CHAPTER FOURTEEN

Federal Aviation Regulation FAR 101

"Good amateur practice is never
having to say you're sorry."
--The American Radio Relay League
Brought to my attention by Mike Manes (W5VSI)

Chapter Objectives

1.0 Understanding FAR 101... 1
2.0 2.0 The Current FAR 101... 6
Good To Know - Sky Color... 16
Near Space Humor... 20

1.0 Understanding FAR 101

To promote the safe use of airspace, the FAA wrote Federal Aviation Regulation 101 (FAR 101). FAR 101 is the near space bible. Violating FAR 101 is a serious mistake, but I'm not saying this to scare you. Meeting the requirements of FAR 101 is easy, but you need to follow the requirements consistently. So be familiar with FAR 101 before launching a near space capsule. When everyone follows FAR 101 it maximizes the use of US airspace while limiting the risks their risks. While a federal agency wrote FAR 101, it is not difficult to understand with a little help. I devote the rest of this chapter to explaining the portions of FAR 101 applying to the amateur near space program. There is a current copy of FAR 101 at the end of this chapter. I recommend you tackle it once you are ready to launch your first mission.

Preliminaries
Early in the development of your near space program, you need to accomplish these tasks.

- Find acceptable launch sites
- Become familiar with FAR 101
- Locate a Flight Service Station (FSS)

Launch Sites
Identify launch sites as early as possible. Do not wait until a week before launch to find your near space port or potential launch sites. A good launch site is one located away from airports and other restricted airspaces. It's also clear of trees, power lines, and other tall obstacles.

Plan your launches so the balloon does not ascend or descend through class B, C, and D airspaces. Consult the sectional chart to determine the tops of these airspaces. As long as the balloon is above them, you can travel over these air spaces. Restricted air spaces are another type of air space to avoid, unless you receive permission from the air space owner. Consult the FSS and sectional chart for more information.

Purchase a sectional chart to locate restricted air spaces. Visit your local airport for the chart. You want an airport that caters to private aircraft so don't bother major airports that service airliner companies. Now that you have found the launch perfect site(s), locate them in relation to the nearest airport. Use the aeronautical map to determine your sites' ranges and azimuths from airports or VORs. Write this information down once you have it. You need to share this information with your FSS contact, as they like to locate sites in relationship to airports and VORs.

FAR 101

Now it is time for you to get familiar with FAR 101. Balloon launches are not a frequent occurrence, so there is a chance that the local FSS will not be familiar with FAR 101. Demonstrating a thorough understanding of FAR 101 makes the FSS feel more comfortable about your balloon launches. Section 1.1 explains the requirements of FAR 101.

The FSS and NOTAMs

To reduce the risks of launching a near space mission, file a Notice To Airman (NOTAM) before each launch. The local Flight Service Station is the organization to call to file the NOTAM; small airports can give you their phone number. A few days before launch, call and explain to the FSS that you're planning to launch a HIBAL (high altitude balloon) and would like to file a NOTAM. Pilots read NOTAMs before they fly, so they will become aware of the time and location of your launch. Here are two ways to locate a FSS near you.

Call the phone number (800) 992-7433. This should route you to the local weather briefing office, which can give you the phone number to the nearest FSS. Note that this phone number does not work with a cell phone, as you could go through any cell phone tower.

Stop at your local airport that caters to private pilots. They will most likely have the phone number listed, and if not, someone there can give you the phone number.

1.1. The Gory Details of FAR 101

FAR 101 governs the operation of kites, rockets, and balloons. It is the regulation you need to be familiar with if you are to operate a near space program. Be familiar with the balloon portion of FAR 101 before you file a NOTAM and launch your first near space mission. Focus on the fact that you are launching a weather balloon, just like the National Weather Service does every twelve hours. If asked, be sure to state that you do not need a wavier, as you meet the requirements of subpart A.

Unfortunately, since a bureaucratic organization developed FAR 101, it can be difficult to understand initially. In this chapter I explain FAR 101, and as best as I know, my interpretation is accurate. This chapter is not an excuse for not reading FAR 101 for your self. Reading it will not take much of your time. If you have earned a radio license, then you can read and understand FAR 101. When it comes to a near space exploration project, subpart A is the portion of this regulation that concerns us most. As long as you do not exceed the applicability (limitations) covered in subpart A, then subpart D does not apply to your near space exploration program.

1.1.1. Subpart A

Subpart A begins the regulation and is general in nature. It begins by stating the regulation's applicability, that is, what conditions it does and does not govern. Then FAR 101 states that these rules apply unless you get a wavier. It goes on to say that you cannot operate kites, balloons, or rockets in a restricted or prohibited area unless you get permission from the using or controlling agency. Finally, subpart A closes by saying that you cannot operate in a way that presents a hazard to others.

