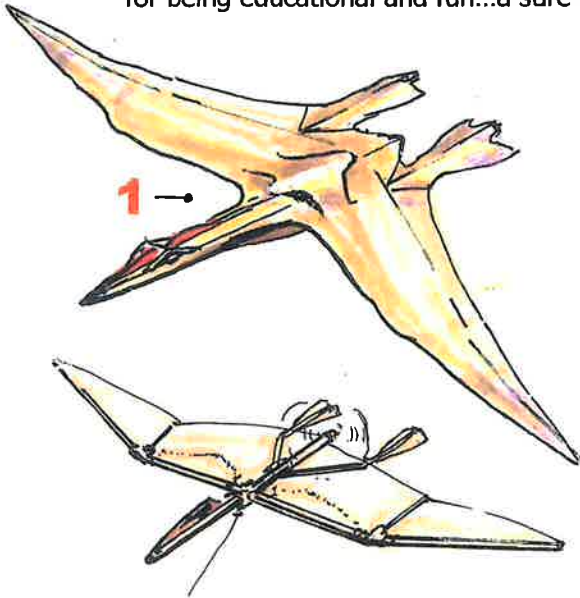
Select 3-views from web, etc.  
Print to fit 3x5 card  
Cur rearange parts, tabs, etc for best fit  
Paste to 3x5 card  
Print to 3x5 card taped to 8-12/11  
Color as desired. Assemble.  
Clip or clay nose weight  
Fly. Enjoy. Repeat.

Additionally, any model design - in and of itself - can be seen as an Industrial Design styling exercise - a sculptural form, perhaps enhanced with surface graphics - and as such could be the Art component of STEAM projects -where Art is added to STEM (science and technology...)

Moreover, model design themes such as scale, cartoon, nature, space, science fiction or fantasy can be expressed using the 3x5 card approach. Many years ago I did an exploratory design exercise for Hobbitco - which resulted in a number of very successful unique e-powered free flight concept models. Some examples are given on the following exhibits (extensive design notebook and flight test videos available on request).

## JURASSIC WINGS

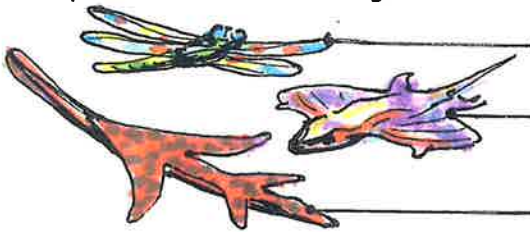
Kids love dinosaurs, especially big mean ones. Pterodactyls are big, can be mean as in Jurassic Park and Discovery Channel Specials or as in Dinotopia they can serve as living aircraft! The Oriental Trading Company has some crude profile dino gliders; but otherwise, I am unaware of any competition. In any case, I believe that properly executed, Jurassic Wings has fine prospects for being educational and fun...a sure-fire market winner, especially the first...Big Wing.



**Big Wing** (Quetzacoatlus) is the heavy weight on the block! This 34" span version is an absolutely excellent e-powered free flight...as depicted in the video (moreover, opening up the turn slightly and adding a bit up elevon lets Big Wing steadily climb out and easily thermal). Moreover, Big Wing is a "natural" candidate for RC either as a soaring glider and/or as an e-powered sport model...using the elevon trailing edges with directly coupled "feet" extensions adds control surface for positive response with only limited control excursion.

A major design variation is a same-size model created from plastic tubes/molded joints/film all packaged in a foot-long 2" diameter tube! This version can be flown as a kite, towline glider and/or rubber-powered. Further development could allow for e-power and even RC?

Some Jurassic Wings, developed as catapult gliders, could be further developed as rubber/e-powered and some as large maneuverable kites/towline gliders...with or without RC.



**Jurassic Dragonfly** models that very large bug.

**Coelurosaurus** depicts an early gliding "lizard".

**Sharovipteryx** is an interesting canard gliding "lizard".



**Dimorphodon** models a squirrley little pterodactyl.

**Scaphognathus** is a small fish-eating pterodactyl.



**Pterodactylus** is a smallish "basic" pterodactyl.



**Pteranodon** was a big 30-footer with a head crest.



**Proavis** models a hypothetical bird ancestor.



**Archaeopteryx** maybe the ancestor of modern birds.

## SOARING WINGS

Soaring Wings are essentially extensions of the Nature's Wings collection, Soaring Wings features birds which are best known for their remarkable flying capabilities.



**Eagle** is an excellent representative of this collection. The e-powered freeflight Eagle is a stable, spirited, remarkable flyer...which probably could be made slightly larger to reduce wing-loading without sacrificing performance. A slightly larger Eagle could also be easily developed as a very exciting RC...using a split horizontal tail as elevons. In its finished form, the Eagle should bear a striking resemblance in appearance and performance to its namesake. The Eagle also has emotional connotations as related to the spirit of flight (100<sup>th</sup> anniversary) and patriotism...both good marketing themes.

In addition to the Eagle, the other soaring-type models now developed as foam catapult gliders, may be further developed as freeflight or RC sailplanes or e-powered free flights (there has been some work done along these lines by others over the years, however I am unaware of any commercialization). Examples include:



**Albatross** is a fine subject for a high performance, cross-country capable sailplane, perhaps with e-powered assist. Care must be taken with the wing design to prevent high speed flutter...as observed in my first test models.



**Hawk** is a good prospect for an all around performer.



**Owl** is another prospect for all around performer.



**Pelican** could be a unique model; having the potential for being developed as a seaplane...and even a RC activated dropping jaw...used as a airspeed brake/flap.



**Raven** is an ideal candidate for slope soaring or thermal soaring model with or without e-power assistance. (I believe there are published plans along these lines?)

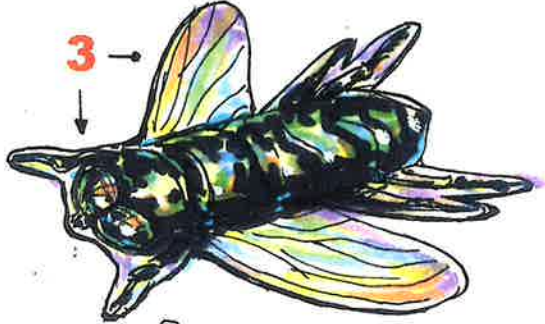


**Vulture/Condor** is an unusual subject; but could be attractive because of its large size, circling flight, and soaring ability.

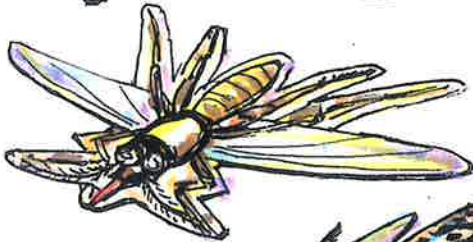


## BUG WINGS

Kids should like Bug Wings...big, bad, bugs with major attitude and altitude...buzzing around the playground or park airspace...with good toy/play value. The desired design "look" can be natural, caricature, or sci-fi fantasy. The basic design can easily be scaled for use as catapult glider, and rubber or e-powered freeflight or RC. The e-powered prototypes average 18" span; however I'm also working on smaller, "economy" sizes with 9-12" spans.



**Fast Food Fly** is a good example. The prototype is a great 18"-span, e-powered freeflight flyer. It is stable, docile, and easy-turning. Good for low-charge flights within smaller fields; but very capable of extended thermal flights with longer charges in larger fields.



**Mutant Mosquito Bomber** is a very good hand launch/catapult foam glider having an excellent, extended, stable glide. It should easily make for a great rubber or e-powered version.



**Mad Mad "Preying" Mantis** is a new development with unexpectedly good flight characteristics, much like the Mosquito.

Other Bug Wings are under development including:



**Big Bad Beetle** is based upon a large ominous-looking scarab variety, finished in either shiny black or colorful iridescent.



**Killer Bee (or Rumble Bumble Bee)** is based upon either of these two varieties and also finished in either black/yellow stripes (or fuzzy black).

