



Pilot Training Program

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This booklet is used as a guide for instructors of the 495th Squadron Radio Control Club, and their students. It primarily applies to how to teach beginners to fly R/C. However there is a large amount of information that is good for all R/C pilots, not just instructors.

However, as good as the intentions of this document are they are still not perfect. Please contact the chief instructor of the club to discuss changes to this document to make it even better. Hopefully we can consistently improve our instruction techniques over time.

Instructors - please read this thoroughly, and re-read it every so often so that as a club we maintain consistency in our instruction of student pilots. At the back of this document is a useful set of appendices including a Field Equipment List and a Mechanics Check List.

Just because you're good at something does not necessarily mean you can teach it. Some of the best fliers freely admit that they do not have the patience to teach beginners. Additionally, teaching requires an ability to see things through the eyes of the beginner, and to modify your discussion accordingly. Not everyone is cut out for this. It is the intention of this text to teach experienced fliers how to teach RC flying. While it will be most useful to beginning instructors and their students, even fliers who have been teaching for some time should find many points helpful.

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SECTION I

INTRODUCTION

Program Objectives

Surely as you were learning to fly, you noticed that the instructors at your flying field were very busy, especially during evening and weekend flying. There probably never seemed to be an abundance of instructors, even during designated instruction times. For this reason, many newly proficient fliers should consider becoming instructors.

In this text, we will show you how you can become an RC flight instructor. While there are many ways you can give back to your club, instructing for a flying season is one of the most rewarding ways.

The objectives of the Pilot Training Program are as follows:

- Promote model aviation
- Retain newcomers to the club
- Maintain a high level of club membership
- Improve Safety
- Achieve a uniform and high quality standard of instruction
- Ensure a sufficient quantity of qualified instructors and assistants

There are many ways to teach RC flying, and no two instructors will totally agree on how every concept along the way should be related. The methods shown are rather simplistic, yet they have been proven over years of instruction and have always worked well. Both students and instructors are encouraged to submit improvements to the club. This helps to ensure that the program evolves to meet the changing needs of our organization.

The goal of the instruction program is to get each student to the point where they can fly safely by themselves. While you may also wish to assist your students with learning aerobatics as well, this text only addresses basic flight. This teaching method consists of **four steps** (or progression levels) a student must achieve to get to the point where they can begin flying on their own. This makes it very easy to teach, since you can organize every technique needed for flying into four basic steps. It also helps you limit the number of things beginners must master as they learn how to fly. While you can eventually mix and match certain techniques described during each step to match your own teaching preferences, we recommend that you thoroughly understand the entire process before you begin changing anything.

Special notes for beginning instructors

Insist on using a buddy box. While experienced instructors may be able to teach without a buddy box, as you begin instructing you will be amazed at how many precarious attitudes beginners will get their airplanes into. Depending on your flying skills, some of these attitudes will not be comfortable to you. It is difficult enough to right a wandering airplane with the buddy box. Doing so after a transmitter is passed can be much more difficult, especially when the plane is close to the ground, as it is when taking off and landing.

Experienced instructors can easily help students with the early stages of learning how to fly (steps one and two) without using the buddy box. As long as we keep the airplane high enough, the plane should never be in danger. However, as the student begins taking off and landing, you must make it very clear

that there will be little the instructor can do to save the plane when it gets close to the ground. More than likely the plane will be dumped (and damaged) several times before take offs and landings are mastered. As long as the student understands this, you can work with them. However, if they show any signals (during steps one and two) that they may blame you for the plane's damage, you should delay teaching them to take off and land until the student accepts this risk.

With the buddy box, you have total control of when you retake control. Conversely, when sharing a transmitter, the student must give you the transmitter before you can retake control. As the student progresses, they may protest when you ask to retake control. They may (incorrectly) feel they are still in total control even though you know better. By the time they finally acknowledge that they are in trouble, it may be too late for you to save the airplane. Make it very clear at the start that if the student protests when you ask to retake control, that you will stop helping them.

You control the pace. Students tend to get a little anxious. You will eventually develop a feel for when a student has progressed enough to move on to each new step. Until then, take it slow. If in doubt about whether a student is ready to move on, keep on the current step until you are absolutely sure.

Be assertive with your control of the master transmitter. Especially when first starting, be ready to take control of the plane at the first sign of mistakes. While this may frustrate students to some extent, you must be totally comfortable with the control of the airplane. There may be times, for example, when a student is coming close to the flight line. They may be flying just fine, but you will have to take control of the plane to avoid the flight line boundary.

Patience is the key. Students will have difficulty with things you (now) find easy. This can be frustrating. If you show your frustration, the student will soon lose confidence. You must constantly encourage beginners, stressing positive accomplishments to build on.

Be on the lookout for new ways to do things. Believe it or not, the best way to thoroughly learn something is to teach it! You will be amazed at how many things you learn from a student's questions. They really force you to think through many things that you may now take for granted. And in order to explain anything, you really have to thoroughly understand it. For questions you can't answer, look for another experienced instructor to help.

Be sure you can fly out of trim airplanes. If you have never taken a new plane off by yourself, you shouldn't take a student's plane up for the first time. To get ready to fly a plane for the first time, practice this. Get your plane in the air and have an instructor intentionally throw off one or more of your planes trims. Practice getting the trims back to normal while controlling the plane in the air.

Keep their left hand on the stick. Through the first two steps of learning to fly, students will be predominantly using only their right hand. You will eventually notice that they tend to let their left hand stray away from the left stick. Urge them to keep both hands on the sticks. As they begin landing and taking off (in steps three and four), their left hand will be needed, and it will be easier if they are comfortable with their left hand on the stick.

Watch for the student's saturation point. We all have a limit to how much new information we can absorb in a given period of time. Keep in mind that your student will be concentrating very hard during practice sessions (especially on their first few flights). There will come a point when they simply cannot take any more without a break. One common symptom of this will be that the student has been doing just fine for about eight to ten minutes of flying. Suddenly, the student starts making mistakes (usually silly mistakes) not normally made. The student may not even understand why they are doing so poorly and begin to get frustrated. As the instructor, you must be able to recognize when the student has had enough. Tell the student they need a break and land the plane.

Two steps forward, one step back. You must remember that your students will have problems along the way to learning how to fly. At times, things you thought your students understood will seem to be

difficult again (especially after long non-flying periods). This can be frustrating for instructors so you'll have to show your patience when faced with this problem. One way to minimize the problem is to do a review of what the student currently knows at the beginning of each flying session. You can review on the ground, reinforcing the student's knowledge as well as begin the practice flying by having the student do seemingly simple maneuvers they already know. This also helps you begin a more complicated (and new) topic on a positive note. However, even with reviews, you must be on the lookout for times when the student needs to take the one step back before they can move forward.

The approach

Section two is devoted to requirements for new students. This chapter includes the most commonly asked RC questions, AMA and club membership rules, a presentation on what makes the best trainer airplane, a discussion of safety, aircraft assembly and control setup and the basics of engine tuning. While these presentations are, for the most part, directed to the beginner, we urge you to read them to help with your ability to relate these important topics to beginners at the field. You can also copy this information and give it directly to students.

When it comes to actually teaching, we break teaching RC flying into four basic steps. In any form of teaching it is good to limit the number of things a student must learn - and RC flying is no exception.

1. **Teaching how to master turns and level flight**
2. **Teaching how to set and hold headings**
3. **Teaching how to land**
4. **Teaching how to take off**

While this may sound overly simplistic, think about it. To get to the point where you are flying by yourself, every technique you master fits into one of these four steps!

Assumptions

Before taking a student up for the first time, there are several things that must be explained. For example, the student should know the basics of aerodynamics and flight, the stick controls on the transmitter (ailerons, elevator, throttle, and rudder) and the function of each control. The student's airplane must be checked out by a pre-flight instructor, have had at least one trim flight and be properly configured to operate with the buddy box. These pre-requisites are covered in detail in section two and appendix B of this manual.

Flying preferences

Instructors tend to teach what they know in the same fashion that they know it. There are several alternatives to almost every important function of flying. Good instructors recognize that their own ways are not the only (and in some cases not the best) ways of doing everything.

How do you handle the left/right problem? Beginners have a common problem when it comes to mastering turning. After entering a turn, they tend to forget which way they are turning and give the wrong aileron to exit the turn (sending the plane deeper into the turn). There are several ways you can help the beginner with this problem. But first, ***establish with the student that right and left commands always refer to the position of the joystick, not the plane.*** This greatly simplifies the learning process for the student.

One teaching aid is to ask the student to turn his body to face the plane's heading. If the student is looking in the same direction as the plane is flying, it will help him remember which way the plane is turning. Another method is to have the student keep repeating (out loud) from the beginning of the turn which way he is moving the stick. A useful rule of thumb for beginners is to instruct them to push the aileron stick in the direction of the low wing when the plane is flying toward them. With any of these

methods, the beginner will eventually become comfortable turning and not need the crutch. The preference is to get them to stand in a stationary position when flying and get them to keep saying out loud the direction they are turning.

