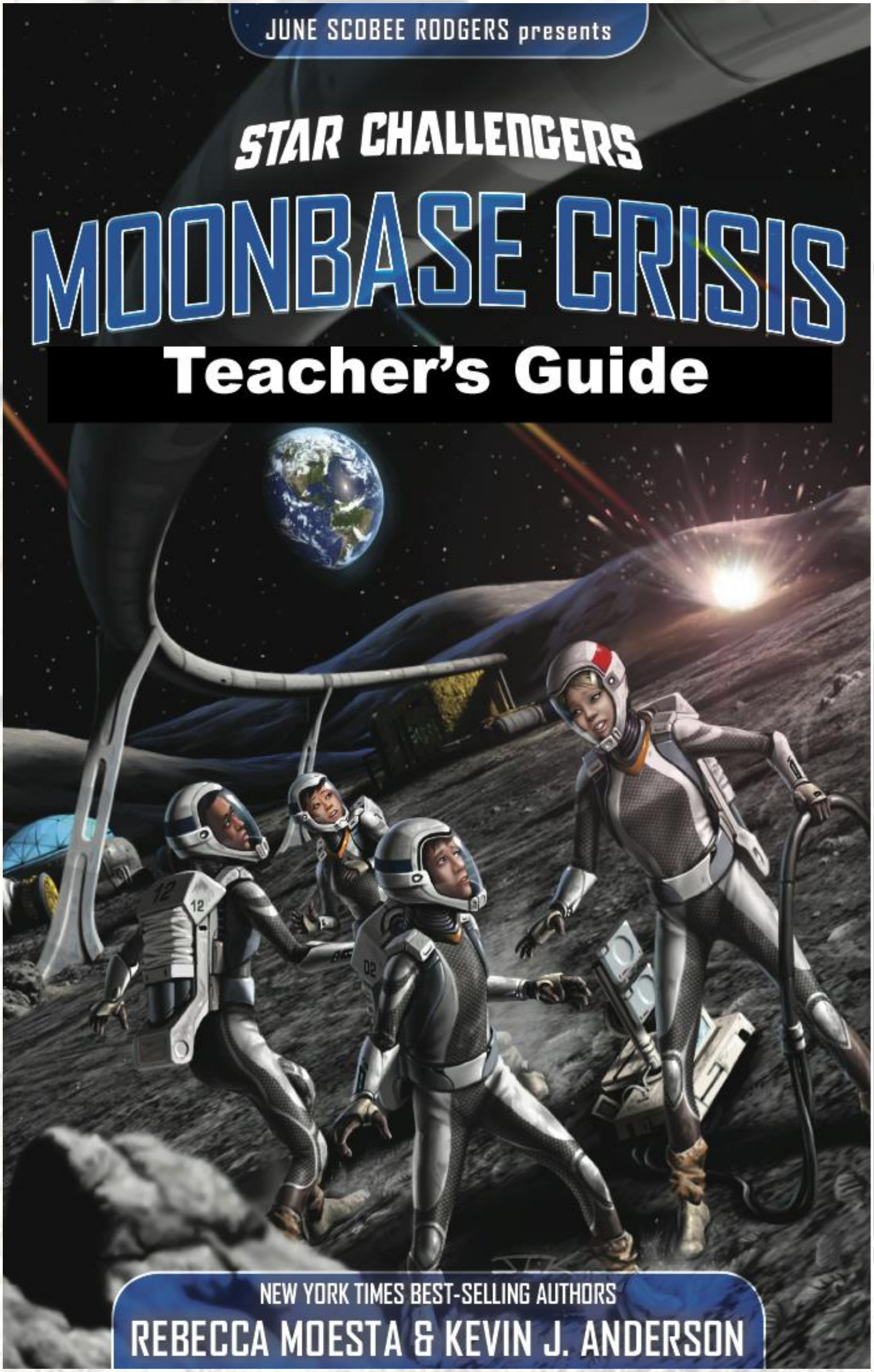


JUNE SCOBEE RODGERS presents
STAR CHALLENGERS
MOONBASE CRISIS
Teacher's Guide
NEW YORK TIMES BEST-SELLING AUTHORS
REBECCA MOESTA & KEVIN J. ANDERSON

Dear Educators,

Welcome to the first book in an exciting new series by the esteemed authors Dr. June Scobee Rodgers, Kevin J. Anderson and Rebecca Moesta. June is the Founding Chairman of Challenger Center for Space Science Education, a non-profit education organization that was established to continue the mission of *Space Shuttle 51-L, Challenger* that was tragically lost in January of 1986. This flight was known as the "Education Mission" as Christa McAuliffe, the teacher chosen to fly aboard the orbiter, was to deliver educational activities to all of the school children in America. June Scobee, whose late husband Dick Scobee was the commander of the shuttle mission, joined the other family members of the Challenger crew to create a one-of-a-kind center that houses a simulated mission control and a simulated spacecraft for students to fly aboard and investigate scientific, mathematical and technical problems. The students work together as a team to solve these engineering tasks and make their mission to a comet, on the moon, on Mars or on Earth become successful solutions to threatening problems.

The *Star Challengers* series of books www.StarChallengers.com are based on student involvement with a Challenger Learning Center mission. The first book *Moonbase Crisis* was written to encourage students to learn the importance of science and math and communication skills in solving real-life problems that they will encounter throughout life. You may find more information regarding Challenger Learning Centers and how to attend or how to establish one in your area at our website: www.challenger.org

Kevin J. Anderson and Rebecca Moesta are award-winning authors of such books as *Star Wars Young Jedi Knights* and *Crystal Doors.* You can find a listing of all of the books they have written on their website: www.wordfire.com

This Teacher's Guide was written by one of our network partners, Susan Morrison of the Challenger Learning Center of the San Joaquin Valley. It is intended to give you a multidisciplinary tool to incorporate a variety of learning strategies into an exciting literary jewel designed to excite and motivate kids. Enjoy!

TABLE OF CONTENTS

Star Challengers: Moonbase Crisis
Teacher's Guide

Star Challengers: Moonbase Crisis is co-authored by Dr. June Scobee Rodgers, whose husband Dick Scobee was the commander of the *Challenger 51-L* space shuttle; as well as Kevin Anderson and Rebecca Moesta who are award-winning science fiction authors of such books as *Star Wars* and *Crystal Doors.* This is the first in a series of three *Star Challengers* books that will excite and engage children in grades 4 – 8.

This Teacher's Guide was developed to extend learning and enhance reading while creating an action-packed tool that will motivate and spark the excitement of science, math and technology as the students see the young characters become engaged in saving the planet.

Star Challengers: Moonbase Crisis is written at a 5th grade instructional level. Students at least halfway through 6th grade or in grades 7 and 8 who are reading at or above grade level can read and enjoy *Star Challengers* independently with or without associated lessons from this guide. Children reading below grade level and all students in grades 4 – 5 will need vocabulary and guided reading support to successfully augment comprehension of this book. Therefore, it becomes a wonderful vehicle for teachers to use to enhance language arts, science, math and technology as it incorporates the national and state standards for those areas.

This teacher's guide has 8 Language Arts and 8 Math/Science lessons closely tied to material in *Star Challengers* that individual teachers may adapt to their own situations. The lessons encourage teamwork – a critically important job skill that is emphasized at the Challenger Learning Centers.

The lessons correlate with the following national standards:

K–12 College and Career Readiness Anchor Standards for Reading: Standards 1–5

K–12 College and Career Readiness Anchor Standards for Writing: Standards 1–2 and 7–10

K–12 College and Career Readiness Anchor Standards for Language: Standards 4–6

Vocabulary Study Ideas

Select words that your students need to know to better understand the story. Assign each student a group of 10 – 25 alphabetically adjacent words to look up in a dictionary and write out their definitions. (Or students may research the words online.) Assemble the words in a class glossary to use while reading *Star Challengers.*

A note about ELD/ESL students: Phonetically simple words that are not common will not be in their oral vocabularies, for example *clog, daze,* and *fend*.