## WEIRD WINGS

This design collection is kind of a catchall for a variety of novelty flyers.



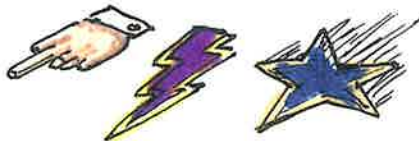
**Daring Duffer's Flying Desk** is in my opinion the best of the lot. The e-powered freeflight version flies OK, stable, and a slow floater when it gains any altitude; but it is a bit underpowered as is. However, the real potential of this unique little flyer is as a more powerful 3-D indoor/outdoor RC...marketed to the more mature flyer...who would tend to understand the notion of "flying a desk". Aerodynamically this is a short coupled stunt biplane with large elevons and the prospect of pivoting the seated duffer figure for major rudder action.



**Lead Balloon** is kind of a cute novelty. It could of course be done as an office greeting card or such; but may have some value as a larger, indoor/outdoor e-powered 3-D/hover capable RC...which of course could go over like the proverbial Lead Balloon?



**Brick** and similar configurations are marginally OK as catapult gliders; and powered versions may have some merit, but need more work, especially in power-to-weight/area ratios to be real contenders.



**Fickle Finger of Fate, Lightning Bolt, Shooting Star** and such are OK as catapult gliders and could be offered as a set; but are questionable candidates for more extensive design/marketing?



**Manta and Sky Shark** are interesting subjects and fly well enough as catapult gliders; but may not warrant development unless a sufficient market can be identified? I believe someone was trying to develop the Shark theme a while back?



**Pig and Pink Elephant** are about the same as the Manta and Sky Shark above...even Model Airplane News published Pig plans recently!



**Ten Ton Tom** is a real turkey! This could be kind of a fun novelty flyer, especially at Thanksgiving...paper glider card/ornament, foam catapult glider, e-powered, especially RC...turkey shoot anyone (with infrared or lasers)? A very interesting theme variation would be along the lines of the syndicated Shoe cartoon characters!? (I'm also doing a penguin & dodo).

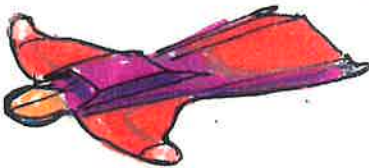


## SKY GUYS

Kids and teens like extreme sports. Adults like 007-type adventure. In either case, Sky Guys can offer hot aerial action. Typically these designs can be offered as catapult gliders and/or rubber-powered and e-powered free flights. Generally with little design modification and sufficient power-to-weight ratios, the Sky Guys should also offer great 3-D RC action as well.



**Sky Boarder** depicts a parachutist atop his board - with graphic plumes of "colored air" curving out to form the wings. It works well as a catapult glider; and OK as an e-powered freeflight (but could use improved powered-to-weight ratio). Conversion to RC should be simple via mounting the gear inside the depth of the board and using the already designed-in elevon surfaces, sufficient in area to provide excellent roll and loop rates.



**Birdman** (or Birdwoman) works well as a catapult glider and e-powered free flight. In the later mode, the model tends to be a relatively gentle flyer, slowly climbing out and looking very realistic in flight. The Birdman company president has indicated interest in this product but I have not followed up as yet.



**Wingman** depicts the parachutist that recently flew across the English channel with a wing strapped to his back. Red Bull sponsored the event. Thus some licensing? In any case, this is a truly spectacular flyer...smooth, steady, and striking in flight. Video shows a straight first test flight; but minor adjustments prove the model capable of making great climbing turn flights. The prototype could be simplified for ease of manufacturing.

Additional unique Sky Guys applicable to extreme sports/action adventure are being developed:



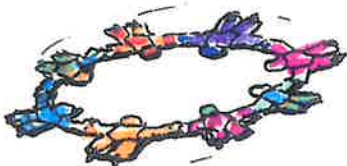
**Rainbow Rider** is a parachutist with plumes of colored smoke (acting as wings)... primarily a max height catapult glider.



**Rocket Belt Rider** is a civilian or secret agent in rocket-powered action. Great as a catapult glider, (possibly adaptable for actual rocket power) or as an e-powered free flight or RC, especially with sufficient power-to-weight ratio for 3-D/hovering. Could also be done as a maneuverable kite.



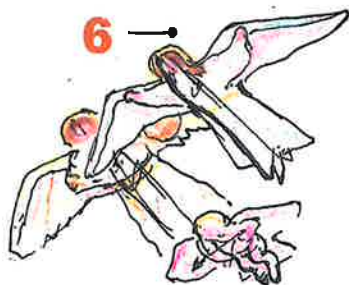
**Ski Jumper** is an interesting catapult-launched glider.



**Tag Team** is uniquely both a flying ring...and a hand launched and catapult glider.

## WONDER WINGS

This is a design collection of subjects drawn from a wide range of well-established myths and fantasies and address a wide variety of potential markets.



**Angelica and Michael and Cupid** are angels. And angels are commercially very popular in the current culture. The angels may be marketed through conventional retail and/or special target marketing such as churches or secular and religious card/gift stores. The designs may range from paper greeting cards to foam gliders to rubber-powered to e-powered freeflight/RC indoors and/or outdoors...even kites. The prototype e-powered freeflight Angelica is a good flyer; and could be even better by slightly increasing the overall size and decreasing the power-to-area ratio...for a slower, more "floating" flight.



**Fairyanna** and her friends are fairies. And fairies are also commercially very popular in the current culture. These models address a market opportunity for young girls. Models should probably be small in size and have low wing loading. The little foam gliders fly well as hand/catapult launched. These could also be whip-powered (poor man's u-control). Work on rubber/e-powered versions has been limited and needs work to achieve sufficiently low wing loading at the desirable small sizes.



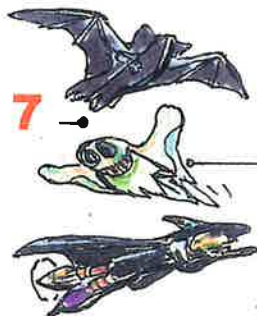
**Dragon, Flying Carpet, Genie, Mercury, and Pegasus** have been done as gliders with some success and all can be further developed as powered freeflight/RC. But there needs to be a clear market opportunity to warrant active development.



**Jay Jay the Jet Plane** is a very lucrative media franchise targeted at the kindergarten set. The foam gliders are good indoors/outdoors. (I believe there may be a crude Nerf-like foam glider available?). Catapult launch is probably not appropriate for this market? But maybe Dad can help the kids play with a rubber or e-power or even RC version with a soft safety prop. In my opinion, this subject can be developed as an inflatable flyer and could also be offered as a controllable kite.



**Santa Claus and his reindeer/sleigh** can be done in a variety of ways including paper greeting card/ornament/glider, foam catapult glider, kite, and even e-powered RC. But it's a theme limited by the holiday and the weather. However, an inflatable indoor RC "blimp" version with audio could be a marketable item...which I am developing.



**Ghost, Witch, and Bat** are closely associated with Halloween which is becoming a major retail holiday. These may be done as a paper or foam card/ornaments/gliders/party favor, e-powered freeflight or especially RC with special effects (noise/lights). My initial catapult glider version is great; but the e-powered freeflight prototype has power curve problems. Otherwise it flies well...and I feel that it has excellent potential as is and as a RC...powered or slope soarer. The Witch is under development. And the Bat is a successful e-powered prototype. See Nature Wings.

**Harry Potter** and related subjects are really a stand alone category.



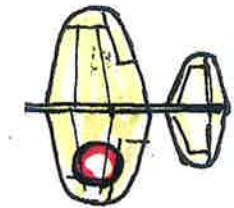
# SORT-A-SCALE AIRCRAFT

FUNNY SCALE & FUN TO FLY

Caricatures (like Clancey Aviation Series of "Bees").

Profile semi-scale (like Road Kill Series).