1.1.2. Subpart B

Subpart B covers moored balloons (balloons tied down to the ground) and kites. Therefore this subpart does not apply to us.

1.1.3. Subpart C

Subpart C applies to unmanned rockets, so it does not apply to us.

1.1.4. Subpart D

Subpart D ends the FAR by covering unmanned free balloons that exceed the limitations laid out in subpart A. In other words, it will not apply to your program if you keep the payload weight light. Subpart D begins by saying FAR 101 applies to unmanned free balloons. The second section lists limitations to the launching of unmanned free balloons. The third section of subpart D states the required equipment and markings on the balloon. Finally it finishes by stating the requirements for reporting balloon positions.

1.1.5. Meeting Subpart A

To meet this requirement your capsules must meet one of the following requirements when it comes to capsule weight.

a. The balloon payload cannot exceed more then four pounds in weight IF it has a surface density greater than three ounces per square inch. To calculate surface density, calculate the area of the smallest face of the module and divide by the capsule's weight.

b. If the surface density is less than 3 ounces per square inch AND the balloon payload consists of one package, then it cannot weigh more than six pounds.

c. If the balloon payload consists of more than one package, then the total weight of the packages cannot exceed 12 pounds AND the heaviest package cannot exceed six pounds in weight.

After meeting one of these weight requirements, your load line must allow the balloon to separate from its payload with an impact force of no more than 50 pounds.

As long as your near space stack meets one of the above weight requirements, and the balloon can separate from the rest of the stack with a less than 50 pounds of force, then you only need to meet requirements under 101. 3 (Waivers), 101.5 (Operations in Restricted Areas), and 101.7 (Hazardous Operations). Let us look at these three requirements in depth.

Section 101.3, says that if you want to carry more weight or use a stronger connection between payload and balloon, then you will need to get a wavier. Section 101.5 says you need permission to launch from restricted or prohibited areas (use an aeronautical chart). Finally section 101.7, says you cannot operate in such a way that the flight becomes a hazard for others.

So here's what the regulation requires, starting with the most restrictive requirement and going to the least restrictive requirement.

a. You cannot launch in such a way that it represents a hazard to people or property when they are not a part of the crew.

b. You cannot drop objects from a near space stack if they represent a hazard to uninvolved people or their property.

c. You cannot launch from restricted or prohibited areas without permission. I recommend staying away from airports, even though most are not located in restricted areas.

d. The load line and its attachment points cannot require more then fifty pounds of force to sever.

e. You cannot launch a near space capsule that has a surface density greater than three ounces per square inch unless the capsule weighs no more than four pounds.

f. If you launch a single near space capsule with a low surface density, then it cannot exceed six pounds in weight.

g. If you fly two or more modules in the stack, then their total weight cannot exceed twelve pounds. Also, no one module can exceed six pounds in weight.

The near space stack discussed in this book will meet these requirements by

a. Using a load line that breaks or separates from the balloon (or the balloon separates from itself) with a force of fifty pounds. Do not use rope or a wire.

b. The near space consists of two Styrofoam boxes. Their individual weights are no more than six pounds. This limits their total weight to twelve pounds. Each module has faces greater than 36 square inches (six inches on a side). This keeps module surface densities below three ounces per square inch when module weights are at the maximum six pounds of weight.

You do not need a wavier to launch with this design. In fact you do not need to file a NOTAM, but it is strongly encouraged. It is your responsibility not to launch from airports or other restricted or prohibited locations without permission. It is also your responsibility not to launch in a way or perform experiments that are a hazard to others.

What If You Exceed These Limitations?

DO NOT exceed the limitations as explained above for your first missions. Wait until you have a couple years of experience before expanding your program into this territory.

If you are operating a flight that exceeds the limitations explained above, then meet the following additional requirements.