Dictionary Sleuth: Divide the class into two teams, e.g. the CIA and the FBI. Number the students in each team. Give the class a word to look up in their dictionaries. Wait until most of the students have found the word. Call a number. The two students with that number go to the board and write the definition. The first student to finish the definition wins a point for their team.

Students, singly or in teams, make crossword puzzles of selected words, which may be photocopied and used by other students during those "I don't have anything to do, teacher" times.

Develop lessons on how selected words' meanings change with the addition of prefixes and suffixes. Students can be assigned to find variants in the dictionary. They could do an internet search of prefixes and suffixes and experiment with adding them to select words and using the resulting words in sentences.

Have students write science fiction themed stories using a selection of words from this and/or the technical science vocabulary list.

Develop spelling lessons using words that demonstrate a particular phonetic or morphological principle.

<u>Words to Know</u>

A
absolute
absorb
absorbent
absurd
access
accommodate
accomplish
accurate
acquiescence
adept
adjust
agency
agility
adjacent
admonish
affect
afoot
aggressive
aggression
alas
allocate
allot
alter
alternate
alternative
amateur
ambitious
ancient
anomalous
anxious
appall
appendage
appropriate
aquarium
arc (v)
array
arrogance
ascertain
assemble
access
assume
attempt
eminent
authentic
avalanche
avoid
awkward

B
backlog
backstage
baffle
bare
barely
barricade
batch
behoove
beseech
biannual
bleak
blush
boggle
bolt (v)
bombard
boulder
bounded
boxseat
breach
bristle (adj)
bulky
bustling

C
camouflage
canister
canted
carom
cascade
category
chamber
charismatic
charlatan
chart (n)
chastise
chauffeur
chuckle
classified
claustrophobic
flinch
clog (v)
clumsy
c'mon
cocky
communicate
compile
complacent
complement (n)
complex (n)
compliment
component
compromised
concept
concern
concur
condescending
configuration
confirm
consequence
consult
contact
contingency
conveyor
cope
counterpart
covert
crackpot
cramped
cranky
create
credulity
crest
crestfallen
crew
crisis
crop (n)
crucial
crud
cryptic

D
dangle
data
daze
debris
hamster
decade
deceptive
deck
decrease
dedicated
definitely
delight
depart
deployment
descent
desolate
despite
detach
detect
determine
diagnostic
diffuse
diplomat
disassemble
discouraged
discretion
disembodied
disheveled
dismay
disorienting
display (n)
distinct
distort
distract
divot
don (v)
downright
drastic
drudgery
dusky
dwindle

E
effect (v)
efficient
egress
elaborate
elite
elude
emerge
inexorable

encounter	flurry	hands-on	inflict
engross	flustered	harried (adj)	influence
enhance	flux	harsh	ingenuity
enlarge	foothold	haul	inhabitant
enormous	formality	havoc	inhospitable
en route	fragile	hazard	initiate
ensure	frantic	herd (v)	initiative
enthusiasm	freakish	hinder	injure
environment	freckled	hitherto	innovate
eon	frenzy	hoax	innovative
epoxy	fringe	hobby	innumerable
erect (v)	frustrated	homeschool	inspect
erratic	fuel	homesick	inspire
establish	fugitive	horizon	install
etch	funding (n)	hostile	installation
evacuate	furry	huddle	instantaneous
eventual	fuse (v)	huff	instruct
exasperation		huge	insurmountable
excavation	**G**	humanity	intact
excursion	garment	hurtle	integrity
exertion	gawky	hyphenated	intention
exhaustion	gaze	hypnosis	intentional
exhilarated	genuine		intently
exhilaration	gesture	**I**	interactive
exotic	gigantic	ID	interminable
expand	giggle	image	intriguing
expansion	glide	immense	introverted
expedition	glimpse	immersion	inventory
experience	glimmer	immobilize	investment
exploit (v)	glint	impact	ironic
extent	glossy	impatient	irony
exterior	grapple	imperative	irreparable
external	grasp (v)	implication	irresponsible
extract	grimace	imply	irritation
extraction	groan	implication	Irish Setter
extraordinary	groggy	impress	
	grueling	incident	**J**
F	gruff	incline	jagged
facility	gullibility	inconceivable	jaunt
falter	gurney	incomplete	jog
fascinating		incorporate	jostle
fend	**H**	incredible	justify
flick	habitable	industrial	jut
flicker	halt	inescapable	
K	motive	pock-marked	resort
kinda	multi-tiered	precarious	resource

L
lack
lag
landscape
latticework
Latin
layout
leap
ledge
lobby (n)
locker
logo
long underwear
lump
lunatic
lurch
lush
luxury

M
maintain
major
makeshift
manifest
manipulation
manual
maneuver (v)
maneuverable
massive
melodrama
merit
methodical
microphone
mimic
miniature
minimize
mirth
mischief
mistrust
misunderstanding
mock
monitor
snicker
snooty
solemn
muse (v)

N
navigate
negotiate
novice
nutrient
nuzzle

O
oblong
obscured (v)
observation
obstacle
obstruction
offload
ominous
optimism
optimize
option
optional
outcrop
outright
overkill

P
pale
pamper
pantry
partition
peak
perch (v)
perform
permit
perplexed
personnel
peter out
pewter
phase
pique
plume
plunge
pocked
tend
tension
tentative
precaution
precisely
preclude
precursor
preoccupied
prepare
presence
previous
principle
priority
pristine
proceed
process (v)
proficient
project
proper
proximity
puncture
purse (n)
purse (v)
pursue

Q
quaint
qualified
queasy
quite

R
reconnaissance
recuperation
reduce
redundant
reflective
regain
relief
reluctant
remiss
repercussion
replica
requirement
research
reserve (n)
vital
voice-activated
void
response
retrieve
reveal
reverse
rhetorical
ricochet
rig
rim
risk
rockface
round-trip
routine
rummage

S
sapphire
sarcasm
sarcastic
scamper
scan
scenario
scoff
scribbling
scritch
scurry
seam
secure (v)
self-sufficient
serpentine (adj)
shan’t
sheepish
shelter
shrink
shudder
significant
significance
similar
simultaneous
situation
skeptical
skim
slapdash
slender

soy
specific
speculate
sprawling
sprout
squat (adj)
squawk
squirm
stable
staff
stare
staring
steep
stern (adj)
stock
stockpile
stow
straightforward
streak (v)
strew
stroke (v)
stud (v)
stuff
stuffy
stun
sturdy
summon
supplemental
supply
suppress
surplus
surrender
surveillance
survey
swarm
swath
symphony

T
task
tedious
telescope (v)
tenure
terminology
terrace
terrain
tether
tinted
tiny
trace (n)
transit
transition
transport
treacherous
tread
twinge
twinkle
twirl
twitch

U
ulterior
unbiased
underestimate
undertake
update
uproar
urgency

V
vacant
vague
vantage
vapor
vast
vehicle
velocity
vent (v)
verify
vessel
vibration
vicinity
vigilance
visionary
volunteer

W
wane
whisk
winch
withering (adj)
witness
wits
wry

Z
zigzag

Science and Technical Vocabulary

Suggestion: Assign each student a few adjacent words to research using dictionaries, science books, encyclopedias, and the internet. Photocopy their work, and assemble a class glossary for each student to refer to while reading the book.