Very low aspect ratio, short moment arm, large "lifting stab" (like Martin Baker-WWII)



Zero Yen



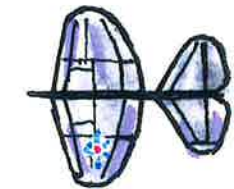
Mild Cat



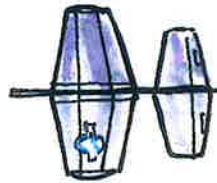
Folk Wolf



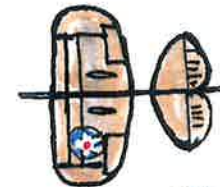
Spit in Fire



Thudnjolt



Must Hang



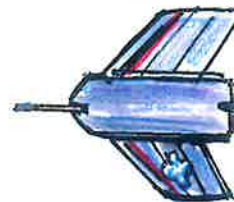
Buffalo Wings



The Barren

Historic, WWI, WWII, racing planes, jets, aliens...if low aspect/max area, short moment, etc.

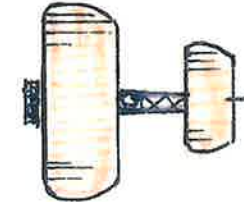
Cut-less



Miss Miggy



Bleary-O



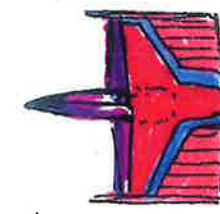
Leer Jet



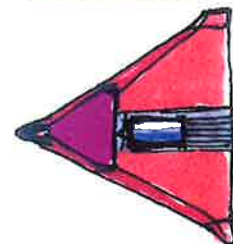
Star Stinger



Alien Air



Bi-wing



Deltoid



3. Class projects (examples of many flying wing type student projects)  
Multiple gliders on 8-1/2x11, designs on 3x5 card, and fantasy themes

V-5-C



4-5-15



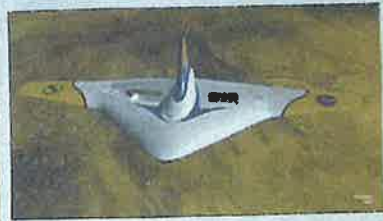
RECENT CLASS  
WILSON ELEM C. M.  
12-15 STUDENTS

201

# MANNED MISSION TO MARS FLYERS



USER CLASS: 1. LOW-1000 LBS TO WEIGHT P/N/O 2. SIMPLE TO LAUNCH, DEPLOY & OPERATE 3. SUITABLE POWER & CONTROL SYSTEMS



2. Mars class- "Flyers"





Orange County Department of Education

# MARS FLYER KIT MFK-1

does not include Power Up motor

200 Kalms Drive P.O. Box 9060

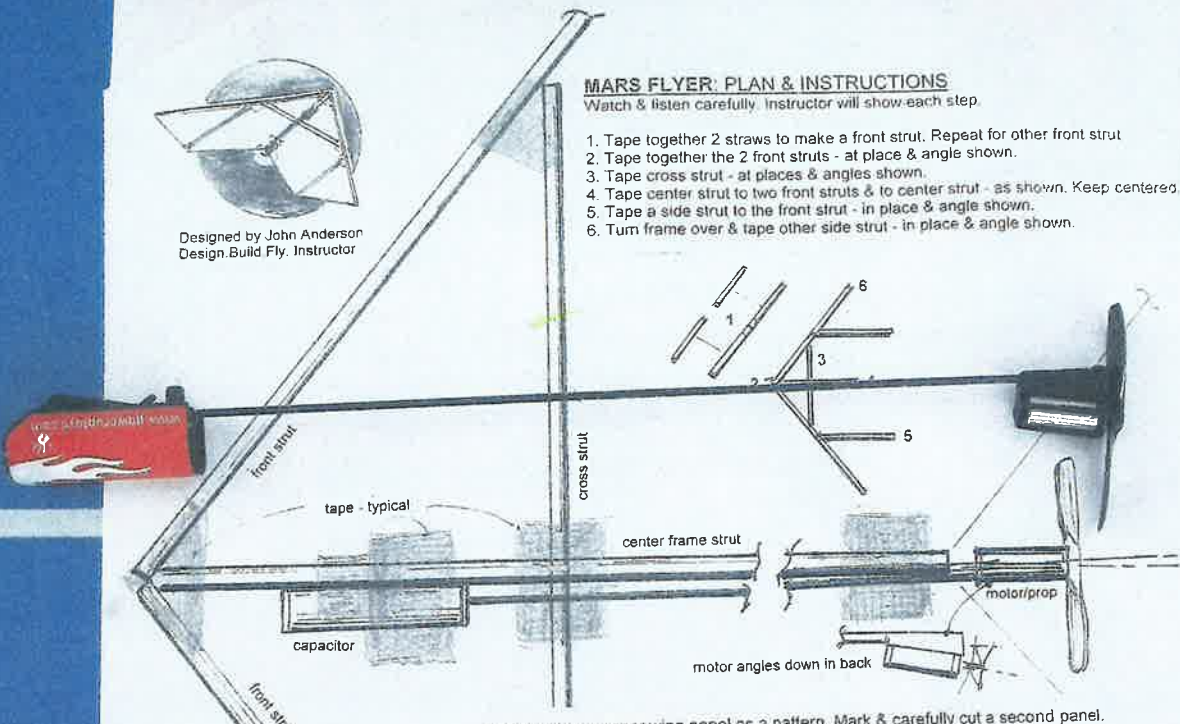


Designed by John Anderson  
Design, Build Fly, Instructor

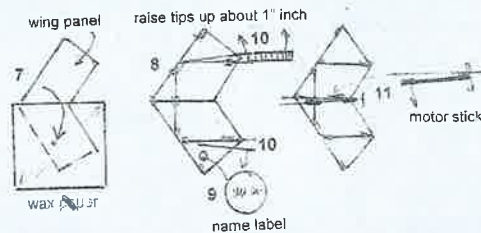
## MARS FLYER: PLAN & INSTRUCTIONS

Watch & listen carefully. Instructor will show each step.

1. Tape together 2 straws to make a front strut. Repeat for other front strut.
2. Tape together the 2 front struts - at place & angle shown.
3. Tape cross strut - at places & angles shown.
4. Tape center strut to two front struts & to center strut - as shown. Keep centered.
5. Tape a side strut to the front strut - in place & angle shown.
6. Turn frame over & tape other side strut - in place & angle shown.

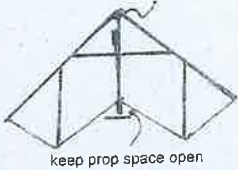


7. Use cut wax paper wing panel as a pattern. Mark & carefully cut a second panel.
8. Place first panel to fit frame & tape to a front strut. Place second panel on frame. Overlap both panels at center strut. Tape both panels together & to center strut. Tape to other front strut. Be sure all is symmetrical.

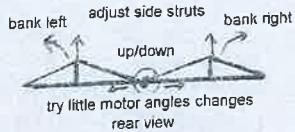


9. Write your name on round label. Place name label somewhere on the wing.

Stalls? Add bit of clay.



10. Use side of scale as guide. Raise rear tip of side strut & tape. Repeat for the other side.
11. Turn the Flyer over (upside down) & tape PowerUp motor stick in place & angle shown.



(cc) John Anderson 2014

Ready to fly! Check angles, taped joints & covering. Test glide Flyer. Observe path. Review with instructor. Instructor will inspect Flyer & assist with first powered flights. Happy Landings - on Earth - and on Mars!

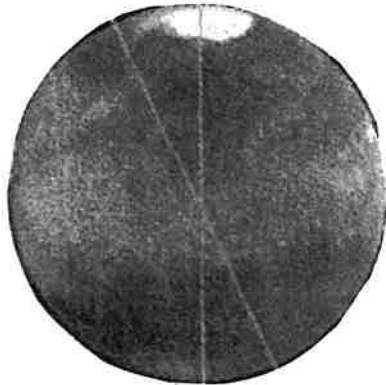


DESIGN. BUILD. FLY: MARS!

# CAN A PLANE FLY OVER MARS?

PROBABLY YES - IF ITS IS DESIGNED FOR MARS VS EARTH.