The end goal is to get the student to visualize themselves inside the model from the pilots position. This visualization will help them as they progress to aerobatics, helicopters, and other areas of aeromodeling.

What throttle setting do you use? Try to keep the throttle setting just high enough for the plane to maintain "hands off" level flight in the air. This ensures smooth docile performance and minimizes the student's natural tendency to over control. It also helps them make level turns. You will eventually need to have the student practice at all throttle settings from idle through full throttle.

How much control surface motion do you want? - Since students have a natural tendency to over control, many instructors like to set up trainers to be very docile, minimizing control surface motion (possibly with dual rates). This means the beginner must move the sticks quite a bit to cause a reaction from the plane. However, the preferred setup is to keep the plane rather responsive for three reasons. First, the student must eventually learn the precise control motions needed with sensitive control surfaces (on this airplane or their next one). Second, on windy days minimal control may not be enough to cause sufficient response from the airplane in certain attitudes. Third, as the instructor, you need the plane to be responsive enough to get out of precarious attitudes.

When do you teach rudder-coordinated turns? It is generally best to teach people to fly without ever manipulating the rudder stick (except for steering on the ground). Most RC airplanes, and especially trainer planes, turn quite nicely with only a combination of aileron and elevator. While rudder coordinated turns make for nicer looking turns, and rudder is helpful when landing in a crosswind, try to keep turning as simple for beginners to master as possible. The addition of rudder coordinated turns should follow successful completion of the first four steps of instruction.

Final approach, one turn or two? If teaching realistic flying, the RC pilot will make two turns during the final approach. One turn will bring them ninety degrees to the runway and the other will bring them right on the middle of the runway. To simplify this, have students make one (180 degree) sweeping turn during final approach.

What is the wind limitation? Most students can learn more easily on calm days but if we waited for perfectly calm days, we'd never fly! However, there comes a point when the wind is blowing so hard that it will be impossible for the beginner to control the plane. For the student's first ten flights or so, I recommend limiting your instruction to when the wind is blowing under 10 miles per hour. As the student progresses, let them fly on windier days. Remember that your student has not truly mastered flying until they can fly with winds around 10-15 mph.

Having said this, it is important to ***exercise caution on days when a significant crosswind exists.*** High wing trainers with their generous dihedral do not handle crosswinds very well. Although flying is not particularly difficult, the ground handling may be hazardous to the planes health! The student's first attempts at landings and takeoffs should be restricted to days where the winds are primarily parallel to the runway. Teaching crosswind handling should be reserved for advanced students only. Each instructor will have a different comfort level with handling high wing trainers in a crosswind. If you do not feel comfortable flying under these conditions, by all means, ask your students to wait for a better day.

SECTION II

PRE-FLIGHT INSTRUCTION

Instructors tend to get the brunt of questions from people just thinking about getting into the hobby. Once someone has begun learning to fly, instructors are bombarded with questions related to all facets of this hobby. Even once a student has learned to fly, if they have questions (especially about aerobatics), they ask an instructor. This section of the program is devoted to handling the most common questions and problems a beginner has. Though as an experienced pilot you already know much of what is presented in this section, this presentation should help you with your ability to relate what you know to beginners. Also, much of this section can be simply copied and given to beginners with questions.

Common RC questions: Most beginners to the hobby tend to have the same set of questions as they enter into the RC airplane hobby. So we'll begin by giving a summary of these questions and supply brief answers.

How does the radio control system work? - As with any kind of radio, a transmitter (held by the flyer) is used to send signals to the receiver (in the airplane). Both are powered by (usually rechargeable) batteries. The radio system can have several channels. Each channel is used to control one airplane function. Servos (one for each channel) are used to cause the actual motion within the airplane to make control surfaces move.

A good beginner's radio configuration has four channels. These channels control ailerons, elevator, rudder, and throttle. Two sticks (like computer game joysticks) on the transmitter give the pilot command of these four controls. With the most common radio setup mode, the right stick is used to control aileron (left/right) and elevator (up/down). The left stick is used to control rudder (left/right) and throttle (idle through full throttle). Like a computer game joystick, the aileron, elevator, and rudder sticks are spring loaded. When you let go, these sticks spring back to the center (neutral) control position. The throttle stick stays where you place it, from idle to full throttle.

Keep in mind that radio control systems can have more than four channels. Other controls for these channels include retractable landing gear, flaps, and even smoke systems. For now, you should concentrate on the four basic controls. Leave the fancy stuff for when you have mastered the hobby.

Within the airplane, servos receive signals from the radio's receiver whenever either of the transmitter sticks is moved. The servos respond according to the motions of the transmitter sticks and cause the control surfaces of the airplane to move in sync with stick movements (through mechanical linkages). Instructors: If an interested person at the flying field has questions about radio systems, be sure to show them on your own airplane.

Other radio terminology:

Trim controls - It is not possible to perfectly set each servo and control surface prior to a model's first flight. Say for example, the plane tends to climb in a hands off condition. The elevator trim control will give the flyer the ability to trim in some down elevator without affecting the joystick for the elevator. In essence, trim controls allow the flyer to set the radio so that the plane will fly straight and level with hands off the radio. ALL radios come with trim controls for the four basic channels. It is advisable to perform mechanical adjustments to the control linkages such that the plane flies nearly hands off with all trims set in the neutral position. This is a trial and error process that may take several flights. The effort pays off though since trim buttons are easily bumped out of position inadvertently and it can be difficult to estimate the settings if they aren't close to the neutral position.

By the way, this is another reason that beginners should seek help. It is highly unlikely that a new airplane will behave perfectly with regard to trim settings. A plane that is not trimmed properly can be very difficult to fly (even for an experienced flier). For a beginner, it may be impossible to fly. During the

new plane's first flight, the instructor will trim your airplane, and advise you on the procedure to mechanically adjust the control linkages to be centrally positioned.

Servo reversing - It is sometimes inconvenient (if not impossible) to mount the servos in a way to properly control the control surface. In many cases, the servo will come out backwards (left aileron comes out to be right aileron, for example). The feature servo reversing allows you to mount the servos in the most convenient manner, and if one or another comes out backwards, the servo reversing switch for that servo (in the transmitter) can be turned on. Servo reversing is a standard feature on most radios sold today.

Dual rates - Though not included on every radio, this feature allows you to change the responsiveness of your airplane's control surfaces (usually this feature only applies to ailerons and elevator). On high rates, your servos will move full travel and the plane will be quite responsive. On low rates, your servos may only move about 40-60 percent of their total travels. This is a nice feature for beginners, since you can reduce the responsiveness of the airplane, making it easier to fly.

Mixing - This feature allows you to have one control automatically invoke another. For example, the radio can be adjusted to automatically give some aileron movement in response to a rudder command (to make for a smoother turn). While this is a nice feature for experienced flyers, it doesn't help beginners learn to fly. Don't go out of your way to find a radio with this feature for your first radio.

Radio styles - AM versus FM-PPM versus FM-PCM - Generally speaking, the most reliable (and most expensive) radio style is FM-PCM (stands for frequency modulation - pulse coded modulation). Next in reliability and price comes FM-PPM (frequency modulation - pulse phase modulation). Finally comes AM (amplitude modulation). Though almost all of these radio styles are highly reliable, we recommend that beginners purchase an FM-PPM or FM-PCM radio.

Trainer system - Commonly referred to as a "buddy box". This feature allows the safest manner of flight instruction. We devote an entire discussion later in this set of questions to the trainer system. Please refer to this information. For now, just remember a beginner should not buy a radio that is not set up to accommodate a buddy box.

How many airplanes can fly at a time? - The FCC has allotted 50 frequencies to model aviation. These frequencies are given numbers, ranging from 11 to 60. In theory, this means that fifty planes could be flying at the same time! However, the likelihood of fifty flyers showing up at the same flying field without duplicating frequencies is low. Also, when more than four or five planes are in the air at the same time, it can be quite distracting to the flyers (mid-air collisions, although rare, do happen). For this reason, the 495th Squadron normally limits the number of planes that can be in the air at the same time to 4 airplanes (three powered and one glider). Note that if one flyer turns his transmitter on when another on the same frequency is flying, the pilot of the plane in the air may lose control of the plane. This is why we require frequency control at the field. Instructors: be sure your students understand the rules of frequency control.

How long can they fly? - Depending on the size of the engine and the size of the fuel tank, the range of flight time can be from about 10 minutes to well over 20 minutes. One common recommendation for a .40-sized engine is about a six ounce fuel tank. This will allow about a 10-12 minute flight.