A
activate
airborne
airlock
airtight
Aldrin, Buzz
android
Ansari
antigravity
Armstrong, Neil
array
asteroid
astronomer
astronomical
astronomy
atmosphere
ATV (All Terrain Vehicle)

B
biosciences
blip
briefing
briefing room
buddy system
bulkhead
bunker

C
cadet
checklist
chemist
CMC (Collaborative Mission Control)
cockpit
comm.
compressed gas
console
constellation
conversion (Chem.)
Copernicus
cosmonaut
cosmos
countdown
course correction
Crab Nebula
crater
Cygnus (constellation)

D
database
debrief
decelerate
decompression
depressurize

E
ecosystem
EEH (EMU Electrical Harness)
ejecta
electrolysis
electromagnetic spectrum
engineering
ESM (equipment storage module)
extraterrestrial

F
faceplate
fiber optics
fissure
flight suit
frequencies

G
generator
geological
geologist
geology
globular cluster

H
habitat
Halley
handheld scanner
hatch
headset
helium
"Help me Obi-Wan Kenobi" (*Star Wars*)
Hercules (constellation)
hexagonal
high res (high resolution)
high tech
hull
HUT (Hard Upper Torso)
hydroponics
hypothesis

I
ICSA (International Collaborative Space Agency)
imager
installation
intuitive (computer)
ISSC (International Space Station Complex)

J
Joint Chiefs of Staff
jumpsuit

K
kilometer
Kobayashi Maru (*Star Trek*)

L
lander
laser
lava
LCVG (Liquid Cooling Ventilation Garment)
liftoff
line of sight
lunar

M
MAG (Maximum Absorbent Garment)
major (military)
MAR (Multi-Axis Rover)
MCC (Main Control Center)
meter
mic
microleak
microphone pickup
Milky Way
mockup
module
modular
momentum

N
NASA
Newton
nominal

O
operations
orbit
Orion (constellation)
Orion Nebula

P
photosynthesis
physics
pioneer
planetoid
porthole
prefabricated
pressurize
programming (n)
protocol(s)

R
readout
reflex
regolith
resource
rover

S
satellite
science fiction
self-contained
sensor
simulator
solar panels
solar array
solar power array
solar radiation
South Korea
Soviet
specimen
spectrograph
spectrum
Spock (*Star Trek*)
starfield
Star Trek
static
strut
suit up (v)
supernova

T
technician
technology
telescope
terrain
test pilot
thruster
time paradox
toggle
topography
trajectory
transmit
transmission
transporter
trapezoidal
tuning

U
umbilical
United Kingdom
universe
Ursa Major (constellation)

V
viewscreen
virtual (computer)
visor

Z
zero-g

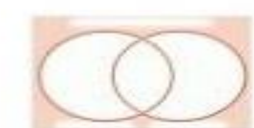
Character Development

Just as in real life, the longer we know people, the more we tend to know about them. We also notice how they change through time. Some ideas for bringing this out to students include:

- Have students do quickwrites about the four major characters after Chapter 4 and again after finishing the book. Compare how the characters have or have not changed. Younger students will need more guidance than older ones.

- After every four chapters, have your students (as individuals, partners, teams, or whole class) discuss and record what has been revealed about each major character and if and how that character has changed.

Minor characters often are less well developed in a story. Have students analyze what they know and don't know (especially background and motives) about Madison, Tony, Mrs. Koslowski, Commander Buchheim, Mrs. Wren, Commander Zota, Noor Ansari, Major Fox, Dr. Wu, Dr. Romero, Captain Bronsky,
Dr. Cushing, and the Kylarn.



A Venn diagram may be useful.
Students might also try to group characters according to how much is known about them.

The character of Song-Ye especially changes over the course of the story. Have students analyze how her personality and attitude develop, noting the background reasons for her initial characteristics as well as turning points in the story that cause her to rethink her initial point of view.

Have students write a biographical (or fictionally autobiographical) sketch of a major or minor character. They can be inventive with minor characters to "fill in the blanks." (This has been a rich mine for authors of *Star Wars* books.)

Have students write a letter to Commander Zota applying for a job as a Star Challenger –- either as themselves or as one of the main characters.

Family members very much affect who we are. Have students describe how Mr. and Mrs. Wren have affected their children, how Dyl and JJ have affected Mrs. Wren, or how Song-Ye's parents have affected her.

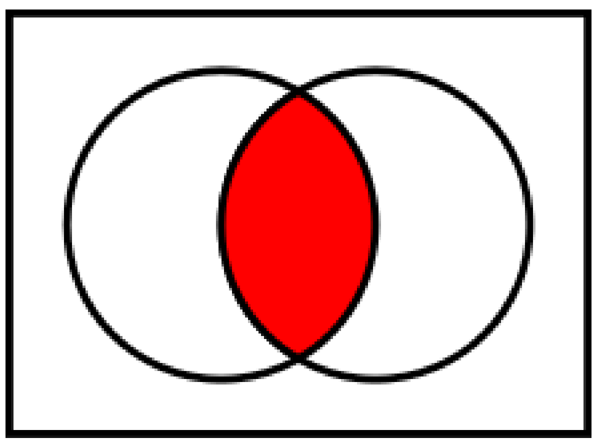
Comparing Characters

These lessons may be configured as individual assignments, pair/shares, team efforts, and/or whole class — and as discussions, quickwrites, and/or formal essays.

Compare the main characters with each other:

Dyl with JJ
Dyl with King
Dyl with Song-Ye
JJ with King
JJ with Song-Ye
King with Song-Ye

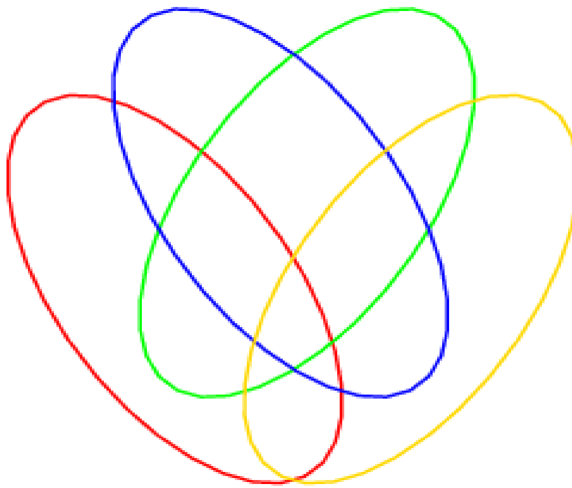
Venn Diagrams are useful for such comparisons:



For Further Consideration:

Which traits do three of the characters share?
What traits do they all share?
What traits do none of them have?

Older students may want to compare all four characters together:



Additional Activities:

- Before reading Chapter 5, have students predict what kind of job each of the four main characters might do as an adult, justifying their conclusions with clues they've learned about the characters' personalities and interests.

- Name a trait and have students suggest which character(s) it describes.

- Have volunteers act out a character, and others guess whom that character might be.

Researching Real People:

Have students research the authors of *Star Challengers* (June Scobee Rodgers, Rebecca Moesta, and Kevin J. Anderson), the crew of the final Challenger Mission – STS 51L (Dick Scobee, Michael J. Smith, Ronald McNair, Ellison Onizuka, Christa McAuliffe, Gregory Jarvis, and Judith Resnik), crews of the Apollo Missions, and/or crews of other Space Shuttle missions.

Have students pay special attention to the personal characteristics of these people – traits that drove them to succeed. With this information, students may:

- write trait lists for the selected persons and post the lists for all the class to see. Then have the class compare similarities and differences in the lists.
- write biographies of the selected persons
- dress up and act as the selected persons, who tell the class about themselves.

<u>Figurative and Idiomatic Language</u>

English is rich with figurative phrases and idiomatic slang. New idioms appear every year. While some eventually fade in popularity, others have a long history. For example, “taking a Sunday drive,” was a popular entertainment in the days before television. “Looking a gift horse in the mouth” has an even longer history, dating back centuries to when all land travel was by horse or on foot.

Activity ideas include:

- discussing the words before reading each chapter.

- writing one of the phrases at the top of a sheet of paper and its definition as used in *Star Challengers* at the bottom, while in the middle drawing a picture of the word’s more common meaning — for example, a picture of picture of JJ pushing buttons on Dyl’s chest for “She knew she shouldn’t push her brother’s buttons.”

- inventing puns using the multiple meanings of the phrases in a silly way

- playing the “Sleuth” game as described in “Vocabulary Study Ideas,” but with students writing the idiomatic phrases when the teacher gives the definition of the phrase as used in *Star Challengers*.

- playing Word Bingo. Students write 25 of the phrases the teacher has selected on their bingo cards. The teacher calls meanings of the phrases as used in *Star Challengers.*

It is not advisable to have students research the phrases. They often don’t appear in dictionaries. Internet searches are prudent only if the computers students are using have really ferocious firewalls. Or the teacher could carefully research websites on figurative, idiomatic, and slang language and bookmark safe ones for student use.