First, you cannot launch in the following conditions

You cannot launch:
A. Within 2000 feet of the ground in Class B, C, D, or E airspace

B. When the clouds cover more than 50% of the sky
C. When horizontal visibilities are less than 5 miles
D. Where the first 1000 feet of the flight takes the nearcraft over towns and cities
E. Where the flight represents a hazard to nonparticipating people

Before you can launch the near space capsule, you must notify an ATC six to twenty-four hours before launch. Give ATC the following information

A. The balloon's identification
B. The time of balloon launch (be accurate to within 30 minutes)
C. The location of the launch site
D. The expected cruising altitude of the balloon[A]
E. The expected trajectory of the balloon to 60,000 feet, including the amount of time required reaching this altitude
F. The dimensions of the near space stack
G. The duration of the flight
H. The predicted landing site

- √ If you have to abort the launch, notify ATC immediately
- √ After the balloon is launched, notify ATC immediately

- √ Record the position of the balloon every two hours during the flight,
- √ Report these positions to the ATC if they ask for them

- √ One hour before you terminate the flight, you must notify an ATC of the following,

A. The location of the balloon (bearing and range to the nearest airport should work)
B. The altitude of the balloon
C. When the balloon is expected to drop below 60,000 feet
D. The expected descent path of the balloon
E. The expected time of landing
F. Call the ATC when the balloon has landed

Your stack must be equipped with the following devices

A. At least two cutdown devices that act independently of each other
B. At least two devices for terminating the balloon envelope (so that it doesn't get stuck up in air space)
C. The near space capsule must be equipped with a radar reflector

Note, there is no reason that A and B couldn't be the same devices. However, each device must be capable of bringing both the near space capsule and the balloon back down to the ground, without losing the location of either. When you use latex balloons you do not have to worry about devices for terminating the balloon envelope, since they will burst at altitude. This envelope termination rule applies to zero pressure balloons, which do not burst.

Now here are additional requirements that may, or may not, apply to your stack, depending on its design or time of flight.

A. If your near space capsule will be operated at night, then it must have strobes attached to it that are visible for at least 5 miles

B. If it has a long, trailing antenna greater then 50 feet long, then the antenna must be able to separate from the nearcraft with less than 50 pounds of force, or be marked with colored pendants that are visible for more then a mile. The pendants cannot be spaced more than 50 feet apart from each other
C. If the load line is more than 50 feet long, it must be marked with conspicuous pennants visible for at least a mile

Wrap Up

Let me state again, the rules outlined in the last section of this chapter do not apply if you fly near spacecraft as outlined in this book. Only when you launch heavy nearcraft, launch with ZPBs, or fly at night, do these last requirements apply.

2.0 2.0 The Current FAR 101

The Current FAR 101 is printed below. This document appears as shown on The Government Printing Office Access Website, at the URL given below:

http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?idno=14;c=ecfr;cc=ecfr;rgn=div5;view=text;node=14%3A2.0.1.3.15

Home Page > Executive Branch > Code of Federal Regulations > Electronic Code of Federal Regulations

2.1.1. Electronic Code of Federal Regulations (e-CFR)

BETA TEST SITE

e-CFR Data is current as of March 14, 2006

Title 14: Aeronautics and Space

Browse Previous | Browse Next

PART 101—MOORED BALLOONS, KITES, UNMANNED ROCKETS AND UNMANNED FREE BALLOONS

Section Contents

Subpart A—General

§ 101.1 Applicability.
§ 101.3 Waivers.
§ 101.5 Operations in prohibited or restricted areas.
§ 101.7 Hazardous operations.

Subpart B—Moored Balloons and Kites

§ 101.11 Applicability.
§ 101.13 Operating limitations.
§ 101.15 Notice requirements.
§ 101.17 Lighting and marking requirements.
§ 101.19 Rapid deflation device.

Subpart C—Unmanned Rockets

§ 101.21 Applicability.
§ 101.22 Special provisions for large model rockets.
§ 101.23 Operating limitations.
§ 101.25 Notice requirements.

Subpart D—Unmanned Free Balloons

§ 101.31 Applicability.
§ 101.33 Operating limitations.
§ 101.35 Equipment and marking requirements.

§ 101.37 Notice requirements.
§ 101.39 Balloon position reports.

Authority: 49 U.S.C. 106(g), 40103, 40113–40114, 45302, 44502, 44514, 44701–44702, 44721, 46308.

Subpart A—General

top

§ 101.1 Applicability.

top

(a) This part prescribes rules governing the operation in the United States, of the following:

(1) Except as provided for in §101.7, any balloon that is moored to the surface of the earth or an object thereon and that has a diameter of more than 6 feet or a gas capacity of more than 115 cubic feet.

(2) Except as provided for in §101.7, any kite that weighs more than 5 pounds and is intended to be flown at the end of a rope or cable.

(3) Any unmanned rocket except:

(i) Aerial firework displays; and,

(ii) Model rockets:

(*a*) Using not more than four ounces of propellant;

(*b*) Using a slow-burning propellant;

(*c*) Made of paper, wood, or breakable plastic, containing no substantial metal parts and weighing not more than 16 ounces, including the propellant; and

(*d*) Operated in a manner that does not create a hazard to persons, property, or other aircraft.