What happens if the engine quits? - Most planes designed for beginners will glide quite well. In the hands of an experienced flier, a plane can be safely landed even if the engine quits. Of course the altitude and attitude of the airplane at the time of the engine failure has a lot to do with how difficult it is to safely land the airplane. The higher the plane, the more time the pilot will have to plan the landing. (Landings without power are called dead-stick landings.)

How far away can the airplane fly? - The rule of thumb is if you can see it you have control of it! Generally speaking, your radio will have control of the airplane for distances of more than a mile. The higher the plane, the greater the range.

How fast do they go? - This depends on the style of airplane as well as the size of the engine. Trainers will fly at speeds of about 20-60 miles per hour, depending on the maneuver. More aerobatic sport planes can reach speeds of well over 90 MPH. Pylon racers designed for speed can go as fast as 150 MPH.

How high can they go? - As high as you can see them. Again, if you can see it, you have control of it! However, flying fields that are located in close proximity to airports usually have some height limitations. Instructors: be sure to relate any rules related to height and position flying.

Is flying an RC airplane like flying a full-scale airplane? - In essence, yes. You'll have the same basic controls a pilot has on a full-scale airplane. However, full scale pilots that have learned to fly RC airplanes say there is quite a difference in actual flying technique. They say an RC airplane responds much faster than a full-scale airplane. They also say that learning to fly RC can be awkward, since there is no feel for the plane's maneuvers. RC flying requires much more hand/eye coordination since you must respond to what you see.

Is it hard to learn to fly? - This is a tough question to answer. Everyone has a different aptitude level for learning RC. This much is certain. RC flying is hard enough to learn that you will not want to try to learn by yourself. You are not likely to meet anyone who learned by themselves that did not go through several airplanes (or at least several crashes) in the process! Fixing airplanes is not nearly as much fun as flying. If you want to learn to fly with the least amount of problems and expense, join the club and work with one of our instructors. He'll flight test and trim your plane, take off and land for you, give you pointers, and stand close by, ready to take control if you get into trouble in the air. While we can't promise that your plane will never crash, you will have a much better chance of keeping your plane in one piece with an instructor than without one.

How long does it take to learn to fly? - Like the previous question, this is tough to answer. It depends upon the student's aptitude. It also depends on how often you practice. The more often you practice the shorter the time it will take to master. You know the saying, "If you don't use it, you lose it!" It truly applies to RC flying. If you only fly once a month, it may take quite a long time. You'll be struggling to remember what was learned in the last session. Some people solo (fly by themselves for an entire flight) in as little as two weeks of practice (every day for several flights). Others may take the whole flying season to learn to fly. Yet others may take more than one flying season. With a good instructor, even the learning stage is fun and rewarding. So this period should seem to go quite quickly, regardless of how long it takes.

What is the best size for learning? - Generally speaking, the smaller the airplane, the less expensive it will be. Unfortunately, the smaller the airplane, the less stable it is and the worse it handles in the wind. Here are the approximate engine sizes as well as the approximate wingspan and weight of several standard classes of RC airplane.

<u>Engine</u>	<u>Wingspan</u>	<u>Weight</u>
.049 (1/2-A)	35-40"	1-2 lbs
.20	40-45"	2-3 lbs
.40	50-55"	4-5 lbs
.60	60-65"	6-8 lbs
.90	70-75"	9-10 lbs
.120	80-85"	10-12 lbs

Keep in mind that all size RC airplanes perform nicely on calm days. We recommend starting with an airplane large enough to handle our typical wind conditions. This means a .40 or .60 size airframe.

What's the hardest part of flying? – Take Off and Landing. Your instructor will first teach you how to keep the plane in the air, making simple turns. Then you'll progress to flying figure eight patterns. Once you can keep the plane in the air by yourself without any problems, you'll learn to land. Finally, once you have mastered all other phases of flying, you'll learn how to taxi and take off.

How much wind can there be? - Experienced flyers can fly (sport planes) in winds well over 20 MPH. However, the more wind, the harder (and scarier) it is to fly. Beginners won't want to fly in winds much over 8-10 MPH until they have mastered the first step of learning how to fly. Crosswinds may be particularly difficult for the beginner and your instructor may ask you to wait for a better day.

What about flight simulators? – The flight simulator software available today is very realistic and an excellent investment for beginners. The student can log many times the number of flight hours on the simulator than is possible at the field in a given period of time. This investment is virtually guaranteed to rapidly improve your hand/eye coordination and accelerate your learning curve. The use of this tool may shave weeks or months off of the time it would ordinarily take to achieve solo certification.

There are members in our club that have learned to fly mostly using the RealFlight simulator. This is not a complete replacement for an instructor but after spending a day with an instructor the simulator can be used for a lot of practice. This is a very effective combination where the instructor time is used to learn maneuvers and the simulator to practice them every day.

What makes a good trainer plane? - Here are some qualities that contribute to making a good trainer plane:

High wing design - You'll notice that all trainer recommendations we give are high wing airplanes. This is the most stable design (even for full-scale airplanes). Since the body of the fuselage is below the wing, the plane will have a natural tendency to right itself after a turn.

Flat bottom or semi-symmetrical wing - Flat bottom wings are best for stability, which is helpful when learning. However, planes with flat bottom wings are not very maneuverable. Once you do learn to fly, you will eventually want to learn how to do some aerobatics. Flat bottom wing designs perform poorly when it comes to aerobatics. Semi-symmetrical wings have a slight curvature to the bottom of the wing. They are not quite as stable as flat bottom wings, but they do allow moderate aerobatics.

Rugged design - It's almost a guarantee that your first plane will get knocked around quite a bit. You'll want to be sure that it can take some minor bumps and bruises. But be careful here! When a plane is designed to be rugged, it usually sacrifices some of its flying characteristics. There are a number of planes on the market that claim to be almost indestructible, and they almost are, but they sacrifice good flying characteristics to be able to make this claim.

Planes that make good trainers and that we have successfully taught people to fly with:

- SIG Kadet LT 40 (ARF and Kit)
- Thunder Tiger Trainer 40 (ARF) and Tiger Trainer 60 (ARF)
- Hobbico Superstar 40 (ARF) and Superstar 60 (ARF)
- Avistar (ARF)
- Carl Goldberg Eagle II (ARF and Kit)
- Hangar 9 Solo Series (ARF)
- Hangar 9 Easy Fly .40 (VRTF)
- Great Planes Trainer 40 (PT-40 Kit)

All these planes are very stable, don't tip stall, can fly very slowly, respond uniformly to controls, and have fairly light wing loading.

Should I build a plane from a kit or buy an ARF (almost ready to fly)? - This is totally up to you. If you enjoy working with your hands, by all means, build your own airplane. You can save a little money (but not much) and you'll have the satisfaction of flying something you built yourself. Also, you'll have the plans to the airplane in case you have to do some repairs after a crash.

On the other hand, if you don't enjoy building, or you wish to get in the air as quickly as possible, there are several excellent flying ARF airplanes on the market. Keep in mind that, even with an ARF, there is still some work to do. While the wing halves, fuselage, and tail section are complete, you do have to final assemble, mount the engine, and install the radio. Most ARFs come with excellent instructions (since they assume beginners are purchasing them), and you can be in the air in about 10-12 hours of building time. The VRTF (virtually ready to fly) designs can be assembled in as little as two hours with no special tools.

Plane and engine size - 40 size trainers offer the best compromise in stable flight and economy. If cost is not a concern, 60 size trainers tend to be substantially more stable than 40 size trainers (especially in higher winds). Difference in total price between a 40 vs 60-size setup is typically less than \$100.

When it comes to engines, you should buy a product with a proven track record of reliability and ease of use. Talk to experienced flyers at your field to get recommendations. OS, Magnum, and Saito engines are among the most common name brand engines at our field. All have excellent reputations and most of our experienced pilots will be very familiar with the initial setup and operation.

As far as power, select an engine that is in the middle or top end of the recommended range for the airframe. As a general rule, it is best to err slightly on the overpowered side. As you begin taking off, a good strong engine makes the procedure much easier. If your plane barely has the power to get off the ground, taking off can be quite a challenge. This extra power is also very handy when practicing approaches and for gaining altitude fast. Additionally, once you have learned to fly, a good strong engine will be needed for your next (sport) airplane.

How much do they cost? - This is also a tough question to answer based on the size of the airplane and how many extras you want to buy. For a .40-sized airplane, here are some basic guidelines for costs. Note that this configuration assumes that you wish to keep the cost down

ARF (almost ready to fly) plane:	\$110.00
.40 sized engine (medium class):	\$80.00
4 Channel FM radio (with cord):	\$150.00
Flight box accessories (fuel, etc.):	\$60.00

Approximate startup cost:	\$400.00

While this may sound expensive, this is a one-time cost. Your radio, engine, and flight box can be used over and over for other airplanes. Don't forget that you need to join the AMA and our club to participate in the training program.