Chapter 1
... it’s <u>not rocket science</u>.
“The Challenger Center uses state-of-the-art technology and simulators ...”
... as her mom drove at <u>breakneck speed</u> to the emergency room.
“... he was <u>quick on the uptake</u>.”
... JJ, who had been a <u>daredevil</u> since she learned to walk ...
She knew she shouldn’t <u>push her brother’s buttons</u>.
The scenario held JJ’s attention better than learning from a book, and she was completely <u>swept up in</u> it.
“<u>Got it covered</u>,” JJ said.

Chapter 2
Though a little put off by the girl, JJ decided to cut her some slack.
... a few of us are total space cadets," ...
... shooting the Korean girl a mischievous look.
... JJ threw a last glance ...
Who wouldn't jump at a chance like this?"
Zota cocked an eyebrow at her.
"Cool," Dyl whispered.
JJ caught her breath ...
... the room's windows were completely blacked out ...
... nice set-up you've got here ...
But music is what my family is really all about.
Sometimes my parents get a gig for a few nights at a jazz club, ...
[My family and I,] we do all right.

Chapter 3
The flight director didn't take offense.
[Commander Zota announced,] "Today you will go to the moon." JJ said, "I'm in."
Bear in mind that you four have a comfortable life ...
... the Korean girl's stick-in-the-mud attitude ...
"Why did you bother coming here if you're going to be such a wet blanket?"

Chapter 4
"Let's all buy into the simulation," King said.
He stood almost a foot taller than Song-Ye, who topped out at five feet.

Chapter 5
I think I'm getting the hang of this spacesuit thing.
Dyl gave King a spacesuited high five.
"But why all the bells and whistles for this simulation?"
"How the blazes did you four get up here?"
We've been pretty short-handed up here since we cut back to only four crew members ...
"Just one straight answer. That's all we're looking for!"

Chapter 6
"If you have any ideas, I'm all ears."

Chapter 7
"I shan't look a gift horse in the mouth."
"You don't have to twist my arm to do a moonwalk," King said.
... important secondary projects have been put on hold.
"I shall expect each of you to pull your own weight."
It still hadn't entirely sunk in that they were actually on the Moon ...
She's a space nut and can tell you about every mission ...
King said, "Getting in and out is kind of a pain."

Chapter 8
“ ... how could we just turn our backs on it?” JJ exclaimed.

Chapter 10
“We don’t simply go on a Sunday drive.”
“Perhaps this one is a lone wolf.” Major Fox sounded unconcerned ...

Chapter 11
Romero seemed to think it was Eden on the Moon.

Chapter 12
They spent hours a day playing online games and hanging out on social websites.
Bleary eyed, looking alarmed, Chief Ansari hurried into the MCC.

Chapter 14
Maybe the Korean girl had a soft spot after all.
“I can take Newton off your hands now.”

Chapter 15
“Maybe we can find some good science for me to do, where I won’t be stepping on your toes.”
“A long time ago on Earth, astronomers had to be night owls.”

Chapter 16
“We’re as much in the dark about that as you are.”
“Cushing is making calculations now, but we’re going to have to do this by the seat of our pants.”
The students had faced a simulated crisis, then followed the ... cool headed instructions of the flight director.

Chapter 18
... the ICSA staff looked like a skeleton crew.
“We don’t want a news reporter to blow it all out of proportion.”

Chapter 19
The three travelers were anxious to ... put the mystery to rest.
“... it should be no problem — a piece of cake.”
Dyl used humor to keep their spirits up.

Chapter 20
King clipped his tether to the major’s suit, then paid it out as he climbed to the next ledge.
Its legs were damaged, and it walked with a drunken gait.
“They’d think their brains out until they came up with a brilliant solution ...

Multiple Meanings

Students need to be aware that the same word may have quite different meanings. This is especially true for students with a weak oral English background.

Activity ideas include:

- discussing the words before reading each chapter

- having individual students or teams look up some of the words in their dictionaries, writing the various meanings, and circling the meaning that applies to the phrase used in *Star Challengers*.

- writing one of the phrases at the top of a sheet of paper and its definition as used in *Star Challengers* at the bottom, while in the middle drawing a picture of the word's more common meaning. For example, a picture of eyebrows with hands holding pencils could represent "Her eyebrows drew together."

- inventing puns using the multiple meanings of a word in a silly way

- playing the "Sleuth" game as described in "Vocabulary Study Ideas," but with students writing the multiple meaning word when the teacher gives the definition of the word as used in *Star Challengers*.

- playing Word Bingo. Students write 25 of the words the teacher has selected on their bingo cards. The teacher calls meanings of the words as used in *Star Challengers.*

Chapter 1
Her brows drew together.
"Meteor shower!" Tony's voice broke from behind them at the sensor station.
"Right, meteor shower!"
Her interest was already piqued since she had long been a space buff.
It was disorienting to board the school buses ...
Sure beats going to math class ...
... his lips gave a mock quiver ...
... fishing her car keys out of her purse ...
"You can drop us off on your way to work."

Chapter 2
... his light brown skin beaded with sweat.
Consulting a printed sheet he held, Zota said ...
"Actually, sir, I haven't made Eagle yet. I'm still working on my project."
JJ had a pretty good memory ...

Chapter 3
Zota pressed his hands palm to palm ...
... the static resolved into crystal clear sound.
... her patch sported a logo that was not NASA.
... our crew is responsible for raising enough private funds.

Chapter 4
... if your suit integrity is compromised or you run low on oxygen.
“Remember when ... we got to watch Dad put on all his gear before going out to fight fires?”

Chapter 6
“This isn’t exactly luck,” Major Fox said in his dry British accent.

Chapter 7
“She’s a space nut and can tell you about every mission from the 1950’s through the Space Shuttle program.”
“We must of course seal the inner door before we can open the outer one.”

Chapter 8
The Halley is about to depart from the ISSC on its biannual run.
They probably would just recall all personnel and abandon it ...

Chapter 9
Ansari bent over, intent and all business.

Chapter 10
Before the first Moon landing, scientists expressed concern that the lunar surface might be *all* loose powder ...

Chapter 11
She beamed at the doctor. “I’ve never met a space hamster before.”

Chapter 12
In most cases an entire shift will go by without anything happening.
The responsibility felt heavy ...
I hope that many more from your generation will follow your example.
It’s hard for me to grasp why humanity became complacent.

Chapter 13
The doctor pulled on a recessed handle in the deck plates ...
... King and JJ settled back and made a game of counting the impacts they spotted.

Chapter 15
“Even though this telescope can see to the farthest fringes of the universe, it can’t pay for itself.”

Chapter 16
... the supply transport would simply coast along in orbit ...
... two of the base staff ... would be rotated back to Earth ...
... his voice sounding more and more tense ...

Chapter 17
The MAR is best suited for the job ...
Once the three cycled through the airlock, ...
Each leg has a separate suspension and rugged wheels ...
King pointed to a chain of pitted scorch marks on the hull.
Right now, there's still too much air inside compared with the vacuum on the outside.
... most of the air should jet out of the *Halley's* cabin in only a few minutes.

Chapter 18
"No, I can't believe any government has the funds to undertake a project of this scope."
... the Korean girl flushed as she remembered that they were far in the future, and no one knew her father any more.
"We will have to mount an expedition to see this base ourselves."
"Head out as soon as possible."

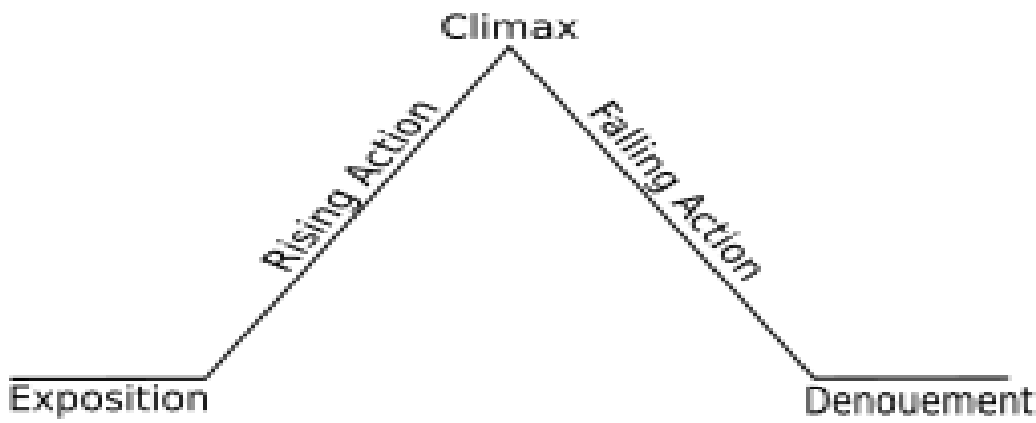
Chapter 19
Deep holes had been dug straight down ... like mine shafts.