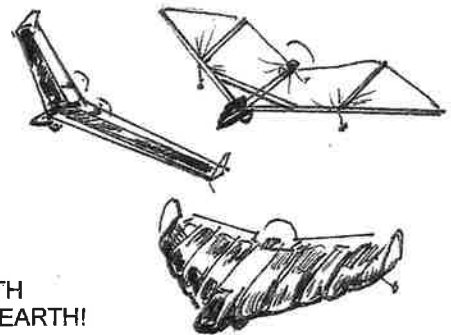
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## MARS

### MARS PLANES:

- \* LIGHT. HIGH LIFT-TO-WEIGHT RATIO
- \* SIMPLE TO LAUNCH, DEPLOY & OPERATE
- \* SUITABLE POWER & CONTROL SYSTEMS



### EARTH VS MARS-IMPORTANT DESIGN COMPARISONS:

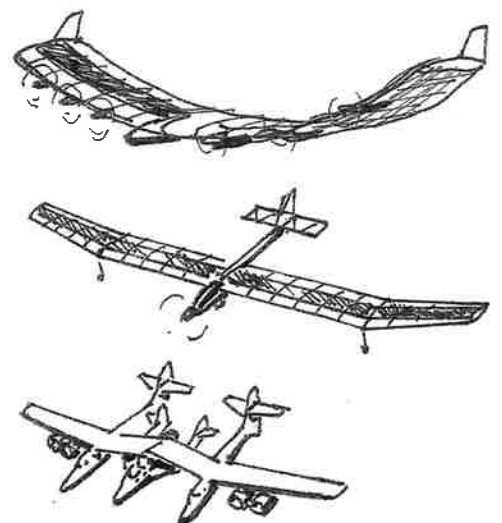
- \* MARS GRAVITY IS 38% OF EARTH. MARS SUNLIGHT IS 40% OF EARTH
- \* MARS ATMOSPHERE MUCH THINNER & MUCH LESS OXYGEN THAN EARTH!
- \* MARS IS FROM 34 MILLION TO 250 MILLION MILES FROM EARTH!



## EARTH

### EARTH PLANES:

- \* SOME SIMILAR TO MARS PLANES
- \* LONG WINGS, VERY LIGHT-FOR THIN AIR FLIGHT
- \* SOLAR POWER/BATTERIES-FOR EXTENDED FLIGHT
- \* LONG DURATION/DISTANCE

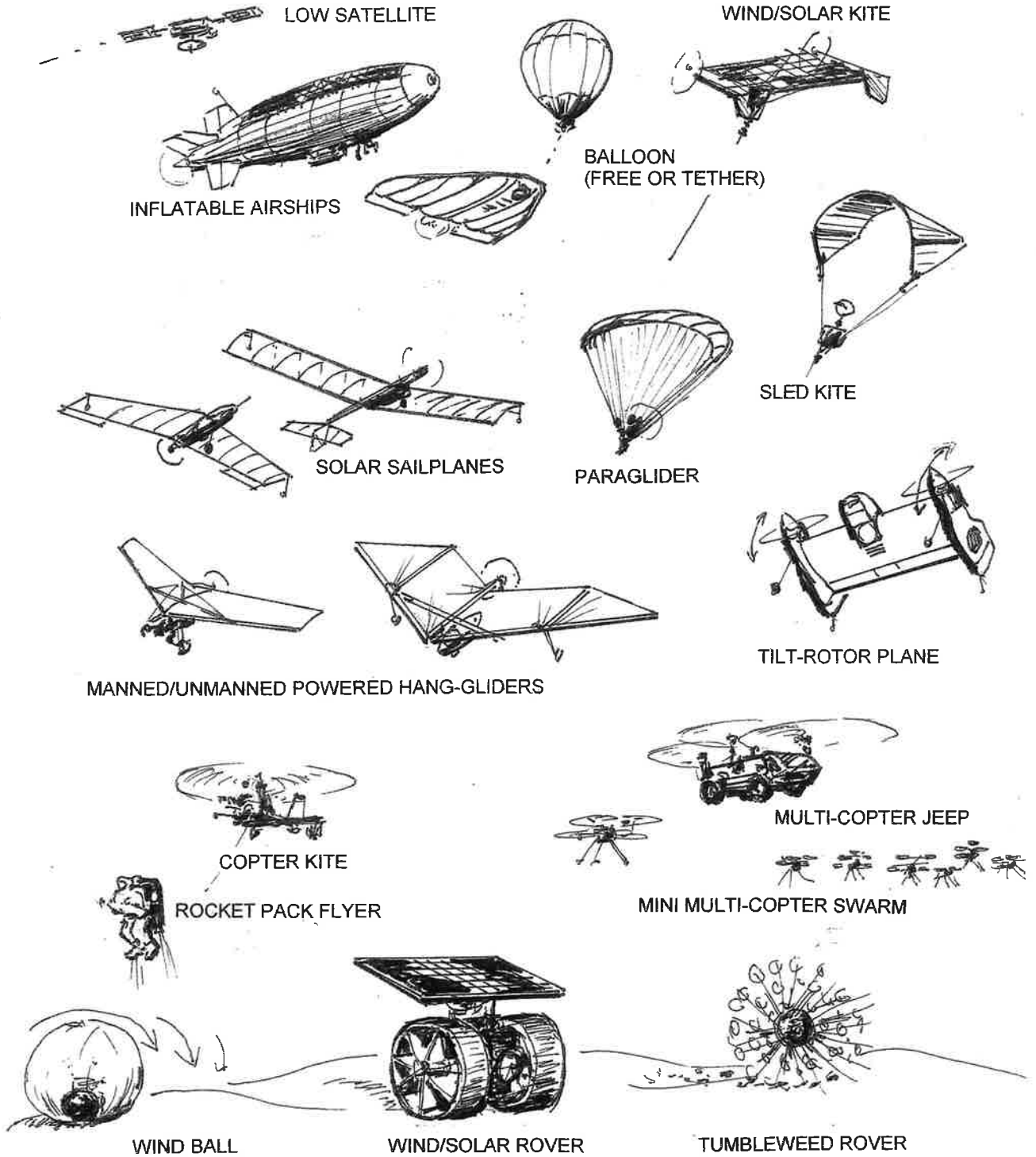




# DESIGN. BUILD. FLY: MARS!

## POSSIBLE DESIGNS

FOR AERIAL AND GROUND MOVEMENT (PROPELLED BY THE WIND/SUN)



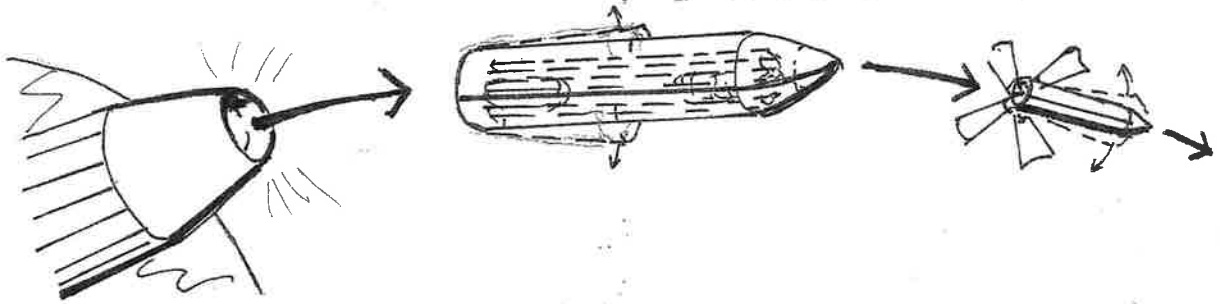
DESIGN. BUILD. FLY: MARS!