What is the trainer system? (IMPORTANT!!) - Imagine you've just built your airplane and you bring it out to the field for the first time. You get together with an instructor and he test flies your airplane and trims it out. Now it is going to be your turn. Your instructor takes off again and gets the plane up to a safe altitude and hands you the transmitter. If you're like most beginners, you'll have the plane on its back almost immediately (beginners have the tendency to over-control the plane). Your instructor quickly grabs the transmitter back from you and rights the plane. Then he gives you back the transmitter. You get about 3 more seconds of practice before he has to grab the transmitter again.

This passing back and forth of the transmitter is very cumbersome, error prone, and downright scary. In the beginning, when you are just trying to keep the plane in the air, passing the transmitter will

suffice. But as you get better, and you begin to do maneuvers closer to the ground (like takeoffs and landings), you'll want a more fail-safe method of instructor control.

Typically called a buddy box, the trainer system allows you to connect a slave transmitter with the master transmitter via a cable. Once set up properly, the instructor will take the master transmitter and give you the slave transmitter. He'll get the plane in the air and when ready, he'll simply press a button and you'll have control. If you get into trouble, he releases the button and he has control again. No more passing transmitters. The trainer system will dramatically improve your odds of learning how to fly without crashing even once (especially as you begin taking off and landing).

Unfortunately, you have to have both a master and a slave transmitter. Most beginners do not want to buy a second complete radio system just to get the slave transmitter. And most pilots will not let you borrow their transmitters to be used as a slave (the servo reversing switches may have to be changed which can cause major problems when they go back to flying their own airplane). Fortunately, the 495th Squadron maintains a buddy box for Futaba and JR radios and cords available to work with students. These are available during normal training times at the field.

Note that the trainer system connector port is not equipped with all radios. Most older AM style radios, for example, do NOT come with this port and those that do typically are not compatible with our modern FM systems. ***You should plan on buying a current model Futaba, or JR FM transmitter to ensure that your radio will operate with our training equipment.*** If you prefer to purchase any other brand of radio system, plan on purchasing your own buddy box and trainer cord as well.

Pre-flight inspections - Beginners to RC flying vary dramatically when it comes to building skills. Some are building their very first flying model and find it quite challenging while others may have built other types of flying models and find it rather easy. The kind of airplane has a lot to do with how difficult it is to get into flying condition. ARF's tend to be rather easy, requiring little more than final assembly while kits can be much more challenging. Additionally, correctly installing radios and engines can be somewhat difficult, even for ARF airplanes.

For these reasons, we insist that all beginners have their planes checked for air-worthiness prior to starting flight training. Instructors will check for problems that need to be corrected. Common mistakes that must be corrected before the plane can be flown include having servos activate control surfaces in the incorrect directions (easily fixed by using servo reversing), not placing foam rubber around the receiver for padding, not properly gluing wing halves (on ARFs), not correctly gluing hinges, and improper center of gravity point. Keep in mind that these are but a few of the many things that can cause an airplane to crash, and the instructor must be on the lookout for many more.

Additionally, there may be things an instructor finds that may not cause the airplane to fail (yet) but should be repaired in the near future. For example, certain control surface hardware (clevises, control horns, and linkages) works better than others. An instructor may be willing to help a beginner today, but ask that some things be changed before further help will be given.

Appendix B includes a complete Mechanics Check List for new planes. Encourage students to go over the check list with their plane at home before bringing it to the field. This will minimize the amount of time spent at the field going over the plane for the first time. Review the Mechanics Check List with the student at the beginning of each flying day. In particular, ensure that the engine can be completely stopped by means of the throttle trim. Do not allow any plane to be flown that is not airworthy in every regard.

IMPORTANT SAFETY NOTE: Be sure that the buddy box is properly matched to the student's transmitter before each and every flight. We often share buddy boxes among multiple students on any given day and the potential for reversed servo controls and/or misaligned flight trims should be assumed to be present at any time.

SECTION III

STEP ONE: TEACHING TURNS AND LEVEL FLIGHT

The objective is to get the student to a point where they can keep the airplane in the air with no help from you. Though the plane may still be "flying the student" to some extent at the end of this step, at least they should be to the point that you are not constantly fearing for the airplane as they fly.

We assume at this point that the training airplane has had a trim flight and any necessary control surface adjustments have been made. We also assume that the student has completed the pre-flight instruction section and understands the basics of aerodynamics and flight, including knowledge of the influence each control surface has on the airplane. Finally, we assume that the student has been taught how to safely start and operate the engine and is familiar with the safety rules of the 495th Squadron.

The time it takes the student to master step one varies dramatically. Believe it or not, some students do so on their very first flight. But it usually takes longer. Regardless of how long it takes, students should not get the feeling that they are in a race to see how long it takes to master any step of flying.

When it comes to time, many beginners think they should master flying their very first time out. When they don't, or whenever they don't feel they are progressing fast enough, they tend to get down on themselves, especially if another beginner seems to be progressing faster. Part of your job will be to keep them from getting discouraged. Make it clear that everyone picks up the hobby at a different pace. Relate the problems you had when you learned to fly. Be sure they are having fun. (If it's fun, who cares how long it takes?) Tell them if they push too hard, the problems they are having only get worse.

Begin on the ground by explaining the basics of turning. Explain that turning is basically a three step procedure:

- 1) bank with the ailerons,
- 2) maintain the turn with up elevator
- 3) level out with the opposite aileron.

Demonstrate turning with hand movements as well as on the stick of the transmitter. Explain that even trainer planes tend to be quite responsive and that only a little motion of stick will be sufficient to maneuver the plane. While the student cannot really get a feel for flying while on the ground, you must prepare them for what to expect in the air. What about the rudder? - If the plane has ailerons, we recommend having the student ignore the rudder when turning for a while. RC airplanes, and especially trainers, turn quite nicely with a simple combination of aileron and elevator. While you may eventually wish to teach the beginner rudder coordinated turns, this tends to substantially complicate the learning process, especially early on. If you intend to teach rudder coordinated turns, wait until the student is well along in step two before you introduce this more complicated turning method.

Demonstrate proper safety practices each time you take the student's plane to the runway. Always perform a final system check with the engine running to ensure that all control surfaces are moving freely and in the proper direction. Before takeoff, advance the throttle briefly to the full position to ensure that the engine is cleared and will not stumble upon acceleration in the takeoff roll.

On the student's first flight, begin by demonstrating a turn. Try to get the plane in an attitude where the student can see both the plane and the transmitter to see the small amount of control you are giving (hold up the transmitter to show them). After entering the turn, stress how important it is to maintain the turn with up elevator. Also demonstrate how a trainer airplane tends to self correct, meaning minor aileron corrections may be required to hold the bank angle. Finally demonstrate exiting a turn with

opposite aileron control. You may want to demonstrate this in both directions, stressing the three step nature of turning - bank with aileron - hold the turn with up elevator - straighten with opposite aileron.

The beginner's first few attempts - We're assuming you're using the buddy box. Always announce to the student whenever you give control or retake control of the plane. Begin by getting the plane into a perfect turning position. You'll need to make it as simple as possible for the beginner's first few tries. Begin at a safe altitude by aiming the plane toward one of the near corners of the field (left or right). This way, soon after the student takes control (by your holding the trainer button on the master transmitter), they will immediately begin the turn. Always have them turn the plane in a direction away from the pits (turning right on your left side and turning left on your right side).

It is quite likely that the beginner will immediately roll the plane over on its back, so be ready for anything as you give them control! Again, you decide when to take over. For the student's first few attempts, you will probably have to retake control soon after you push the trainer button. Don't be afraid of hurting feelings by retaking control! As soon as the student is in trouble and you retake control, right the problem and set the plane up again for another turn.

As the instructor, **you set the rules for when you retake control**. Early on, tell students that there will be times when they may be in control of the airplane, yet you may still retake control. The first time has to do with the flight line. If it even appears that the student might eventually cross it and fly over the pits, you must retake control. While it is possible that the student may have been able to continue flying without crossing the flight line, you should not take any chances where safety is concerned, especially on the student's first few flights. Second, **set an altitude limitation**. While learning how to turn, students tend to lose altitude in each turn they make. When the plane descends past a certain altitude, you should retake control, even though they may be doing rather well (this also gives them the goal of keeping the airplane above your cut-off point). Third, **set a distance limitation**. If the plane gets so far away that it becomes difficult to see, you should retake control. You may also want to set a similar rule based on your own comfort level. Tell the student that if they get the plane into an attitude you don't feel comfortable with, you'll retake control. This may not be caused by a problem or mistake on their part; you simply don't want the plane to get into an attitude from which you cannot recover!