(4) Except as provided for in §101.7, any unmanned free balloon that—

(i) Carries a payload package that weighs more than four pounds and has a weight/size ratio of more than three ounces per square inch on any surface of the package, determined by dividing the total weight in ounces of the payload package by the area in square inches of its smallest surface;

(ii) Carries a payload package that weighs more than six pounds;

(iii) Carries a payload, of two or more packages, that weighs more than 12 pounds; or

(iv) Uses a rope or other device for suspension of the payload that requires an impact force of more than 50 pounds to separate the suspended payload from the balloon.

(b) For the purposes of this part, a *gyroglider* attached to a vehicle on the surface of the earth is considered to be a kite.

[Doc. No. 1580, 28 FR 6721, June 29, 1963, as amended by Amdt. 101–1, 29 FR 46, Jan. 3, 1964; Amdt. 101–3, 35 FR 8213, May 26, 1970]

§ 101.3 Waivers.

top

No person may conduct operations that require a deviation from this part except under a certificate of waiver issued by the Administrator.

[Doc. No. 1580, 28 FR 6721, June 29, 1963]

§ 101.5 Operations in prohibited or restricted areas.

top

No person may operate a moored balloon, kite, unmanned rocket, or unmanned free balloon in a prohibited or restricted area unless he has permission from the using or controlling agency, as appropriate.

[Doc. No. 1457, 29 FR 46, Jan. 3, 1964]

§ 101.7 Hazardous operations.

top

(a) No person may operate any moored balloon, kite, unmanned rocket, or unmanned free balloon in a manner that creates a hazard to other persons, or their property.

(b) No person operating any moored balloon, kite, unmanned rocket, or unmanned free balloon may allow an object to be dropped therefrom, if such action creates a hazard to other persons or their property.

(Sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)))

[Doc. No. 12800, 39 FR 22252, June 21, 1974]

Subpart B—Moored Balloons and Kites

top

Source: Docket No. 1580, 28 FR 6722, June 29, 1963, unless otherwise noted.

§ 101.11 Applicability.

top

This subpart applies to the operation of moored balloons and kites. However, a person operating a moored balloon or kite within a restricted area must comply only with §101.19 and with additional limitations imposed by the using or controlling agency, as appropriate.

§ 101.13 Operating limitations.

top

(a) Except as provided in paragraph (b) of this section, no person may operate a moored balloon or kite—

(1) Less than 500 feet from the base of any cloud;

(2) More than 500 feet above the surface of the earth;

(3) From an area where the ground visibility is less than three miles; or

(4) Within five miles of the boundary of any airport.

(b) Paragraph (a) of this section does not apply to the operation of a balloon or kite below the top of any structure and within 250 feet of it, if that shielded operation does not obscure any lighting on the structure.

§ 101.15 Notice requirements.

top

No person may operate an unshielded moored balloon or kite more than 150 feet above the surface of the earth unless, at least 24 hours before beginning the operation, he gives the following information to the FAA ATC facility that is nearest to the place of intended operation:

(a) The names and addresses of the owners and operators.

(b) The size of the balloon or the size and weight of the kite.

(c) The location of the operation.

(d) The height above the surface of the earth at which the balloon or kite is to be operated.

(e) The date, time, and duration of the operation.

§ 101.17 Lighting and marking requirements.

top

(a) No person may operate a moored balloon or kite, between sunset and sunrise unless the balloon or kite, and its mooring lines, are lighted so as to give a visual warning equal to that required for obstructions to air navigation in the FAA publication “Obstruction Marking and Lighting”.

(b) No person may operate a moored balloon or kite between sunrise and sunset unless its mooring lines have colored pennants or streamers attached at not more than 50 foot intervals beginning at 150 feet above the surface of the earth and visible for at least one mile.

(Sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)))

[Doc. No. 1580, 28 FR 6722, June 29, 1963, as amended by Amdt. 101–4, 39 FR 22252, June 21, 1974]

§ 101.19 Rapid deflation device.

top

No person may operate a moored balloon unless it has a device that will automatically and rapidly deflate the balloon if it escapes from its moorings. If the device does not function properly, the operator shall immediately notify the nearest ATC facility of the location and time of the escape and the estimated flight path of the balloon.

Subpart C—Unmanned Rockets

top

§ 101.21 Applicability.

top

This subpart applies to the operation of unmanned rockets. However, a person operating an unmanned rocket within a restricted area must comply only with §101.23(g) and with additional limitations imposed by the using or controlling agency, as appropriate.