# MARS FLYER CONCEPT

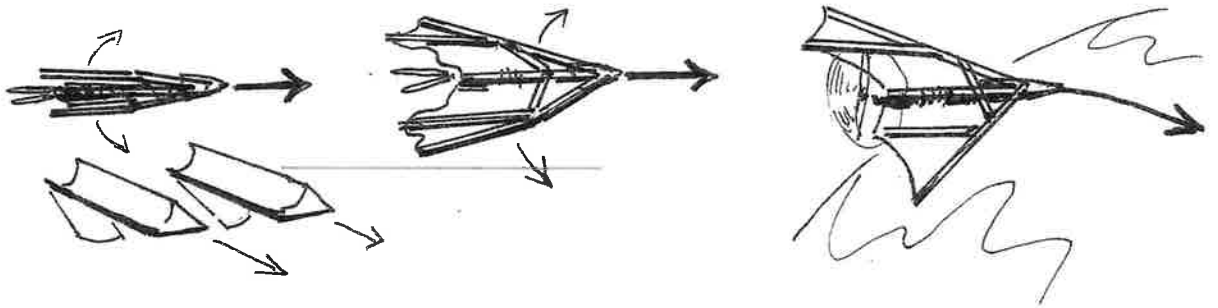
MANNED/UNMANNED SOLAR-POWERED MEMBRANE WING

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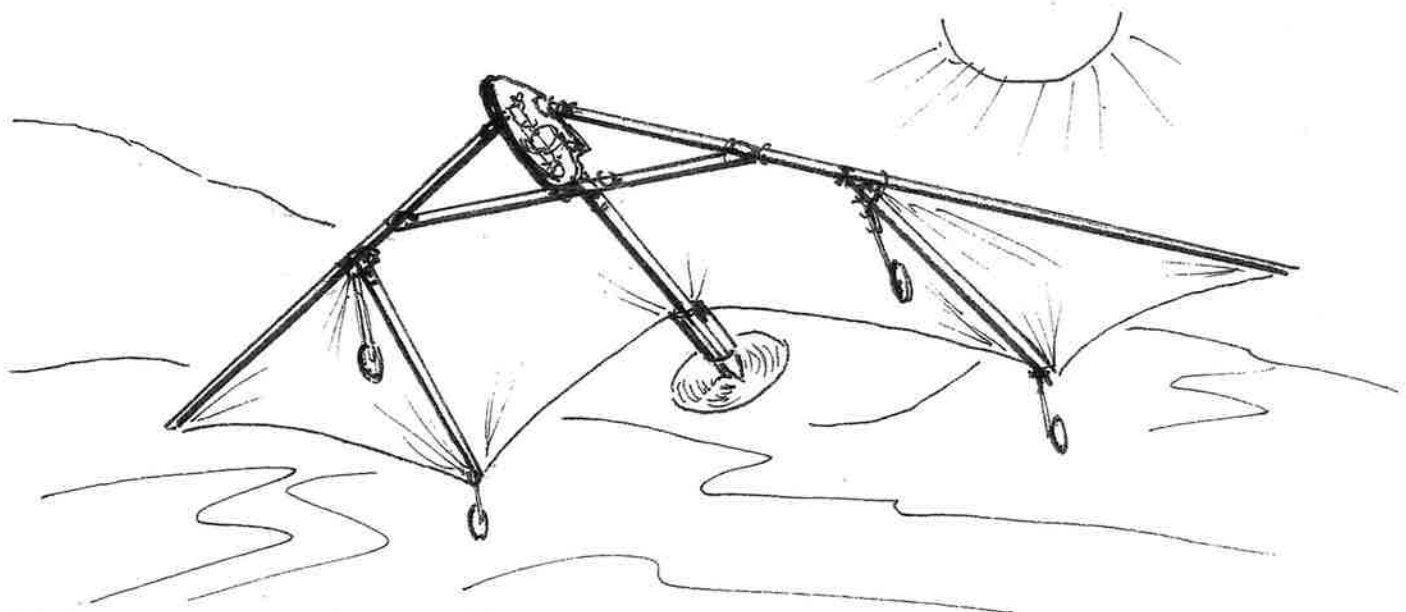
SIMPLE, LIGHT-WEIGHT STRUCTURE (EIGHT EQUAL-LENGTH AIRFRAME SEGMENTS FOLD INTO COMPACT LAUNCH PACKAGE)...



....WHICH UNFOLDS AND DEPLOYS IN UPPER MARTIAN ATMOSPHERE...



WHERE IT USES FLEXIBLE SOLAR MEMBRANE WINGS FOR CONTROL AND EXTENDED POWERED FLIGHT/EXPLORATION.



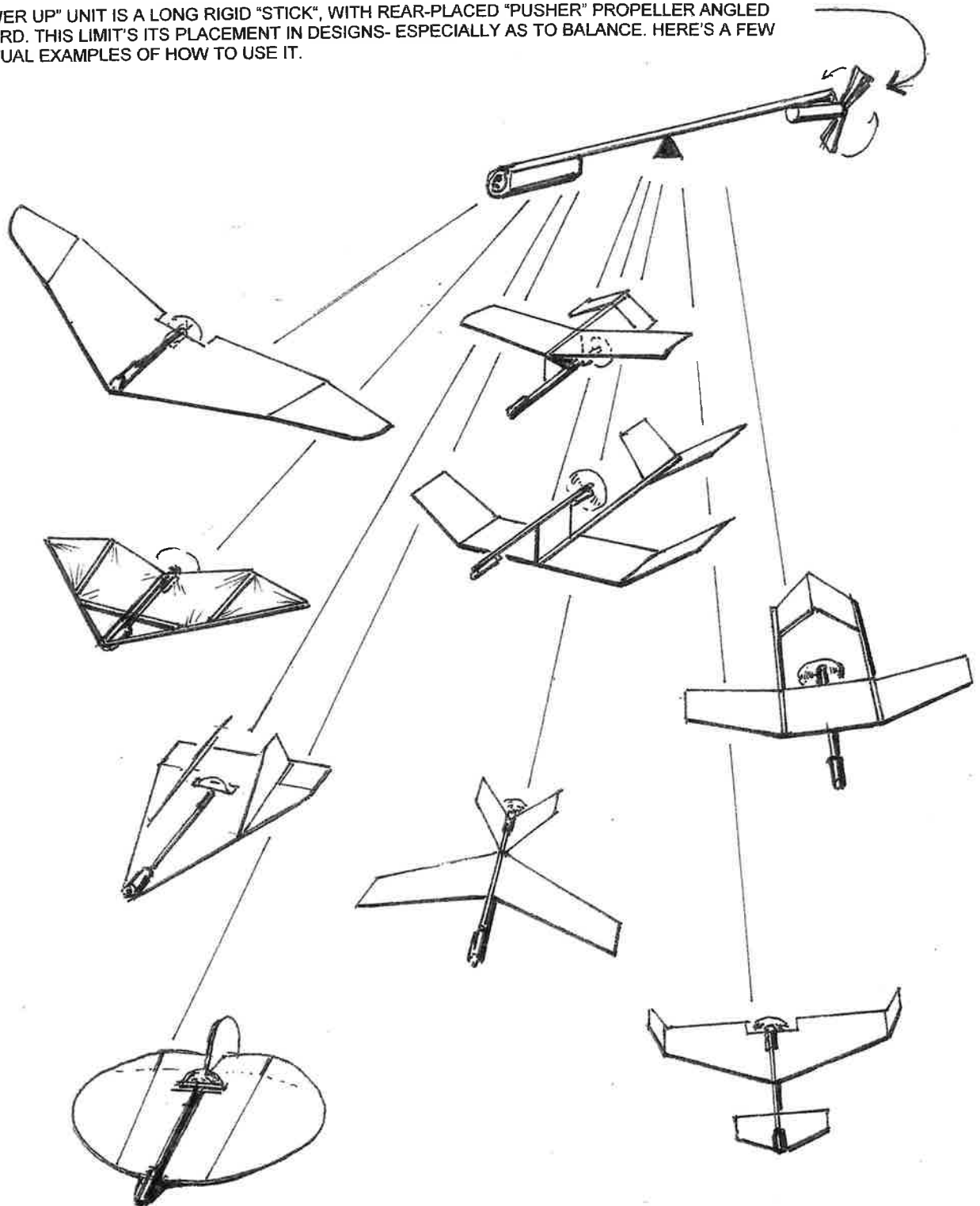


DESIGN. BUILD. FLY: MARS!