Chapter 20
Fox tethered all of their suits together for safety in case one ... of them should slip and fall, but he left enough play to give them freedom of movement in the descent.
They began to climb, working their way past a sheer rockface.
King clipped his tether to the major's suit ...
Steeling his thoughts, King climbed to a higher terrace ...
The rock seemed sturdy enough, anchored into the crater wall.
His mind reeled with exhaustion.
"Keep still; I'm getting you to the rover."

Chapter 21
The occupants of that base are bound to come over here.
They'd think ... until they came up with a brilliant solution.

Chapter 22
Major Fox remained grave.
"We could draw straws," Fox said quietly.

Narrative Development



Elements of narrative development are variously described:

Exposition, Introduction, or **Preconditions**
Rising Action or **Buildup**
Climax or **Main Event**
Falling Action and Denouement or **Wind Down**

Generally the Rising Action comprises the bulk of the story, so the pyramid should be lopsided with a long, gradually rising left slope and a short, steep right slope.

Some lesson ideas:

Have older students briefly summarize each chapter and note where that chapter belongs in the narrative structure.

Younger students will need more guidance. Scramble these story elements, and after explaining narrative development, have students decide where to put the elements on the story pyramid. This may be done as a whole class, in teams, in pairs, or individually:

- JJ and Dyl do a Moon Mission at a Challenger Learning Center with their class.
- JJ, Dyl, King, and Song-Ye attend an “advanced simulation” with Commander Zota.
- The cadets arrive at Moonbase Magellan.
- The cadets become familiar with the moonbase.
- Meteor shower!
- The supply ship spots an alien base and is fired upon.

- The supply ship crashes.
- The supply ship crew is rescued.
- The Moonbase Magellan crew try to convince ICSA on Earth that there is a very serious problem.
- JJ, King, and Major Fox spy on the alien base while the others repair the supply ship.
- Moonbase Magellan is attacked and destroyed by aliens.
- The cadets return to their own time.
- Zota and the cadets discuss what must be done to avoid a future conquest of Earth by the aliens.

The following activities may be done whole class, by students in teams or as partners or individually.

Foreshadowing:
From Chapters 1 to 7, there are lots of hints and clues that something quite out of the ordinary is about to happen, followed by the cadets' dawning realization that they really are on the Moon.

- Have students hunt for the foreshadowing hints and clues.
- Have students summarize the discussion and debate among the cadets as they form and then discard hypotheses to explain their experiences before they finally conclude that they are truly on the Moon.

Author's Purpose: Have students surmise the author's reason for writing this book, supporting their ideas with selections from the text.

Theme: The theme is the main idea or message of a story. Have students decide on the major theme(s) and message(s) of this book, supporting their conclusions with selections from the text.

Predictions: This is the first book in a series. Have students predict what will happen in Book 2 and how the longer story will eventually turn out.

We Can Save the Earth! — Expository Writing Ideas

Besides possible alien invasions, many other potential threats loom over our planet:

- exponential population growth
- global climate change
- air and water pollution
- insufficient energy and other resources
- a future major meteorite strike
- wars with increasingly deadly weapons
- pandemics
- and other depressing disasters.

Students may work individually, as partners, in teams, or as a whole class. Younger children will require more support and guidance than older ones.

Have students research one or more the above global problems or others that they identify.

For each problem, have them:

- identify its causes
- predict what will happen if nothing is done
- describe steps that governments and non-governmental organizations can take to solve the problem
- describe what they personally can do to help alleviate the problem

Have students write their conclusions

- as an essay about one of the problems or
- as an essay about a number of them with an introductory paragraph, main body paragraphs each devoted to one of the problems, and a concluding paragraph.

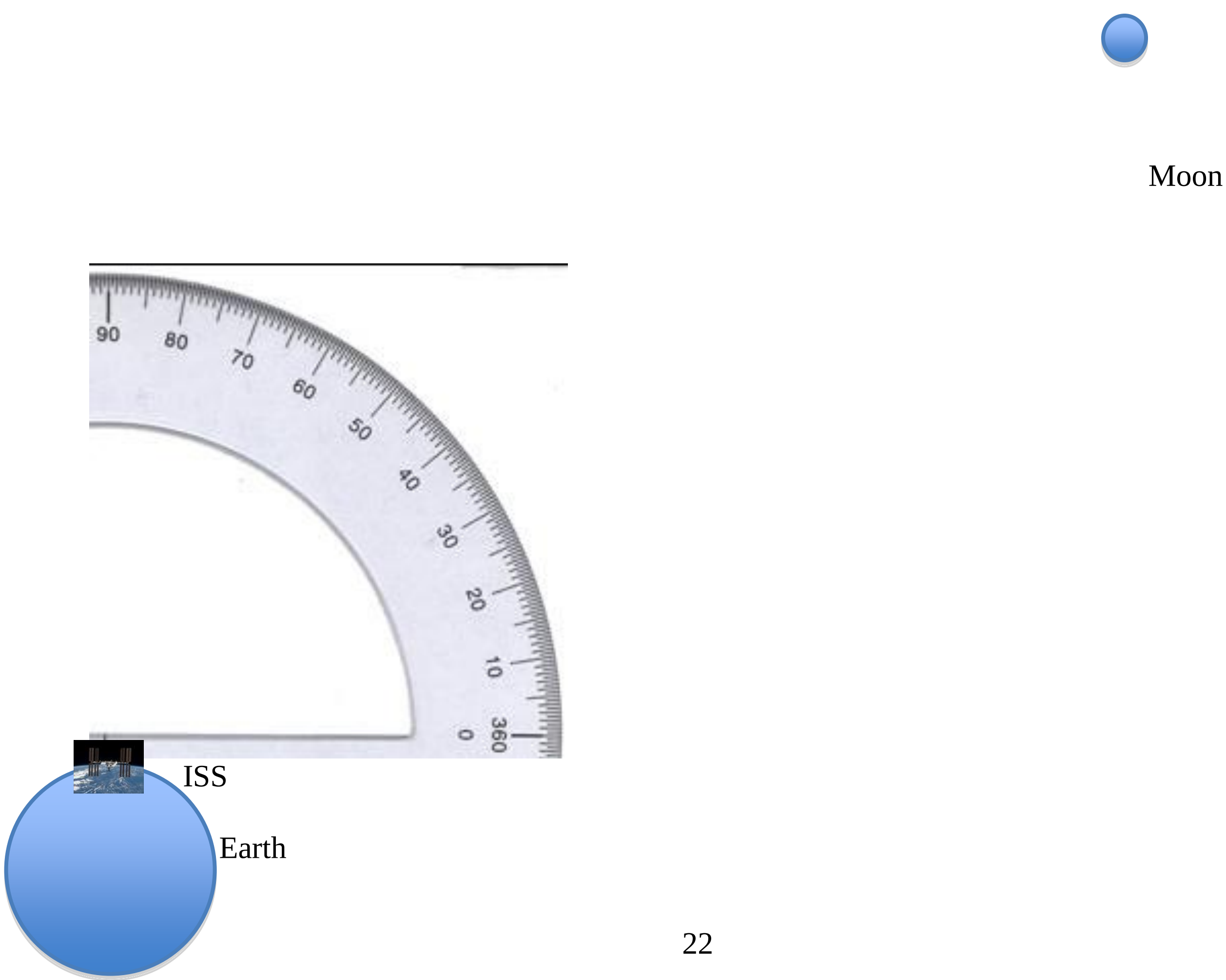
<u>**Moon Math**</u>

1. Sending a rocket to the Moon requires hitting a target that is 238,832 miles away and traveling at a speed of about 2288 miles per hour.