[Doc. No. 1580, 28 FR 6722, June 29, 1963]

§ 101.22 Special provisions for large model rockets.

top

Persons operating model rockets that use not more than 125 grams of propellant; that are made of paper, wood, or breakable plastic; that contain no substantial metal parts, and that weigh not more than 1,500 grams, including the propellant, need not comply with §101.23 (b), (c), (g), and (h), provided:

(a) That person complies with all provisions of §101.25; and

(b) The operation is not conducted within 5 miles of an airport runway or other landing area unless the information required in §101.25 is also provided to the manager of that airport.

[Amdt. 101–6, 59 FR 50393, Oct. 3, 1994]

§ 101.23 Operating limitations.

top

No person may operate an unmanned rocket—

(a) In a manner that creates a collision hazard with other aircraft;

(b) In controlled airspace;

(c) Within five miles of the boundary of any airport;

(d) At any altitude where clouds or obscuring phenomena of more than five-tenths coverage prevails;

(e) At any altitude where the horizontal visibility is less than five miles;

(f) Into any cloud;

(g) Within 1,500 feet of any person or property that is not associated with the operations; or

(h) Between sunset and sunrise.

(Sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)))

[Doc. No. 1580, 28 FR 6722, June 29, 1963, as amended by Amdt. 101–4, 39 FR 22252, June 21, 1974]

§ 101.25 Notice requirements.

top

No person may operate an unmanned rocket unless that person gives the following information to the FAA ATC facility nearest to the place of intended operation no less than 24 hours prior to and no more than 48 hours prior to beginning the operation:

(a) The names and addresses of the operators; except when there are multiple participants at a single event, the name and address of the person so designated as the event launch coordinator, whose duties include coordination of the required launch data estimates and coordinating the launch event;

(b) The estimated number of rockets to be operated;

(c) The estimated size and the estimated weight of each rocket; and

(d) The estimated highest altitude or flight level to which each rocket will be operated.

(e) The location of the operation.

(f) The date, time, and duration of the operation.

(g) Any other pertinent information requested by the ATC facility.

[Doc. No. 1580, 28 FR 6722, June 29, 1963, as amended by Amdt. 101–6, 59 FR 50393, Oct. 3, 1994]

Subpart D—Unmanned Free Balloons

top

Source: Docket No. 1457, 29 FR 47, Jan. 3, 1964, unless otherwise noted.

§ 101.31 Applicability.

top

This subpart applies to the operation of unmanned free balloons. However, a person operating an unmanned free balloon within a restricted area must comply only with §101.33 (d) and (e) and with any additional limitations that are imposed by the using or controlling agency, as appropriate.

§ 101.33 Operating limitations.

top

No person may operate an unmanned free balloon—

(a) Unless otherwise authorized by ATC, below 2,000 feet above the surface within the lateral boundaries of the surface areas of Class B, Class C, Class D, or Class E airspace designated for an airport;

(b) At any altitude where there are clouds or obscuring phenomena of more than five-tenths coverage;

(c) At any altitude below 60,000 feet standard pressure altitude where the horizontal visibility is less than five miles;

(d) During the first 1,000 feet of ascent, over a congested area of a city, town, or settlement or an open-air assembly of persons not associated with the operation; or

(e) In such a manner that impact of the balloon, or part thereof including its payload, with the surface creates a hazard to persons or property not associated with the operation.

[Doc. No. 1457, 29 FR 47, Jan. 3, 1964, as amended by Amdt. 101–5, 56 FR 65662, Dec. 17, 1991]

§ 101.35 Equipment and marking requirements.

top

(a) No person may operate an unmanned free balloon unless—

(1) It is equipped with at least two payload cut-down systems or devices that operate independently of each other;

(2) At least two methods, systems, devices, or combinations thereof, that function independently of each other, are employed for terminating the flight of the balloon envelope; and

(3) The balloon envelope is equipped with a radar reflective device(s) or material that will present an echo to surface radar operating in the 200 MHz to 2700 MHz frequency range.

The operator shall activate the appropriate devices required by paragraphs (a) (1) and (2) of this section when weather conditions are less than those prescribed for operation under this subpart, or if a malfunction or any other reason makes the further operation hazardous to other air traffic or to persons and property on the surface.

(b) No person may operate an unmanned free balloon below 60,000 feet standard pressure altitude between sunset and sunrise (as corrected to the altitude of operation) unless the balloon and its attachments and payload, whether or not they become separated during the operation, are equipped with lights that are visible for at least 5 miles and have a flash frequency of at least 40, and not more than 100, cycles per minute.

(c) No person may operate an unmanned free balloon that is equipped with a trailing antenna that requires an impact force of more than 50 pounds to break it at any point, unless the antenna has colored pennants or streamers that are attached at not more than 50 foot intervals and that are visible for at least one mile.