## OTHER E-POWERED DESIGNS

FOR THE "POWER UP" UNIT

THE "POWER UP" UNIT IS A LONG RIGID "STICK", WITH REAR-PLACED "PUSHER" PROPELLER ANGLED DOWNWARD. THIS LIMITS ITS PLACEMENT IN DESIGNS- ESPECIALLY AS TO BALANCE. HERE'S A FEW CONCEPTUAL EXAMPLES OF HOW TO USE IT.



THESE MODELS MAY BE MADE OF FOAM, INDEX CARD PAPER, SODA STRAWS, WAX PAPER, ETC  
ADDITIONAL "POWER UP" INFORMATION AND DESIGNS ARE AVAILABLE ON THE WEB. .

DESIGN. BUILD. FLY. & MARTIAN FLYER-WEB SEARCHES:  
JOHN ANDERSON. INSTRUCTOR 2/12/2015

THERE IS GREAT STUFF ON THE WEB.  
HERE'S A STARTER SEARCH LIST. HAVE FUN!

ACADEMY OF MODEL AERONAUTICS  
AERODYNAMICS FOR KIDS  
AEROSPACE FOR KIDS  
CIVIL AIR PATROL  
ELECTROSTATIC WALKALONGS  
EXPERIMENTAL AIRCRAFT ASSOCIATION  
FLIGHT SIMULATORS FOR KIDS  
FLYING FLAPJACK  
FLYING MODELS FOR KIDS  
FLYING WINGS  
FOAM GLIDERS  
FUTURISTIC AIRPLANES  
HARBOR SOARING SOCIETY  
INDOOR GLIDERS  
INDOOR FLYING MODELS  
LUFT46 (AMAZING DESIGNS AND ART WORK)  
MARS AIRPLANES  
MICROWAVE POWERED PLANE  
PAPER GLIDERS  
POWERUP GLIDERS  
ROCKET MODELS  
RUBBER POWER PLANES FOR KIDS  
SOLAR POWERED MODEL PLANES  
SOLAR POWERED PLANES  
SPACE SCIENCE FOR KIDS  
WALKALONG GLIDERS

---

INSTRUCTION:  
HARBOR SOARING SOCIETY OFFERS FREE RADIO CONTROL FLYING LESSONS  
AT FAIRVIEW PARK IN COSTA MESA. VISIT THE WEB SITE 1HHS.ORG  
FOR MORE INFORMATION PHONE INSTRUCTOR TED BROBERG 714-235-6430



**DESIGN. BUILD. FLY.**

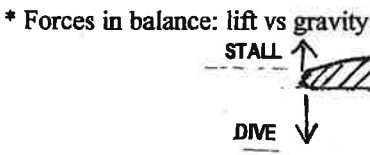
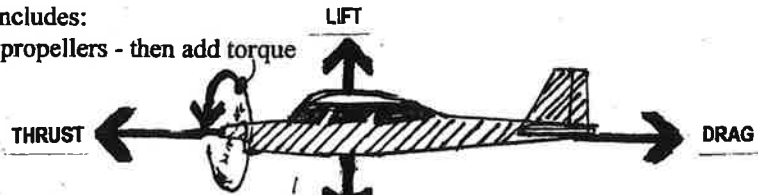
Learning to fly:

- \* Nature: Many types of plant seeds, insects, reptiles, flying snakes, fish, birds, and mammals, have "floated", glided, flapped, and soared through the skies since ancient times. Humans are not natural fliers.
- \* Humans: In a few hundred years, humans learned to fly. An early human throws a rock, makes and throws a spear, adds feather to make an arrow. Then watches birds, builds wings., learns to glide. Soon adds motors and flies hundreds of passengers at near supersonic speed across the oceans of the world. Makes rockets and flies off into the endless, airless oceans of space. Many fools and heroes died learning the secrets of flight.
- \* Airplanes fly in the air. The higher the altitude the thinner the air. Space is airless. Take a breath of air, exhale the air into your hand. How can a huge, heavy plane "float" through thin air as if by magic?

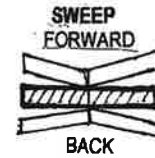
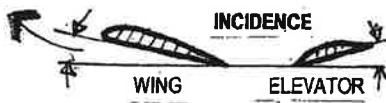
The "magic" of aerodynamics:

Aerodynamics (a branch of Physics) includes:

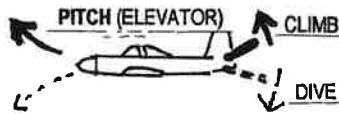
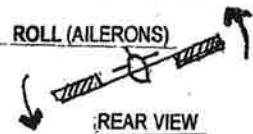
- \* Forces: lift, thrust, drag, gravity. If propellers - then add torque



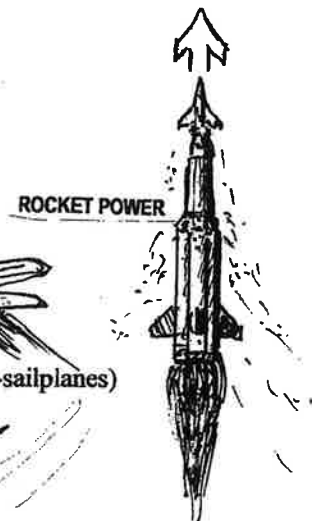
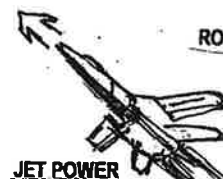
- \* Angles: incidence, dihedral, sweep, thrust



- \* Control: Roll (ailerons) pitch (elevators), yaw (rudder). Flying wings may use elevons instead. Add flaps for lift/slowing and thrust (power) for speed and climb.



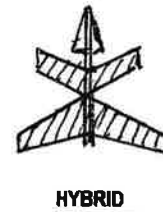
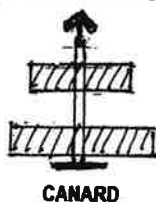
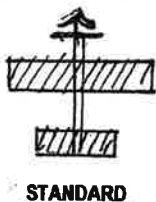
- \* Power - gravity plus various engines - pulling or pushing



- \* Proportions and weights (heavy pointy and fast jets/rockets) light, long wings, slow-sailplanes)

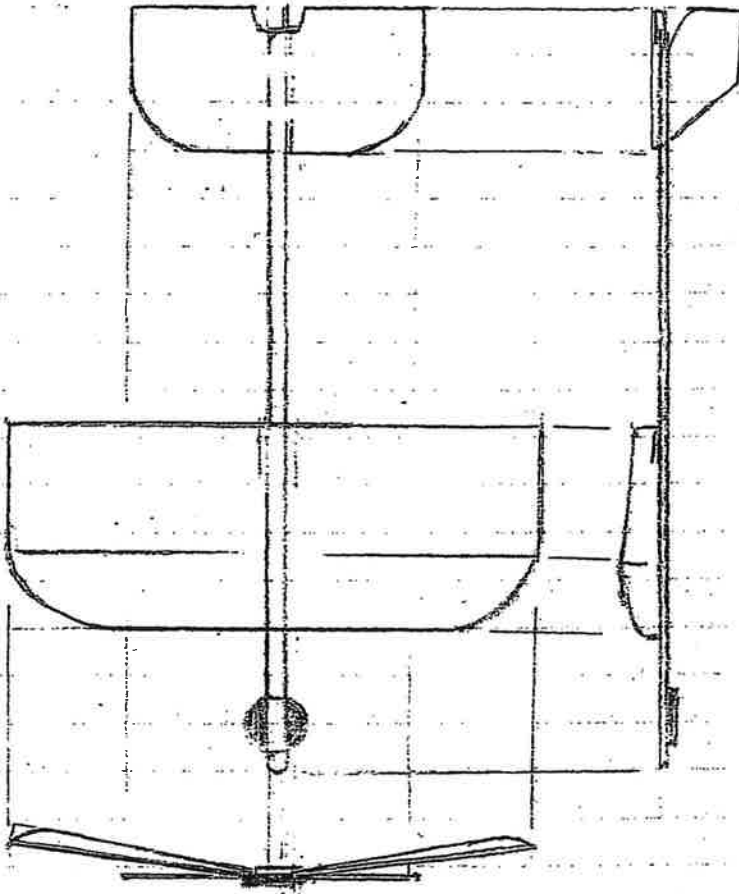


- \* Shapes : regular (wing in front, tail in back), canard (tail in front wing in back-Wright Bros), flying wings (wing and tail together and various interesting combinations of these).