Grades 4 – 6: Round the Moon's distance and velocity to the nearest 1000.

Grades 6 – 8: Write the Moon's distance and velocity in exponential notation.

Before sending people to the Moon, NASA sent rockets to take photos – starting with the Ranger Missions in the early 1960s. Rangers 1 and 2 failed to launch. Rangers 4 and 6 experienced technical failures. Rangers 3 and 5 missed the Moon entirely. Ranger 7 finally succeeded in July of 1964. So rocket science really <u>is</u> rocket science – *hard*.



2. Imagine that you are launching a probe from the International Space Station to the Moon's South Pole. Measure from the top of the small vertical line just above the ISS. What is your launch angle? And what would be your launch angle for the Moon's North Pole?

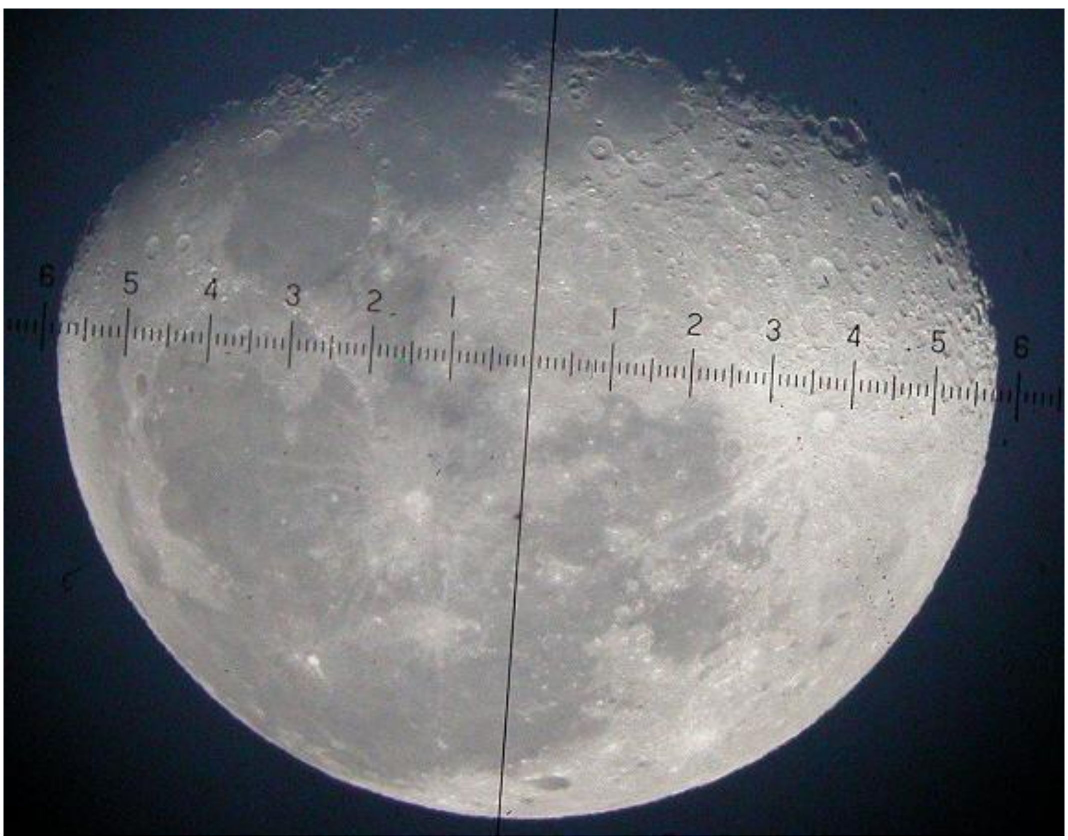
3. It takes the Moon about 27.3 days to orbit the Earth. About how many times does the Moon orbit the Earth in a year?

4. The radius of the Moon's orbit is about 239,071 miles. What is the diameter of its orbit?

5. The Apollo 11, 14, and 15 astronauts left reflectors on the Moon. Thanks to these, scientists can very accurately measure the distance from Earth to Moon by bouncing laser light off of the reflectors. They have discovered that the diameter of the Moon's orbit is increasing at the rate of about 1½ inch per year. At this rate, how many feet farther will the Moon be from the Earth in 100 years?

6. Looking at the Moon through a telescope marked in centimeters (below), what is the apparent radius of the moon?

What is its apparent diameter?



Moonbase Crisis Math

Chapter 1

1. The Moon's diameter is about ¼ of the Earth's, so the Moon's diameter is _________% of the Earth's.

2. The Moon's gravity is about 1/6 that of Earth. Express that as a decimal and as a percent.

3. What is your weight on Earth?

4. If you were on the Moon, what would you weigh?

Chapter 3

1. The speed of light is 186,262 miles per second. What is the speed of light in miles per hour?

Grades 7 – 8: Use exponential notation to write the speed of light in miles per hour.

2. It takes 1.3 seconds for a message to travel from Earth to the Moon. A conversation taking 10 seconds to complete on Earth would take how long if one of the speakers was on Earth and the other on the Moon?

Chapter 4

1. "Song-Ye ... topped out at five feet." How tall is she in centimeters?

2. The Moon's temperature ranges from +200 to -300 degrees F. Earth's temperature range is +136 to -127 degrees. How much greater is the Moon's temperature range than the Earth's?

Chapter 9

Pilots express directions both in degrees of a circle and by reference to a clock. Straight ahead is "twelve o'clock." "Turn to 90 degrees" means "Turn right." Ansari predicts that a meteor will strike 500 meters away from the Main Control Center "at two o'clock." What is that in degrees?

Chapter 13

Dr. Wu says that one of his panels is reflecting only 38% of expected light. Which fraction is this closest to? ½, 1/3, ¼ or 1/5?

Growing Food on the Moon

Why do we need plants? What would happen to us if there were no plants?

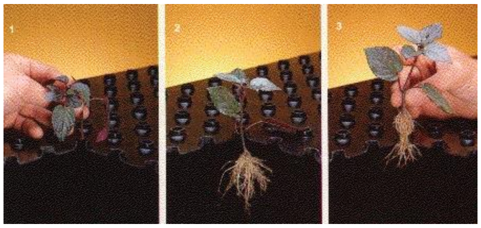
In Chapter 11, Dr. Romero explains to Song-Ye why we need plants.

There are three ways to grow plants:

The regular way in watered soil: the dirt provides the nutrients.

Hydroponically: Plants are grown in water with nutrients ("plant food") added to the solution. Gravel or other materials may be used to support the roots.

Aeroponically: Plants are grown suspended with their roots bare. The roots are kept saturated with a nutrient and water mist sprayed onto them. Aeroponics is more complex than hydroponics, but NASA studies have shown that it uses 65% less water and 25% less nutrients. In addition, aeroponics protects plants from algal growth and from becoming water logged.



To do:

Over one month (or at least two weeks), compare plants grown in soil, hydroponically, or aeroponically.

Materials needed:

- a six pack of plants
- a sheet of Styrofoam or cardboard (Styrofoam is better.)
- 6 clear plastic cups (available in picnic sections of most grocery stores)
- liquid plant food

Procedure:

1. Keep 2 plants in their soil in their compartments. Cut their compartments from the six pack and place each, braced to stand up straight, into its own plastic cup.
2. Remove the other plants from their six pack compartments. Rinse off the soil from their roots.

3. Cut out Styrofoam discs big enough to cover and cap the plastic cups. Make a hole in each disc big enough to push the plant through but small enough to keep the plant from falling through the hole. If you have difficulty, push the plant through a too-large hole without damaging the roots, and then use duct tape to make the hole smaller.
4. Insert the 4 plants into the 4 discs.
5. Put two of these plants into two cups ½ full of water with an appropriate amount of nutrient solution (following the directions on the plant food bottle.) These plants should be lifted out of the water daily and the water stirred to aerate them. Nutrient should be added according to the directions on the bottle. Water should be added as needed and changed at least once a week.
6. Put the last two plants in two cups with no water. Keep a spray bottle of a water and nutrient solution next to them. Keep the plant roots saturated with water.
7. Record and compare plant growth over the month. Use photos, height, measurements, written lab records, and bar or line graphs. You might also measure and keep a record of how much water you used for each pair of plants.