Though you have explained the three steps to turning on the ground and the student may have seemed to understand quite well, when in the air, the student will probably have problems remembering these three seemingly simple steps. Also, they will not be able to give the correct amount of aileron and elevator to make good turns. For these reasons, you will probably have to talk them through their first few turns. Don't be afraid to talk to the student while they fly (though be careful to stick to the point so as not to get them confused). Here is an example conversation (though very one-sided) you might have with a student on their first few turning attempts. At this point, you have just set the plane up for the student to make a gradual left turn when you push the trainer button to give the student control of the plane.

"OK. I've set you up to make a nice gentle left turn. Give a little left aileron to get the turn started and be ready to bring in up elevator. See that left wingtip drop. That's it. Not too much now or you'll have to give some right. That's it. You'll need some up elevator now. Waited just a little too long to bring in the up. See that nose drop a bit. Hold the turn with the up. Nose is still dropping. You need more up. That's it. Hold the turn until your heading back toward the runway. Good. Remember, you're turning left. Be ready to straighten with right. OK. Begin to straighten. Not too much now or you'll over-control. Good. Now let's try a right turn..."

Be careful with how much talking you do. Stick to the main points of the step. In this case, bank with aileron, hold the turn with up, and straighten with opposite aileron. Save any discussions that are not directly related to the subject at hand until the plane is on the ground.

That brings up a good point. After each flight, be sure to review the flight with the student. Stress those areas where progress has been made and be sure to offer praise. For those things the student is having problems with, you now have the student's full attention and can offer advice and constructive criticisms.

One more point about talking to students as they fly. While it's good to talk to help them get comfortable with a new flying technique, you'll want to be sure that the student is not just mimicking your instructions and confirm that the student truly understands the maneuver you are teaching. Once they are following your instructions and turning quite well, keep your mouth shut for a while and just watch them fly. If they continue to do well, they truly understand the maneuver you have been teaching.

If the student is having problems making turns (as most will), concentrate on each step independently. Begin by making sure they can give the correct amount of aileron control to get the desired bank angle. Beginners have the tendency to give too much control, rolling the plane to a very severe bank angle. You'll probably have to keep stressing how little stick control they need to give. Make sure they understand the relationship of bank angle to the plane's tendency to lose altitude. The more bank angle, the more the tendency to lose altitude quickly.

Once they can set the correct bank angle, concentrate on having them maintain the turn with the elevator. Make sure they are making gradual, level turns, neither gaining nor losing altitude (though gaining is always better than losing). Stress the relationship of bank angle to elevator. The more severe the bank angle, the more up elevator required to hold altitude (and the tighter the turn). Also stress that it is important to begin giving up elevator as soon as they see the wingtip begin to drop to the desired bank angle. Beginners tend to wait too long, and the plane loses altitude before entering the turn. This is somewhat difficult to master, because if they pull in up too early, the plane will simply climb (eventually stalling). Beginners also have the tendency of forgetting which way is up. The elevator stick may seem backwards to a person who has never been exposed to any form of flying. Stress that it's just like a full-scale aircraft. Pulling back on the stick makes the plane go up. If they hold the transmitter more horizontally, it may help them remember this.

As they progress further in this step, stress the importance of maintaining the bank angle with aileron control throughout the turn, especially if they're flying a very self-correcting trainer plane with a flat bottom wing and a lot of dihedral. Have them practice this by making full 360-degree turns. Have them fly the plane in a full gradual circle. Even a plane that is not very self-correcting will require minor adjustments of aileron to maintain the correct bank angle. Once they master the 360 turn in one direction, have them practice it in the other. Also, once they can perform one 360-degree turn, have them continue the turn several times, making several 360-degree turns consecutively. This practice forces the beginner to maintain a gradual turn for a long period of time.

Finally, have them concentrate on exiting the turn by applying opposite aileron until the plane is flying level again. The most common problem here is that the beginner forgets which way the plane is turning and they attempt to straighten by applying the wrong aileron direction to exit. This, of course, sends the plane into an even sharper turn. ***As the instructor, you must be prepared for this mistake every time the beginner ends a turn! The lower to the ground the airplane is, the more important it is that you be ready.***

There are several things you can do to help the student with this problem. One way (that many experienced fliers do not like) is to have the student physically turn with the plane. If they are facing the same direction as the airplane, it will be easier to determine which way to exit the turn. Another way is to have the student keep saying (out loud) which way they are turning throughout the turn. They will then know which way to exit the turn. Another common problem for beginners exiting turns is they continue to hold the up elevator too long. This of course, will make the airplane climb at the end of the turn, and possibly cause a stall. They must practice until they can exit the turn at the same vertical attitude as entered.

Another problem to watch for is the student's tendency to turn much too severely. They bank hard, pull in a lot of up, and level out quickly. While their turns may look rather well, you must force them to turn gradually. When they turn so radically, it will be difficult (if not impossible) for them to come out of the turn on a predictable heading, which will be very important in step two to flying. If the beginner is having problems, it doesn't hurt to point out that turning gradually is the most difficult way to turn. Though they must master gradual turns, once they do, they can look forward to learning the split-S and Immelman turns, which are much easier turns to perform.

From the very start, be sure that the student practices left and right turns equally. With no intervention from you, most students will fall into the habit of making turns in only one direction. Most beginners tend to favor left turns. Force them to practice turns in both directions. Many students find it more difficult to make right turns. They may complain that the wingtip drops more quickly and more severely (along with the nose of the plane) when making right turns. They also complain that the plane tends to fall further into the turn while holding the turn with up elevator. This is related to how much engine thrust the plane has (possibly too much right thrust). Though some of this tendency can be removed by removing some right thrust, it also makes an excellent time to stress how small corrections must be made with ailerons during each turn. It also makes a good time to have them practice full 360-degree turns in both directions.

What about planes that don't have ailerons? - Though you don't see them as much any more, there are trainer planes that have only rudder, elevator, and throttle. Believe it or not, these planes fly quite similarly to planes with ailerons. As you apply rudder, the wingtip will still drop. You still hold the turn with up elevator. And you still exit by applying the opposite rudder. You will notice, however, that the nose of rudder controlled airplanes tends to drop more severely in turns. Be sure you've practiced flying a rudder-controlled airplane before you try to help someone for the first time. It takes some getting used to.

Throttle setting - Most model airplanes are overpowered, including trainers. This means you usually won't need full throttle to keep the plane in the air. As you know, planes tend to be much more responsive at full throttle. For most of our practice flying, keep the throttle at a setting that ensures docile performance. As the beginner progresses, be sure they can handle the airplane at any throttle setting.

Wind and turning - Ideally, the wind will be calm during the beginner's first few flights. However, do not consider the student competent with this first step until they have flown in wind of at least 8 - 10 miles per hour. They will find that wind presents its own problems to turning smoothly. It will appear that the plane will be sluggish when turning into the wind, while quite responsive when turning in a direction with the wind. This of course, means that different stick control amounts will be necessary with every turn. The best advice is to tell beginners to fly what they see. If they give a little aileron control and the plane does not respond, they simply have to give more. Getting the student used to this idea early is very helpful. As we start slowing the airplane down for landing practice, this tendency for response to become sluggish will be compounded.

Ballooning tendencies - Many trainers have the tendency to climb with speed, especially trainers with flat bottom wing design. The faster they go, the more they want to climb. While some of this tendency can be overcome with engine downthrust, engine speed is only one factor that influences the plane's speed. As a beginner makes their first few turns, it is likely that the plane will lose altitude. As it loses altitude it picks up speed. When the beginner exits the turn, the plane will have the natural tendency to climb, due to the increased speed. We call this tendency ballooning, since the plane resembles a hot air balloon as it rises for no apparent reason. Be ready to explain this tendency. To avoid it, the beginner must make level turns. If the plane does not lose altitude in a turn, it will not pick up speed, and it will not climb at the completion of the turn.

The beginner will also notice a tendency for ballooning whenever the airplane is turned into a high wind. To the airplane, it is just as if airspeed increased by the wind speed. The plane will tend to rise. This can be corrected (to some extent) by applying down elevator as the plane comes into the wind.

Try not to let the student get too bogged down with trying to overcome ballooning. Though it may seem like the plane is doing something wrong, it is just a natural tendency for trainer planes. Try to have them accept the fact that trainers tend to balloon. Tell them that their next airplane (probably a sportier plane) will not have this tendency. Demonstrate this on your own sport airplane.

You know they're getting close when - One signal that the student is getting close to the completion of this step is that they begin to complain that the airplane always seems to climb. Be sure to praise them at this point! They have overcome their tendency to lose altitude in every turn. Now it will be a relatively simple matter of flattening out their turns. They can bank slightly more severely with the aileron or not give quite as much up elevator to hold the turn.