**DESIGN (SHAPES, PROPORTIONS, THREE-VIEW DRAWINGS)**

Aircraft may have many shapes and proportions depending on the type and purpose of the plane. The shapes and proportions are shown on design plans. A three-view design plan shows the top, front, and side of the plane. The views line up on a grid, so that all are at the same size. Sketch your designs below.



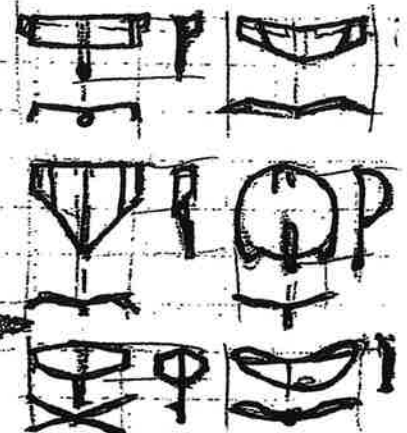
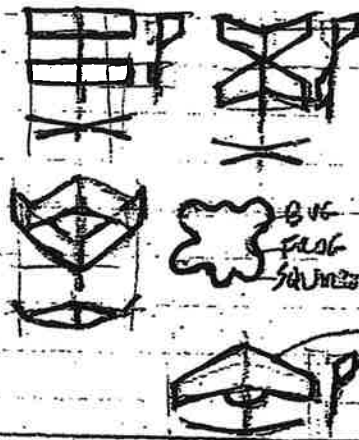
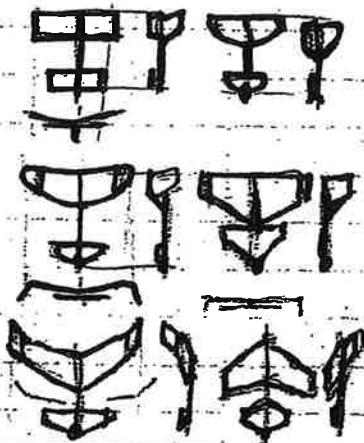
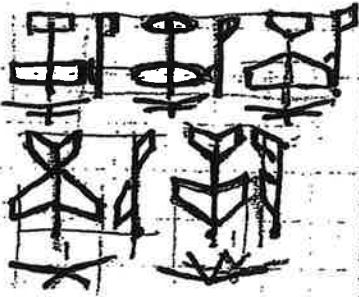
MOST KIDS  
CANNOT DO THIS  
EFFECTIVELY!  
A MAJOR ED FAILURE!  
IF YOU CAN'T VISUALIZE/DRAW IT  
OR INNOVATE?  
A.

"STANDARD"

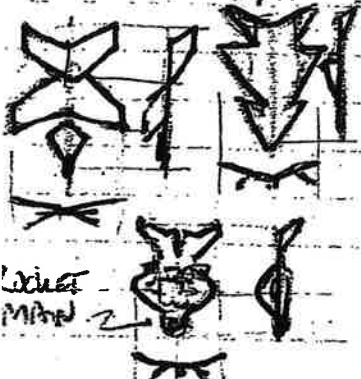
"CANARD"

"TANDEM"

"FLYING WING"



COMPOSITE-HYBRID





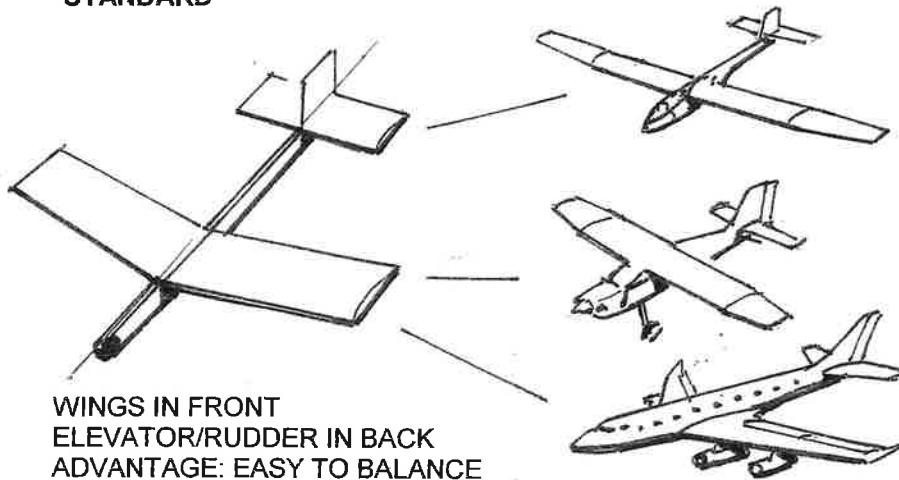
DESIGN. BUILD. FLY: INTRODUCTION

# BASIC SHAPES & VARIATIONS

THREE BASIC SHAPES & FORM FOLLOWS FUNCTION

---

## STANDARD



WINGS IN FRONT  
ELEVATOR/RUDDER IN BACK  
ADVANTAGE: EASY TO BALANCE

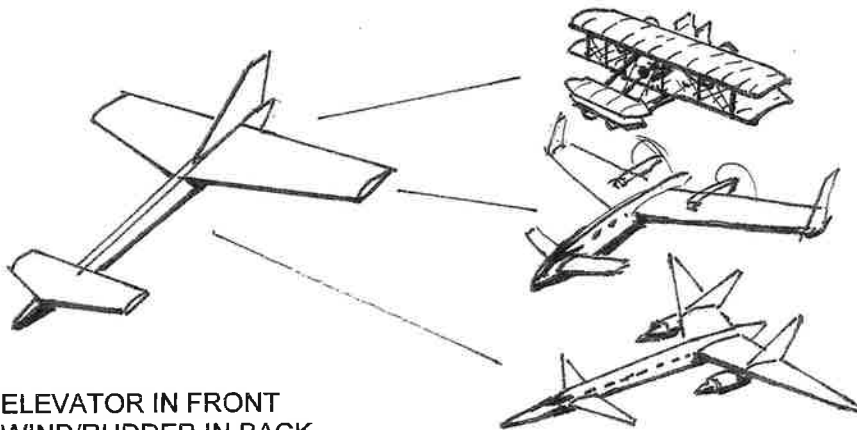
GLIDER/SAILPLANE  
LONG THIN WINGS/SOARS SLOWLY

LIGHT PLANE "REGULAR SHAPE"  
MEDIUM FAST

JET FIGHTER/TRANSPORT  
SWEPT WINGS/POWERFUL/FAST

---

## CANARD



ELEVATOR IN FRONT  
WIND/RUDDER IN BACK  
ADVANTAGE: STALL RESISTANT

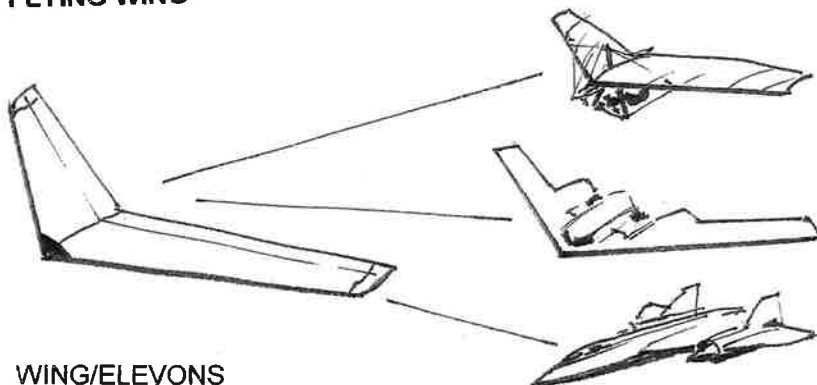
WRIGHT BROTHERS 1<sup>ST</sup> TO FLY  
BIPLANE (2 WINGS)/SLOW