At the end of the experiment, compare how well the pairs of plants grew along with their water and nutrient consumption.

Which method would you recommend for the Moon considering that the Moon has no dirt with nutrients and very little water?

NASA portable aeroponic tower

Shoebox Moonbase

Working individually or in teams, make moonbase modules from shoeboxes or similarly sized boxes along with other equipment necessary for the base.

Five modules are described in *Star Challengers*:

1. the Equipment Storage Module (ESM) in Chapters 5, 6,and 7
2. the Main Control Center (MCC) in Chapter 5, 6, and 8
3. the Ag Module or Ag Bubble in Chapters 6 and 11
4. the observatory or astro module in Chapters 6 and 15
5. the habitation or hab (crew quarters, sickbay, dining area, gym) module in Chapter 6 and 9

Also described are:

- a modular rover vehicle in Chapter 10
- solar power collectors in Chapter 8
- a water mining area in Chapter 8
- a telescope array in Chapter 15
- a MAR (Multi-Axis Rover) in Chapter 17

Other possible modules for an expanded base:

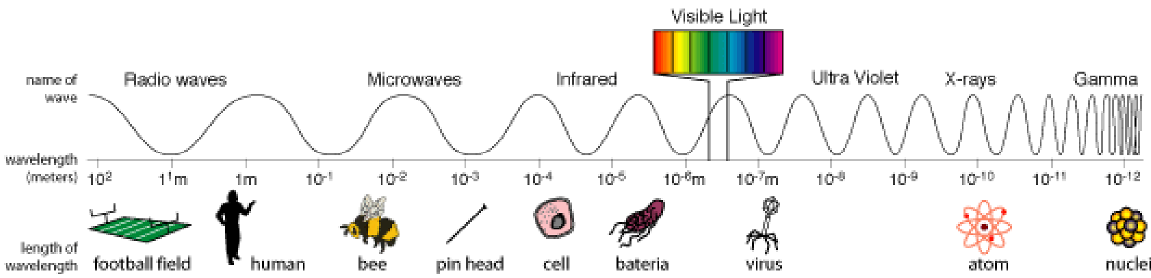
- lunar geology lab
- low gravity experiments lab
- additional ag and hab modules
- separate modules for crew quarters, sickbay, dining area, and gym/recreation

*Make your base to scale. Use plastic astronaut figures, which may be inexpensively purchased in packages at toy stores, the toy section of discount stores, or online. Imagine that the astronauts are 5 to 6 feet tall, and scale other items to match.

*Design and draw your modules and equipment first. Use rulers and other measuring tools to make your scaled measurements accurate. Measure real furniture to get an idea of how big the furniture and equipment should be relative to your astronauts.

*Connect your modules with tubes. Give your modules windows and hatches. Lighting and power for your modules can come from holiday tree lights cut into short sections and attached to batteries. On/off switches may be made from paperclips or aluminum foil. You might also experiment with attaching the holiday tree lights to solar panels, which can be bought from hobby and electronic stores or online.

<u>The Electromagnetic Spectrum</u>

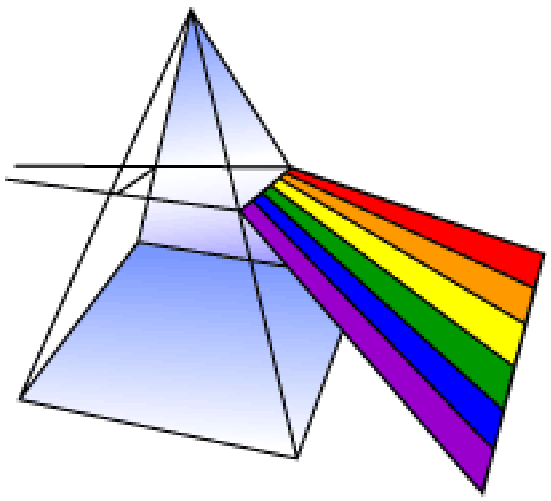


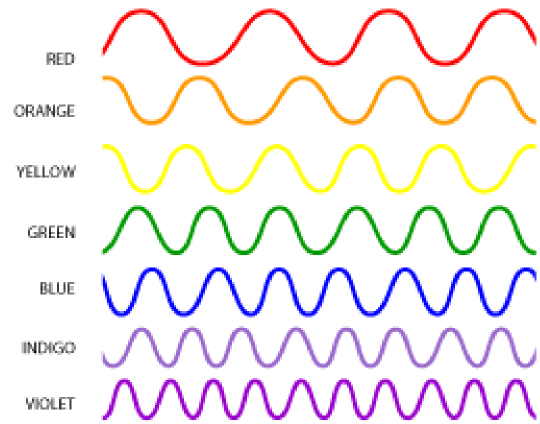
Electromagnetic radiations travel in waves. Waves have peaks (crests) and valleys (troughs.) Some types of radiation produce crests far apart from each other. Others produce crests that are really close together. The pictures above show how long the waves are – from the length of a football to an atomic nucleus too tiny to be seen by the most powerful microscope. The distance between crests is called the wavelength. The electromagnetic spectrum is the gradual shift from waves with distant crests to those with really close crests.

How fast the crests and troughs undulate (move up and down) is called the <u>frequency</u>. Different types of radiation have different frequencies. The spectrum goes all the way from radio waves (very low frequencies) to gamma rays (very high frequencies). When you change radio stations or TV channels, you are changing frequencies.

Our eyes and ears are electromagnetic wave sensors! The frequencies we can hear are lower that those we can see. Most frequencies we can neither see nor hear, but they can be detected and measured using special instruments, such as the spectrograph in the astro bubble mentioned in Chapter 15 in Star Challengers.

The light we can see is just a tiny part of the entire spectrum. It is white to our eyes unless it is broken up into its actual wavelengths. Glass crystals and raindrops will do this – breaking up white light into the colors of the rainbow. Each of those colors has its own wavelength.





The visible light spectrum has the colors of the rainbow:
Red, Orange, Yellow, Green, Blue, Indigo, and Violet (ROY G. BIV)

In Chapter 17, Major Fox explains why the moonbase can't hear messages from the lander in the crater even though they can receive transmissions from Earth, which is much farther away: "Like light waves, radio waves are part of the electromagnetic spectrum. If a wall comes between you and a lamp, for example, it blocks light. Transmitting a radio signal requires an open line of sight between the sender and receiver. From the moonbase, the crater wall blocks the signal to the next crater, but there is no obstruction overhead for a signal to Earth."

Spectrum Activities:

Astronomers and chemists indirectly identify the composition of substances by seeing which wavelengths are emitted from or absorbed by them.

1. In the astro bubble (Chapter 15), Dr. Wu says, "We can use filters to view through a particular part of the spectrum."

You can have fun blocking only red light waves using a filter. Draw a picture or write a secret message using blue, green, or black crayons, markers or pencils and then disguise it with distracting marks in red and orange. When you look at the picture through red cellophane, the cellophane blocks the reflection of the red and orange marks, allowing only the other colors to be seen.

2. Refraction is the change in direction of a wave due to a change in its speed when it passes from one substance to another. You can experiment with refraction by looking

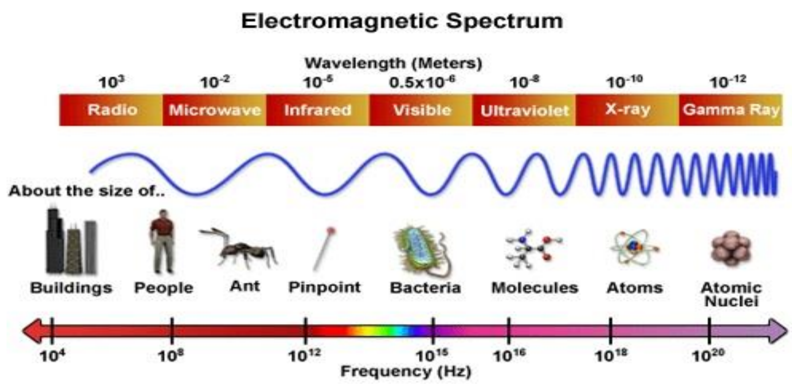
through any transparent object that is not flat to see how the image beyond changes as the light reflected from those images is refracted.