When the plane gets too high, simply have them cut the throttle a few notches and continue flying. Eventually the plane will descend. Once a comfortable altitude is reached, have them increase the throttle a little and concentrate on making more level turns. It is best to have students control the descent of the plane by themselves (instead of retaking control) since it provides an excellent opportunity for the student to practice manipulating the throttle.

When are they finished with this step? - Generally speaking, when the student can keep the airplane in the air for a whole flight with no coaching from you, they have mastered this step. Be sure, however, that the student can turn left and right equally well. It is quite common that a student becomes much more comfortable with one way or the other, and ends up constantly setting up the plane to turn in the comfortable direction. Force them to practice turning in the direction they feel least comfortable with!

SECTION IV

STEP TWO: TEACHING HOW TO SET AND HOLD HEADINGS

The objective is to get the student to the point where they can fly the plane under complete control at all times while in the air.

If the student truly mastered the first step to flying, this step should be relatively easy to master. You can begin stressing the importance of being able to set and hold headings even during step one. As they begin to make level turns (even after their first successful attempt), stress how important it is to come out of the turn in a predictable direction. This will be very important during the setup and final approach for landing!

Setting headings - By setting a heading, we mean the student must be able to exit each turn in a predictable manner. By holding a heading, we mean the student must be able to keep the plane flying in the headed direction (without wandering) for as long a period as required. Again, at the completion of step one, the beginner may be able to keep the plane in the air, but the plane may be flying the pilot to some extent. The beginner may still be reacting to the airplane instead of making the airplane react to stick movements.

Explain that the key to setting precise headings is knowing when to begin exiting the turn with the opposite aileron. The smoother and more gradual the turn the easier this will be. At what point opposite aileron must be applied depends on the severity of the turn. The more gradual the turn, the sooner the (equally gradual) opposite aileron is applied, and the easier it is to smoothly exit the turn on the desired heading. As mentioned in part one, beginners tend to turn much too severely, making it very difficult to exit turns precisely.

To practice, begin by making the student fly figure eight's. The best pattern consists of left turns on the left side and right turns on the right side. This gives the student practice at setting up landing approaches from both sides of the field. Begin to stress the importance of flying much more precisely. Since we fly on a rectangular shaped flying field, use each corner of the field as the target heading after completion of each turn. The student is told to maintain each turn until the desired heading is reached. They should then execute a $\frac{1}{4}$ turn to set up a diagonal vector to the next corner. While the first few attempts will not be perfect, this practice forces the beginner to think about exiting the turn at the proper heading very early in the turning process.

Figure eight's are excellent for heading setting practice because you (the instructor) can easily monitor the beginner's progress. You will be able to tell if the student is catching on or still having problems. As long as the student has truly mastered step one and can consistently make smooth level turns, the two most common problems a beginner has at this stage is one, exiting too early, or two, exiting too late. If exiting too early, the student must turn again to eventually get the heading they want. If exiting too late, the student will overshoot the desired heading and have to turn back. Both of these problems lead to over controlling the airplane. Talking the student through the first few turns can help with each of these problems.

If they have either of these two problems, stress the importance of being able to begin exiting the turn slightly before the desired heading is reached. ***The more gradual the turn, the easier exiting should be.*** By the way, this is the reason we said during step one that you should keep the student from turning too radically. While radical (very severe) turns may be easy for the student to master, when it comes to setting headings, radical turns are very difficult to exit in a predictable manner and lead to over-controlling.

Free Form Turns - Once the student has mastered figure eight's have them practice free form turns. Based on the position of the airplane at a given time, call the turn you wish them to make. For example,

if you say "45 degrees right", expect the student to veer off to the right on a new heading 45 degrees from the start. If you say "180 degrees left", expect a complete turn to the left. This practice forces the beginner to fly the plane in new and different attitudes, and commonly turns up trouble spots (attitudes and positions in the sky with which the student is not yet comfortable). We all had trouble spots as we began flying (even some experienced fliers still have some trouble spots). For those areas the beginner has trouble with, give more practice. But at the completion of this practice, the beginner should be able to control the plane in almost any position in the sky!

Trim Settings - This is about the point in the training when you should introduce the student to setting transmitter trims while flying. They have pretty much mastered the ability to keep the plane in the air when the plane is perfectly trimmed. Give the student some practice with an out of trim airplane. On the slave transmitter, reach over and throw the aileron or elevator trim slightly off center. The beginner will be forced to determine what is wrong and correct the trim problem. Once you have started doing this with a beginner, repeat trim setting practice on the first flight of each practice session.

Holding headings and flying with precision - Once the student has mastered figure eight's and free form turns, you must stress the importance of being able to hold a heading. Even the most stable airplanes tend to wander from set headings based on wind direction and velocity. The student must be able to keep the plane going in a given direction. This must be mastered before they will be able to land. (During the final approach, the beginner must be able to hold the plane right on the middle of the runway all the way to the ground!)

For practice, once again begin with the figure eight. They must practice making minor corrections as the plane tends to wander from its desired heading. Stress that the direction and amount of wandering will vary almost every time, based on wind speed, wind direction, and the planes attitude at the completion of the previous turn. They must always be ready to apply these minor corrections in order to hold headings. The eventual goal of this practice is to make perfectly shaped figure eight's with the crossover right in the middle of the flying field. Once mastered, the student can truly fly the airplane with a great deal of precision.

Next, have the student fly a pattern that takes them right down the middle of the runway (still quite high of course). One way to do this is have them fly a long oval shape with the upwind side of the oval right on the middle of the runway. Have them practice holding the heading on the runway for the entire length of the flying field.

What about throttle settings? - Most of the practice to this point has been at one throttle setting. As stated during step one, most students find it easier to fly with a throttle setting that is just strong enough to keep the plane in the air, making for a docile flying airplane. However, before progressing to step three, you should direct the student to practice flying the plane at different throttle settings. When they decrease the throttle, the plane will become less responsive, simulating how a slightly under-powered plane will respond just after take off. As the throttle is increased, the plane becomes more responsive, simulating how an over-powered plane will behave during take off.

A note about rudder-coordinated turns - Most trainers will turn quite nicely without rudder control. In fact, the influence of rudder may make it quite difficult for the beginner to master turning. They may not even notice any difference if the rudder control surface is small. For this reason, we usually omit rudder-coordinated turns from basic flight training. It is often best to wait until the student has their first sport airplane when the rudder will have more of an impact on the quality of turning.

When are they finished with this step? - When the beginner has mastered the ability to fly the plane under complete control at all times, when they can fly the airplane in virtually any attitude, when they have gotten all of the left/right, up/down mistakes out of their system - and when they can set and hold headings, flying with precision - then they are ready to progress to step three, landing the airplane.

SECTION V

STEP THREE: TEACHING HOW TO LAND

The objective is to get the student to the point where they can make consistent approaches from both directions and land safely. This is a good time to explain to the student the risks associated with learning to land. The plane will be flying very close to the ground and at slow airspeeds. In the event that the student gets the plane into trouble, there may be very little that the instructor can do to save the plane, even on the buddy box.

A note about engine reliability - This step requires a great deal of throttle changing. Before starting this step, it would be wise to confirm that your student's engine will maintain idle, go from idle to full, and in general, perform without stopping or stuttering at all throttle settings.

Are they ready to land? - If all steps to this point have been truly mastered, landing will simply be an extension of what the student already knows. However, if they are having problems with this step, it should be taken as a signal that further practice (especially with step two) is needed.

Teaching slow flight characteristics - Before the beginner can begin learning how to land, they must understand how the plane responds at slower speeds. With the plane rather high, have them reduce the throttle to just above idle and fly the figure eight pattern. Have them take note of how the ailerons respond more sluggishly. Also have them note how, at idle, it is impossible to keep the plane from losing altitude (especially in the turns). Most importantly, have them note how if they try to maintain altitude by pulling back further with up elevator, the plane will eventually stall.

As they continue to lose altitude in their figure eight pattern, eventually have them kick the throttle back up to regain altitude. Have them repeat this several times. Be sure they can still maintain control even at slow speeds (especially holding a heading into the wind). Be sure they know at what point the plane will stall. And be sure they know what tends to happen during a stall. Fortunately, most trainers are very stable in a stall and no radical controls will be required to recover (though you may wish to explain that more aerobatic airplanes may not be so forgiving when they stall).

In step two, we had the beginner flying with precision. We had them flying right down the middle of the runway (in an oval pattern). The goal was to hold the heading all the way from one end of the field to the other. Now have them repeat this practice (still up high), but this time have them reduce the throttle for each pass down the middle of the runway. Again, be sure they can hold the heading for the length of the field at idle. Have them increase the throttle at the end of each pass. Be sure to make them practice this from each direction.

During the actual approach the beginner must begin letting the plane come closer to the ground. But first have them practice the approach pattern up high. Teach a symmetrical approach pattern. That is, the same basic pattern should be used from either side of the field (left or right). This also makes it quite easy to practice from both directions.