(d) No person may operate between sunrise and sunset an unmanned free balloon that is equipped with a suspension device (other than a highly conspicuously colored open parachute) more than 50 feet along, unless the suspension device is colored in alternate bands of high conspicuity colors or has colored pennants or streamers attached which are visible for at least one mile.

(Sec. 6(c), Department of Transportation Act (49 U.S.C. 1655(c)))

[Doc. No. 1457, 29 FR 47, Jan. 3, 1964, as amended by Amdt. 101–2, 32 FR 5254, Mar. 29, 1967; Amdt. 101–4, 39 FR 22252, June 21, 1974]

§ 101.37 Notice requirements.

top

(a) *Prelaunch notice:* Except as provided in paragraph (b) of this section, no person may operate an unmanned free balloon unless, within 6 to 24 hours before beginning the operation, he gives the following information to the FAA ATC facility that is nearest to the place of intended operation:

(1) The balloon identification.

(2) The estimated date and time of launching, amended as necessary to remain within plus or minus 30 minutes.

(3) The location of the launching site.

(4) The cruising altitude.

(5) The forecast trajectory and estimated time to cruising altitude or 60,000 feet standard pressure altitude, whichever is lower.

(6) The length and diameter of the balloon, length of the suspension device, weight of the payload, and length of the trailing antenna.

(7) The duration of flight.

(8) The forecast time and location of impact with the surface of the earth.

(b) For solar or cosmic disturbance investigations involving a critical time element, the information in paragraph (a) of this section shall be given within 30 minutes to 24 hours before beginning the operation.

(c) *Cancellation notice:* If the operation is canceled, the person who intended to conduct the operation shall immediately notify the nearest FAA ATC facility.

(d) *Launch notice:* Each person operating an unmanned free balloon shall notify the nearest FAA or military ATC facility of the launch time immediately after the balloon is launched.

§ 101.39 Balloon position reports.

top

(a) Each person operating an unmanned free balloon shall:

(1) Unless ATC requires otherwise, monitor the course of the balloon and record its position at least every two hours; and

(2) Forward any balloon position reports requested by ATC.

(b) One hour before beginning descent, each person operating an unmanned free balloon shall forward to the nearest FAA ATC facility the following information regarding the balloon:

(1) The current geographical position.

(2) The altitude.

(3) The forecast time of penetration of 60,000 feet standard pressure altitude (if applicable).

(4) The forecast trajectory for the balance of the flight.

(5) The forecast time and location of impact with the surface of the earth.

(c) If a balloon position report is not recorded for any two-hour period of flight, the person operating an unmanned free balloon shall immediately notify the nearest FAA ATC facility. The notice shall include the last recorded position and any revision of the forecast trajectory. The nearest FAA ATC facility shall be notified immediately when tracking of the balloon is re-established.

(d) Each person operating an unmanned free balloon shall notify the nearest FAA ATC facility when the operation is ended.

Browse Previous | Browse Next

Good To Know - Sky Color

Everyone knows the sky is blue, but many people don't know why it’s blue. As you know, the visible spectrum, the colors of light emitted by the Sun, starts at violet at one end, goes to blue, green, yellow, orange, and finally ends at red on the other end. Each color of the spectrum consists of particles of light, or photons. Photons of light can also be thought of as waves, similar to the waves in water (except waves of light don’t require a medium to carry them like waves in water need water to carry them). Waves have many characteristics, one of them being their wavelength. Wavelength is a measure of the distance between similar portions of the wave, for instance, from one peak to the next peak. The difference between the colors in the spectrum is the wavelength of the photon carrying them. Blue light consists of photons with a wavelength smaller than the wavelength of red light photons. Photons that carry blue light have a wavelength of about 450 nanometers (billionths of a meter) whereas red light photons have a wavelength of about 700 nanometers (nm). How photons react with particles of matter depends partially on the size of the particles in relationship to the wavelength of the photons. For the most part, photons of light do not interact with particles that are smaller than their wavelength. As it happens, the molecules in our atmosphere (molecules from the air and the dust and droplets of water suspended in the air) have an average size close to the wavelength of a photon of blue light. Photons of red light, with wavelengths larger than the molecules in our atmosphere, do not interact as strongly with air molecules. Because of their smaller wavelengths, photons of blue light interact about five times more strongly with atmospheric molecules than do the photons of red light. Because air molecules more greatly effects visible light closer to the blue end of the spectrum than to the red end of the spectrum, most of the red and lesser amounts of orange and yellow light travel straight from the sun to our eye. Photons of blue light are randomly scattered out of this beam of red light and eventually reach our eyes from all directions, even from the direction of the ground. If there's enough air below your eyes, then the ground takes on a blue tint. This preferential scattering of light makes the sun more yellow in color and the sky blue. When looking away from the sun in the sky, you still see sunlight, but only its bluer wavelengths. As the sun approaches the horizon sunlight travels through more atmosphere. This extra atmosphere scatters more of the longer wavelengths out of the Sun’s light, eventually leaving only red light to reach our eyes, hence red sunsets. This scattering based on wavelength was first explained in 1871 by the physicist, Lord Rayleigh and is called Rayleigh Scattering.