BEECH STARSHIP EXEC PLANE  
EXCITING DESIGN/FAST

FUTURE JET TRANSPORT  
STREAMLINED/HYPERSONIC

---

## FLYING WING



WING/ELEVONS  
WITH/WITHOUT RUDDER  
ADVANTAGE: PURE AERO SHAPE

HANG GLIDER SIMPLE/SLOW

1950'S FLYING WING BOMBER  
REVOLUTIONARY/FAST

SR-71 BLACKBIRD-STEALTHY  
VERY FAST

DESIGN. BUILD. FLY: INTRODUCTION

# BASIC PRINCIPLES/MANY POSSIBILITIES

DESIGNS FROM NATURE, SCIENCE FICTION, /FANTASY, AEROSPACE & NOVELTY

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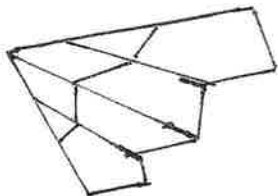
**BUG (STANDARD)**



**BAT (FLYING WING)**



**BIRD-SOARING  
(STANDARD - LONG WINGS)**



**DRONE (FLYING WING)**



**DRAGON (CANARD)**



**DESK-PILOT  
(STANDARD - BIPLANE)**



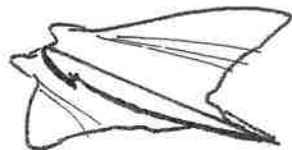
**FLYING FISH  
(STANDARD - SWEEPBACK)**



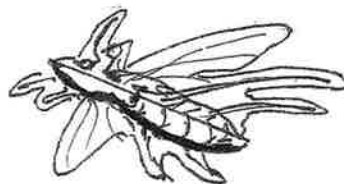
**FROG (CANARD)**



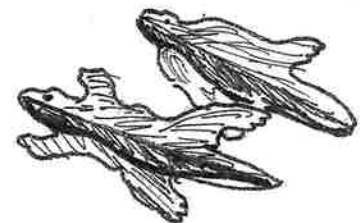
**FAIRY (STANDARD - TANDEM)**



**MANTA (FLYING WING)**



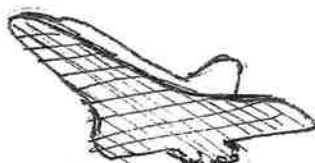
**MOSQUITO (STANDARD - TANDEM)**



**MAMMAL GLIDERS (CANARDS)**



**SHARK (STANDARD - STUB WINGS)**



**SPACESHIP/SHUTTLE  
(FLYING WINGS)**



**SUPERHEROS (STANDARDS)**



DESIGN. BUILD. FLY: INTRODUCTION

# WOW PLANES!

UNIQUE DESIGNS OF THE NEAR FUTURE



SOLAR SAILER



GIANT AIRSHIP



HYPERSONIC  
JET/ROCKET



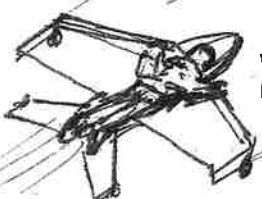
SUPERSONIC TRANSPORT



ADVANCED FIGHTER



SMART DRONE



WING SUIT  
FLYER



COPTER PLANES

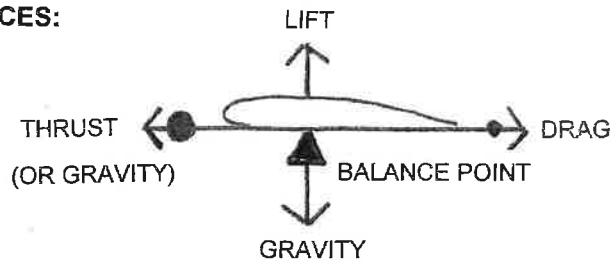


WAVE SKIMMERS

# AERODYNAMICS & CONTROLS

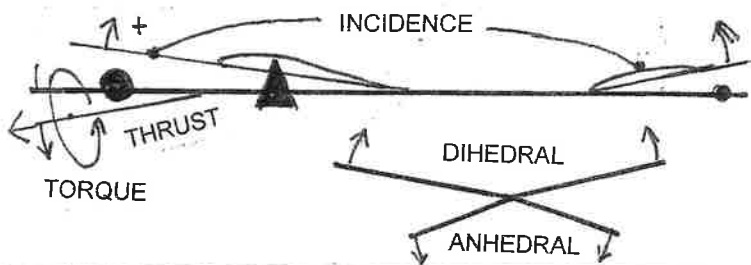
HOW A PLANE FLIES!

**FORCES:**



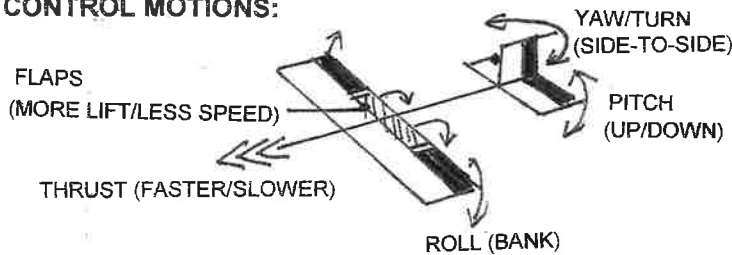
**LIFT:** AIR PUSHES UP FROM THE BOTTOM  
 PULLS UP FROM THE TOP. MUST EXCEED GRAVITY  
**THRUST:** GRAVITY/POWER PULLS FORWARD.  
 MUST EXCEED DRAG  
**DRAG:** STICKINESS OF AIR HOLDS PLANE BACK  
**GRAVITY:** EARTH PULLS PLANE DOWN  
**BALANCE POINT (LIKE TEETER TOTTER):**  
 SHOULD BE AT CENTER OF LIFT/GRAVITY

**ANGLES:**



**THRUST:** ANGLE OF PULLING FORWARD  
**TORQUE:** ANGLE OF ROTATION DIRECTION  
**INCIDENCE:** ANGLES OF WING AND ELEVATOR  
 TO PREVENT STALLS AND DIVES  
**DIHEDRAL:** ANGLE WINGS BEND UP FOR STABILITY  
**ANHEDRAL:** ANGLE WING/TAIL ANGLE DOWN

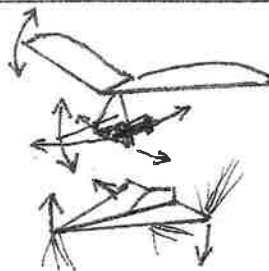
**CONTROL MOTIONS:**



- \* ROLL (BANK)
- \* PITCH (UP/DOWN)
- \* YAW/TURN (SIDE-TO-SIDE)
- \* THRUST (FASTER/SLOWER)
- \* FLAPS (MORE LIFT/LESS SPEED)

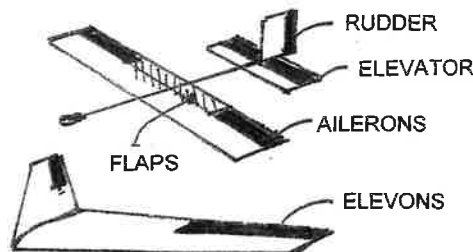
**CONTROL METHODS:**

- \* WEIGHT SHIFT
- \* REACTION
- \* AERODYNAMIC



**WEIGHT SHIFT:**  
 MOVING PILOT BODY AS NEEDED  
 (LIKE HANG-GLIDING)

**REACTION:**  
 JETS OF THRUST (AS IN SPACE)



**AERODYNAMIC:**  
 AIR PRESSURE AGAINST SURFACES:  
 \* RUDDER - YAW (TURN)  
 \* ELEVATOR - PITCH (UP/DOWN)  
 \* AILERONS - ROLL (BANK)  
 \* FLAPS - LIFT & SLOW  
 \* ELEVONS - BOTH PITCH & ROLL (TO BANK & TURN)