If there is little traffic at the field, and you secure permission from any other flyers, you can use a modified figure eight pattern for teaching approaches. Starting with the plane flying right down the middle of the field from right to left, have the student veer off to the right (at about 45 degrees) shortly after the plane passes by. Have them hold this heading until the plane has made sufficient room to make a left final approach turn. The student will then begin a long sweeping left turn with the goal being to end the turn with the plane perfectly aligned with the middle of the runway. At this point they cut the throttle to just above idle and hold the heading just until the plane passes by. The student then increases the throttle and veers off to the left (at about 45 degrees). The heading is held until enough room is made for a right approach turn. The student will then begin the long sweeping right turn to line up with the middle of the runway. This is repeated over and over again. As the student gains proficiency, the throttle is cut earlier and the plane is allowed to come closer to the ground. While all of this may sound a little difficult,

if the student has truly mastered setting and holding headings, believe it or not, this is actually rather easy! All we are really adding at this stage is the increase and decrease of the throttle.

SAFETY NOTE: Low level modified Figure Eight patterns should only be flown on the designated training night, unless there are no other pilots present on the flight line. At all other times, the basic flight pattern rules remain in effect. We don't want to be teaching our students to violate basic club safety rules!

Though it is rather difficult to explain, the student must understand that the nose of the plane must maintain a slightly downward attitude throughout the final approach turn (especially if the throttle is cut). This is how we cause the plane to maintain airspeed as it comes to the ground. The windier it is, the more important this point (and the more severe the downward attitude). While some pilots try to counteract the wind with higher throttle settings, the descent of the airplane allows much finer control of airspeed than throttle. **If the nose of the plane balloons up at the end of the final approach turn, the plane will eventually stall.** It will be impossible to maintain airspeed, and if very close to the ground, could result in disaster. As the student is practicing approaches up high, have them pay particular attention to the nose of the airplane.

Once the student has progressed to the point where they can consistently align the plane with the runway and bring the plane to within twenty to thirty feet of the ground, they are finally ready to land. Once again, remember that beginners tend to rush this. You must determine when they are ready. If anything, a little more practice than necessary won't hurt. Also, remember to be aligning your master transmitter throttle setting to their transmitter, so you'll be ready to take over at any moment!

Explain to the student that landing (if done right) is really nothing more than letting the airplane drift to the ground. Done properly, the student will not be having to force down elevator into the approach to get the plane to come down. It will do so naturally because of the low (idle) throttle setting. During the last twenty to thirty foot of descent, the beginner must keep the wingtips nice and level. The student has to be ready with sharp, precise corrections to keep the plane on the center of the runway. The natural tendency of the plane at idle will be to descend, so if the proper heading is maintained, it is a relatively simple matter of waiting until the plane comes to the ground. When the plane drifts down to within about 1-2 feet above the ground, explain that they should gently pull back on the up elevator to cause the plane to flare out. Of course, you should demonstrate the landing procedure prior to having the beginner do it.

A beginner's first few landings tend to be a little rough. Beginners tend to panic when low to the ground. They forget which way to turn, especially if minor aileron corrections are necessary. Tell them to remember that if approaching from the right, right is your friend, meaning if they panic, giving right aileron will take the plane in the direction away from the pits. If approaching from the left, left is your friend. Dumping the plane is always better than flying into the pits.

Practice, practice, practice. Though a beginner's first successful landing is a great confidence builder, do not let him think he has mastered landing just because he has done it once. As with taking off, every landing will be different so be sure to practice landings over and over again - in several directions and in different wind conditions.

What about dead sticks? - Sooner or later, we all have to land without power. One obvious way to practice this is to simply cut throttle and pretend the engine is no longer running. At first, have the plane in a nice approach position so the beginner can land with relative ease. As you continue practicing, get the plane into more precarious conditions when you cut throttle. Even if you just have the student tell you what they would do if the engine quits in a given position may be good enough. In any case, be sure the student is prepared.

SECTION VI

STEP FOUR: TEACHING HOW TO TAKE OFF

The objective is to get students to the point where they can taxi and take off. Remind the student that while practicing takeoffs, the plane will be very close to the ground, and there may be little that the instructor can do to save the plane if he gets into trouble. Make it very clear at this point to the student that proceeding to this next level involves risk.

Setting the plane's ground tracking - Experienced pilots can taxi and take off even if the plane is not perfectly tracking on the ground. In fact, if you've had a hard landing or two during training, it is likely that you may not have realigned the plane's ground tracking for the sake of saving some time. You may have simply held in some corrective rudder (coupled with nose or tail wheel) during the taxi run. However a beginner will not be able to handle a plane on the ground that does not track straight.

Before you turn the plane over to the student to take off, be sure the plane is tracking straight, and after every hard landing from this point on, be sure to check the tracking before the next takeoff. **This is very important!** In the hands of an inexperienced pilot, a plane that is not ground tracking properly can be very dangerous indeed (especially if the plane veers toward the pits).

One way for the beginner to set tracking (at home) is to let the plane roll down a shallow grade (with the radio on). Many suburban driveways are perfectly graded for this. With the rudder stick neutral, let the plane roll down the grade and watch for left/right tendencies. Be sure to tell the beginner not to adjust for tracking with the rudder's trim (this will, of course, affect flight trim). Adjustments must be made mechanically, within the airplane.

Taxiing and making the takeoff run can be quite difficult to master. First of all, if they have a four-channel system with rudder attached to steering on the left stick, they will probably find it awkward to precisely use their left hand. They will also find it difficult to control throttle and rudder independently. Begin by making them get comfortable with the left stick without the engine running.

Once they can move one control without the other, explain the plane's ground handling characteristics. You've been doing a lot of taxiing with their airplane to this point, and while different airplanes can have dramatically different ground handling characteristics (tail dragger vs tricycle gear, for example), you should be able to help them understand how responsive their plane will be on the ground.

Be sure to explain the plane's natural tendency to accelerate quickly as soon as it begins moving. As they develop a feel for what it takes to get the plane moving, they will make the plane move smoother. But first and foremost, be sure they keep the plane moving slowly - be sure to be ready to retake control as soon as the plane gets moving too quickly. As for steering with left and right, it may take quite a bit of practice, since it must be done with the left hand. Also, the same left/right problem they had in the air when the plane is coming toward them may recur.

Take off practice - Once they can handle the plane well on the ground, have them head the plane into the wind and practice some high-speed takeoff runs. Don't let them take off quite yet. As soon as the plane builds up speed, have them cut the throttle. **Remind the student that the engine torque will normally pull the plane to the left.** Force them to see how little rudder it takes to make the plane respond at high ground speeds. Beginners have a tendency to over control with rudder their first few times, so be ready to retake control at all times (keeping your master transmitter set to idle).

By this point, the student should be quite comfortable with handling the plane on the ground. But you'll still want to make it as easy as possible for his first few takeoffs. Explain that taking off is just a matter of building up flying speed heading into the wind while holding a little right rudder. Once flying speed is reached, he must apply just a small amount of up elevator (though some well-trimmed planes may actually lift off by themselves). Once the plane comes off the ground, the nose will be pointed up slightly

and the student can release the up elevator and the right rudder. If the plane is properly trimmed, the plane will continue its gradual climb at full throttle until it reaches a comfortable altitude and can be turned. As the plane rises, the student must be ready to make minor corrections to hold the plane's heading directly into the wind (with aileron and rudder) and to maintain a gradual ascent (with elevator). **Always have the student make the first turn away from the pit area!** Once the plane has reached a safe altitude, the throttle can be cut. Beginners tend to be so nervous during the first few takeoffs that they forget to cut the throttle. Of course, you should demonstrate taking off prior to having them do it.

If other traffic allows it, position the student so that he can takeoff in a direction directly away from him. Walk him out to the middle of the runway if necessary. (Once he masters this, the student will still have to learn how to take the plane off in different directions while standing at the pilot's station.) As the student increases throttle for takeoff be sure to increase the master transmitter's throttle setting in the event you must retake control.

Beginners have problems in three areas. First, they have problems holding the plane in the **proper heading** with the rudder while the plane is on the ground. This can be very dangerous if the plane wanders off in the direction of the pits. Be sure to let them know that just because they started the takeoff roll does not mean they have to take off. If anything looks wrong or they feel panic for any reason, have them cut the throttle! By the way, this is why the high-speed practice runs are so very important. During these runs, the beginner does not expect to take off and will be cutting the throttle every time. With this experience, they will be much more likely to cut the throttle at the first signs of problems during actual takeoff runs.

Second, when taking off in winds over about 5 mph and especially with a crosswind, beginners have trouble holding the **wingtips level** after the plane lifts off. Since the plane is not moving very fast at this point, it may respond rather sluggishly. The beginner must be ready with firm, accurate aileron and rudder control. When taking off in any kind of cross wind, be sure to make them predict which way the wind will tend to blow the plane as it lifts off the ground. This way, they will be ready to apply the opposite aileron.