An ascending near spacecraft experiences a reduction in the air pressure. Less air pressure means there are fewer air molecules to scatter the Sun’s light. As a result, the sky begins to take on a darker, purpler color (less blue mixed in with the black of space). Once in near space, the amount of air molecules in the sky is far too low to effectively scatter the blue photons emitted from the sun. This gives the sky an inky black appearance (remember that black is not a color but is really an absence of light). Instead of being scattered out of the Sun’s light, more blue light reaches us directly from the Sun. The sun appears whiter in color (white being a combination of all colors) than it does on the ground. Not only is the Sun whiter, it’s also brighter because there’s also less air to absorb sunlight. One consequence is that the sunlight in near space also contains more dangerous UV radiation. Once in near space, there is much more atmosphere below the near spacecraft than there is atmosphere above it. With greater amount of atmosphere below, there is more scattering of blue light below. This gives the ground a blue tint.

Photograph of Horizon in Near Space

The Ground Photographed from Near Space

Encyclopedia Of Physics, second edition, Rita G. Lerner and George L. Trigg

Blue Sky Demonstration

You may want to give this demonstration when giving near space presentations to groups. I first saw this demonstration presented at an astronomy conference in Kansas.

Materials

- An overhead projector
- A small aquarium[B]
- A large plastic stirring spoon
- A small measuring cup
- A bottle of pine oil cleaner

Preparation

√ Set up the projector where it can shine on a wall or screen that everyone can see
√ Fill the aquarium with plain water
√ Set the aquarium on the projector
√ Set aside a small amount of pine oil (do not add it to the aquarium water, yet) and the spoon

Explanation

Explain to your audience that light is made of particles and waves. But for this demonstration, the wave aspect of light is more important. One characteristic of all waves is the distance between their peaks. This characteristic is called wavelength.

√ This is basic science stuff but you may want to draw a diagram at this point.

The only difference between the waves making up blue light from say red light is the size of their wavelengths. Red light has a wavelength about twice as long as blue light. The wavelength of red light is about 700 nanometers and the wavelength of blue light is about 400 nanometers. A nanometer is one billionth of a meter, or one millionth of a millimeter. One millimeter compared to one kilometer (about 3000 feet) is the same ratio as one nanometer compared to one millimeter. It takes over 63,000 wavelengths of blue light to span one inch.

If the obstacle in the air is smaller than the wavelength of a photon of light, then the light beam does not notice it. The light continues in its original direction as if the obstacle was not there. Waves of light behave a little funny when they approach obstacles about the size of their wavelength. If an obstacle is about the same size as the wavelength of a photon of light, then the light crashes into the obstacle and bounce off in a random direction (assuming the light isn't absorbed first). It so turns out that air molecules have sizes in between the wavelengths of red and blue light. As a result, red light hardly notices molecules in the air while blue light cannot help but notice the same molecules in the air.

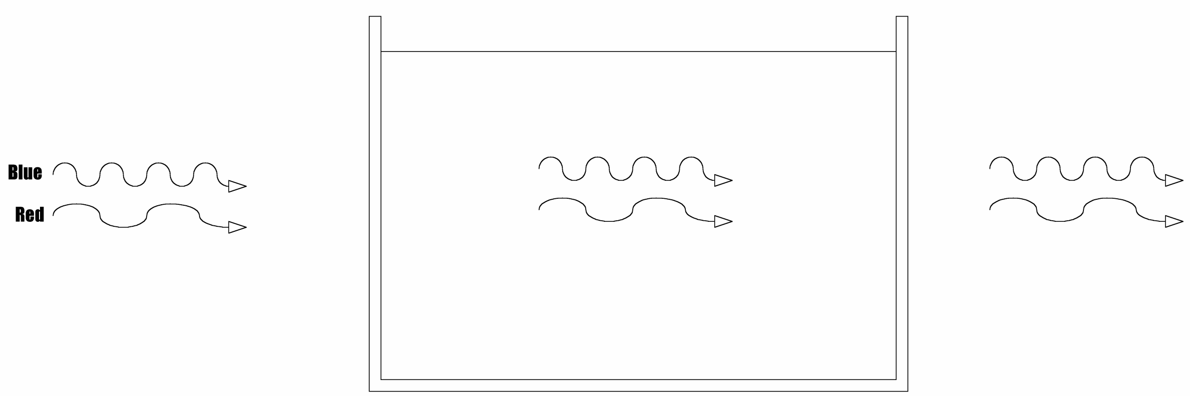
Imagine how an elephant would respond to a gnat in its way and how an elephant responds when another elephant is in its way.