Third, beginners tend to apply **too much up elevator** to get the plane off the ground. Or they hold the elevator in too long. Either way, the plane will have the tendency to stall soon after liftoff.

Practice, practice, practice. Many beginners think they have mastered takeoffs with their first successful one, regardless of how scary it was. However, you must stress that each takeoff will be different, and it will take many takeoffs to become fully proficient. Wind direction, wind speed, and rudder sensitivity will make for a few nerve-wracking moments. As soon as the student has successfully taken off, instruct him to relax, fly a full circuit around the field and set up to land. Have the student do it again - and again - and again. If all practice is done on a nice calm day, be sure you are with them the first few times they take off on windy days.

One excellent way to practice landing (and taking off) is with touch and go's. After landing (without killing the engine), have the beginner taxi back, take off, and land again. As they gain proficiency, have them reapply throttle as soon as the plane touches down, performing a true touch and go.

When have they completed this step? - When you are confident that they are in complete control on the ground, when you have seen them make a mistake and know enough to cut the throttle (they recognize when to abort takeoffs), when they can repeat the takeoff roll time and time again regardless of wind conditions, when they can maintain the takeoff heading in a nice gradual climb over and over again - then they are ready to take their solo certification test

SECTION VII

IMPORTANT THINGS A BEGINNER MUST KNOW

Here we include discussions that beginners need to be aware of as they learn to fly. These presentations are made directly to the beginner, so feel free to copy and distribute this information to your students.

When can I fly by myself? The whole point of RC training is to get the beginner to the point where they no longer need the constant help of an instructor. Once you have successfully completed the pre-flight instruction, the four steps of the training program and have earned your solo certificate you should be ready. You must understand, however, that this training will not by any means transform you into an expert pilot! The practice you receive in training is done with close supervision. In the real world, there will be no instructor there to take control when things go wrong. ***You can quickly and unexpectedly get your plane into rather precarious situations from which you may not recover.*** This knowledge should inspire you to be quite cautious for a while.

A few words on discipline. It is important that student's have proper expectations set up front for the approach to flight instruction. Flight training can be very enjoyable and rewarding, for both the student and the instructor. But the instruction must be taken seriously in order to be effective. Instructors should not simply be baby sitters tied to a child by an electronic umbilical cord. The instruction process should proceed from step to step, with each prior step being mastered before moving on to the next. ***The student should not be sidetracked by attempting loops, rolls and other aerobatic maneuvers prior to achieving solo certification status.*** Repetitive practice of the basic training maneuvers will prepare you to react more instinctively when the time comes for aerobatic instruction. The first priority is to develop your skills to become an independent, competent, responsible pilot.

Safety! Safety! Safety! The time we spend at the flying field is intended to be fun, right? From the time we pull into the parking lot until the time we pack up to leave, the only thing on our minds is to enjoy the time away from our troubles. Nobody likes going out to the field only to be bombarded with a bunch of rules and regulations. And of course, no one likes to be yelled at for doing something wrong. We all want to go about the business of having fun.

Unfortunately, our hobby can be a dangerous one. As flyers, we must all treat the hobby with respect and acknowledge the potential for danger. There are numerous times when what one flyer thinks is safe and acceptable will be totally rejected by other flyers on the flight line. We've all heard and seen what happens when a fellow flyer steps out of line. It isn't a pretty sight.

Truly, no intelligent flyer will intentionally do something to cause an accident. It is only when one flyer or another makes an unintentional mistake that accidents can occur. While beginners bear the brunt of the silliest mistakes, even experienced pilots have been guilty of unwittingly breaking safety-related rules.

Appendix A

Field Equipment

The equipment required to get a trainer off the ground can be very inexpensive. There are a few basic items that will suffice to get a beginner into the air and learning to fly but there are other items that can be added to make the job a lot easier.

MINIMUM EQUIPMENT

NAME	DESCRIPTION
Glow Plug Driver	Clip on battery for supplying power to glow plug
Chicken Stick	Stick used for flipping the prop to start the engine
Fuel	Fuel mixture recommended by engine manufacturer
Fuel Bulb	Rubber bulb used to transfer fuel to model tank
4 - Way Wrench	Combination wrench with sizes to fit glow plug, prop nut, etc.
Tool Box	Any box suitable for carrying the other equipment

These items should cost about \$60. This can vary depending on the brand of the items and the place from which the items are purchased. An assortment of screwdrivers, pliers, and allen wrenches may also be needed to perform field maintenance.

OPTIMUM EQUIPMENT

NAME	DESCRIPTION
Starter	Battery powered motor for starting model engine
Glow Plug Connector	Clip on battery connector for supplying power to glow plug
Power Panel	Power distribution panel for distributing power from a field battery to starter, glow plug connector, etc.
Field Battery	Small 12 volt wet or gel cell battery
Fuel	Fuel mixture recommended by engine manufacturer
Fuel Pump	Electric pump used to transfer fuel to model tank
4 - Way Wrench	Combination wrench with sizes to fit glow plug, prop nut, etc.
Field Box	Tool box specifically designed for carrying model field equipment

These items will cost about \$200. The cost will vary depending on the brand of the items and the place from which the items are purchased. Field box kits are available for a wide range of prices but can be built from readily available materials. An assortment of screwdrivers, pliers, nut drivers, and allen wrenches is also desirable to perform field maintenance.

Appendix B

Mechanics Check List

POWER PLANT

1. PROPELLER

- Propeller nut tight
- Spinner on tight
- Propeller balanced

2. ENGINE

- Hold down bolts tight
- Head bolts tight
- Carburetor secure
- Glow plug tight
- Note: carburetor will be "stroked" during the CONTROL operation.

3. FUEL SYSTEM

- Lines connected properly
- Line routing , bends, kinks
- Tank mounting
- Clunk free

FUSELAGE

1. CONTROLS

- Throttle control free
- Servos mounted securely and tight
- Servo hardware tight
- Servo pushrods clear of mechanical interference

2. LANDING GEAR

- Main Gear and Nose Gear Hardware tight
- Wheels free and collars tight

3. RECEIVER

- Check all receiver plugs for proper seating
- Check antenna routing
- Check receiver overall crash protection

4. BATTERY AND SWITCH

- Check switch mounting (opposite muffler side of fuse.
- Check wire leads for routing and binding and proper hook-up
- Check battery crash protection
- Check battery voltage

EMPENNAGE

1. VERTICAL STAB

- Check all glue joints for rigidity where joined to fuse
- Check rudder hinges
- Check rudder control horn
- Rudder throw will be checked and set under CONTROL OPERATION

2. HORIZONTAL STAB

- Check all glue joints for rigidity where joined to fuse
- Check elevator hinges
- Check elevator control horn
- Elevator throw will be checked and set under CONTROL OPERATION

WING

1. CONTROL SURFACES

- Check aileron hinges
- Check aileron control horns
- Aileron operation will be checked and set under CONTROL OPERATION 2

2. WING ALIGNMENT

- Check wings center section joint
- Check wings for warp

CONTROL OPERATION

1. TRANSMITTER

- Check for your PIN on the frequency pole and no frequency conflicts before operating transmitter
- Check transmitter voltage meter for proper operating voltage
- Check for proper flags on transmitter
- Set all trim controls on center

2. RUDDER AND NOSE GEAR

- Check rudder for correct direction (check also nose gear if tricycle gear) (change transmitter switch if necessary)
- Check for proper throw
- Check all hardware for tightness (especially nose gear control horn on shaft)

3. ELEVATOR

- Check for correct direction (change transmitter switch if necessary)
- Check for proper throw
- Check all hardware for tightness

4. AILERON

- Check for correct direction (change transmitter switch if necessary)
- Check for proper throw
- Check all hardware for tightness and check aileron control shaft from pushrod connection through trailing edge bearings to connection on aileron. There should be no "slop" in the system.
- Check for symmetry in neutral position.
- Check all hardware for tightness

5. THROTTLE

- Check for correct direction (change transmitter switch if necessary)
- Check for proper throw. Trim down-carb barrel closed. Trim up-carb open to fast idle. Throttle control off for these checks. Throttle full up-carb barrel full open.
- Check all hardware for tightness

BUDDY BOX OPERATION

1. TRIM

- Set all transmitter and buddy box trim to neutral or center position.
- Ensure that the buddy box power switch is OFF.

2. OPERATION

- Check buddy box for proper tracking with main transmitter for Rudder, Elevator, Aileron, and Throttle. Correct buddy box as necessary to track with main transmitter.

3. RANGE CHECK

- Range check transmitter with antenna collapsed and distance of 200 feet.
- Check also operation of buddy box through transmitter at the range check.