Demonstration

√ Turn on the projector

Explain that the aquarium of water represents the atmosphere and the projector represents light from the Sun.

Currently this is an atmosphere with no particles of dust, droplets of water, or tiny variations in density. At this time, with nothing to scatter light in the atmosphere, no sunlight is being scattered in the water to give it any color and the Sun is white

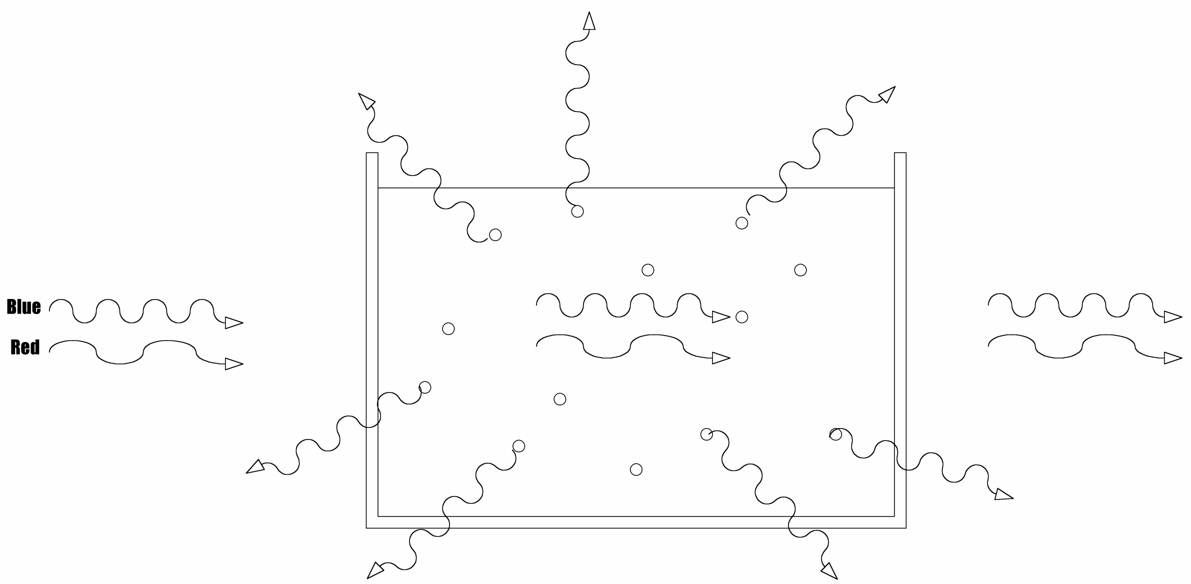


***Clear Water** – Both blue and red wavelength pass through*

When dissolved in water, pine oil forms tiny little droplets. The droplets are the proper size to strongly effect blue light, but not red light. The droplets of pine oil you are about to add represent molecules in the atmosphere.

√ Pour a capful of pine oil into the water and stir
√ Note: It doesn't take very much pine oil, so add too little to begin with and add more if necessary.

(The water in the aquarium takes on a blue tint while the projected light on the wall becomes reddish). 1



***Water with Particles** – The blue wavelengths collide with the particles and are scattered*

√ Point out that now with scattering molecules in the air, the Sun has taken on a redder appearance and the sky a bluer appearance.

As the Sun sets, its light passes through more molecules in the atmosphere. In doing so, the red light begins to be affected, and starts scattering out of the beam of sunlight.

√ Add more pine oil and stir
√ Note: The more pine oil added, the redder and dimmer the projected light on the wall.

Near Space Humor – Comix

Job Hazards – *Recovery crewmember given ample motivation to hustle; neglects site documentation in favor of saving his own skin.*

[A] This requirement indicates the FAA expects you are flying zero pressure balloons. This requirement doesn't make sense for latex balloons, and therefore may not be applicable.

[B] Get an aquarium that fits on an overhead projector. It is not important if it is a snug fit, only that you can fit the aquarium on the overhead.