Also experiment with how water in a glass refracts images. Put a pencil or other long object into a glass of water and see how the water refracts the image. Also pick up the glass of water and look at other objects through it to see how refraction distorts their images.

3. Diffraction is the change in direction of a wave as it bends around a blocking object. Diffraction is used in spectrographs to divide starlight into different wavelengths for analysis. Diffraction grating paper, single lenses, and glasses can be purchased from most science education vendors.

Screw various types of light bulbs (incandescent, fluorescent, bug lights, black lights) into a table lamp with the shade off. Look at them through diffraction grating. Notice how their light diffracts differently. Draw the different light patterns.

4. Math for Grades 6 – 8: Write the wavelengths in standard notation.



Lunar Lighting

Consider these questions:
Why do we always see the same side of the Moon?
Does the moon rotate?
Is the other side of the Moon always dark?
What causes the curved shadow we often see on the Moon?
What causes the lit part of the Moon to change shape?

Before doing the activities, in team and/or whole class discussion, perhaps after individual quickwrites, record class members' initial hypotheses that answer the above questions.

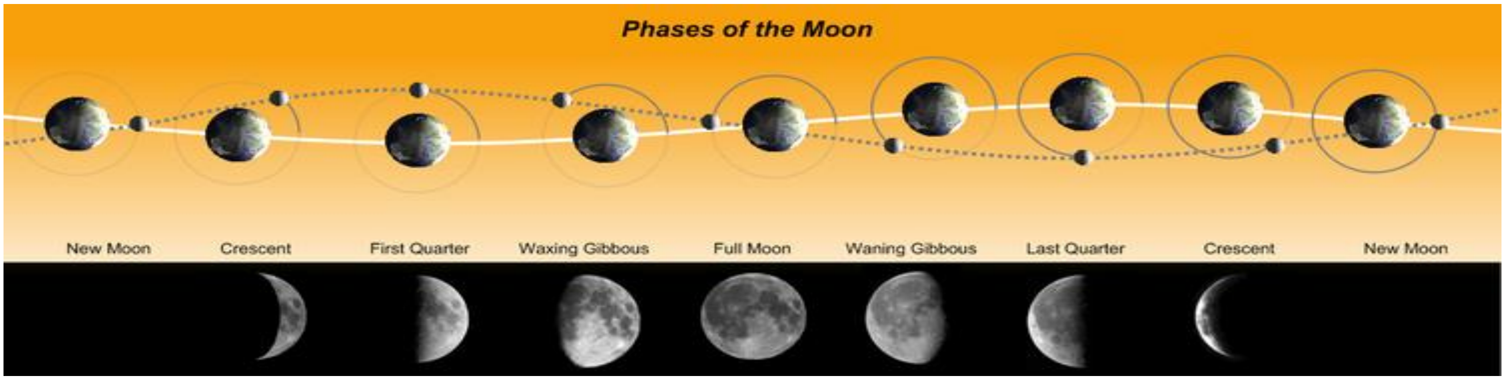
Then have each student makes a "moon on a stick." Moons may be made of Styrofoam balls (available at craft stores) or old tennis balls pierced and stuck on the sharpened end of a pencil, or ping pong balls glued to the used up eraser end of an old pencil. Have them draw the "face" of the "man in the moon" on one side of the ball.

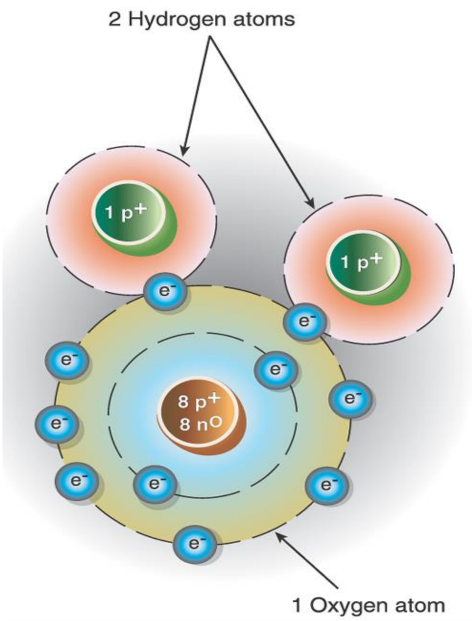
This activity may be done outside using the actual sun or inside using a lamp with the shade removed. Students will need plenty of space to move about.

Have student(s) hold the "Moon" at arm's length slightly above their heads. Their heads represent the Earth. Have them do a 360 degree rotation several times. Do <u>not</u> rotate the ball on the stick. Have the "face" always pointing toward them.

Use one side of the room as a reference. This is a model of how the Earth and Moon move in relationship to each other. Did the Moon always point in the same direction or did it rotate? (Do note the error in this model. The Earth and Moon do not rotate at the same rate. The Earth is actually completing somewhat more than 27 full rotations while the Moon completes a full orbit and rotation.)

Have students notice how the light changes on the "Moon" as it "orbits" the Earth. Does the light sometimes shine on the side that is always turned away from the Earth? As the "Moon" moves around the "Earth," notice it pass through its monthly phases. What causes the curved shadow and the changes in shape of the lit part of the Moon?





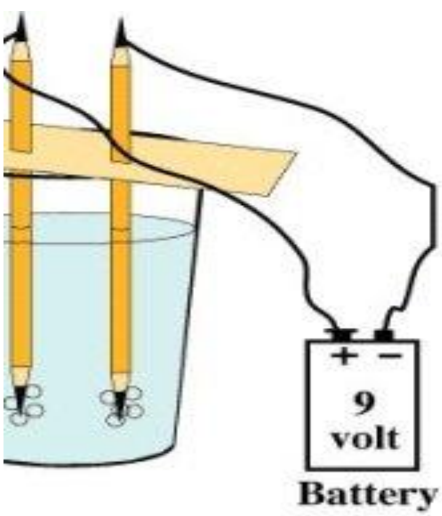
Splitting Water

At Moonbase Magellan, the astronauts mine the regolith for water ice. Through electrolysis, they turn the ice into oxygen to breathe and hydrogen to fuel the lander.

As you probably know, water (H_2O) is a molecule made of 2 hydrogen atoms and one oxygen atom that are bonded together. The oxygen atom has space for 2 more electrons in its outer shell. A hydrogen atom has only one electron. It has space for another. So hydrogen and oxygen are easily attracted to one another so they can share each other's electrons to fill each other's empty spaces.

Electricity can be used to break the bonds between the hydrogen and oxygen atoms, changing water, a liquid, back into two gases.
Electrolysis is the scientific term for this splitting water process.

To split water, you need the following:



1. a 6 or 9-volt battery
2. two alligator clip leads or insulated wire
3. a glass (made of glass)
4. a square of thin cardboard big enough to fit over the glass
5. two #2 pencils sharpened at both ends
6. warm water
7. an adult to supervise

Procedure:

1. Fill the glass with warm water.
2. Punch holes in the cardboard about an inch apart.
3. Put the cardboard over the glass.
4. Push the pencils through the holes and into the water, but do not let them touch the bottom of the glass.
5. Using alligator clips or wires with the insulation stripped off of both ends, connect the graphite at the top of each pencil with the battery leads. If you don't have alligator clips, you may use tape to hold the wires in pace. If the wires slip off of the battery leads, tape a paperclip to the lead and attach the wire to the paperclip.

What happens?

You will see bubbles around the pencil tips in the water. These bubbles contain hydrogen and oxygen gas given off by the water molecules that have been disassembled by the electric current. One of the pencil tips should be giving off more bubbles than the other. These will be the hydrogen bubbles. Can you think of why?

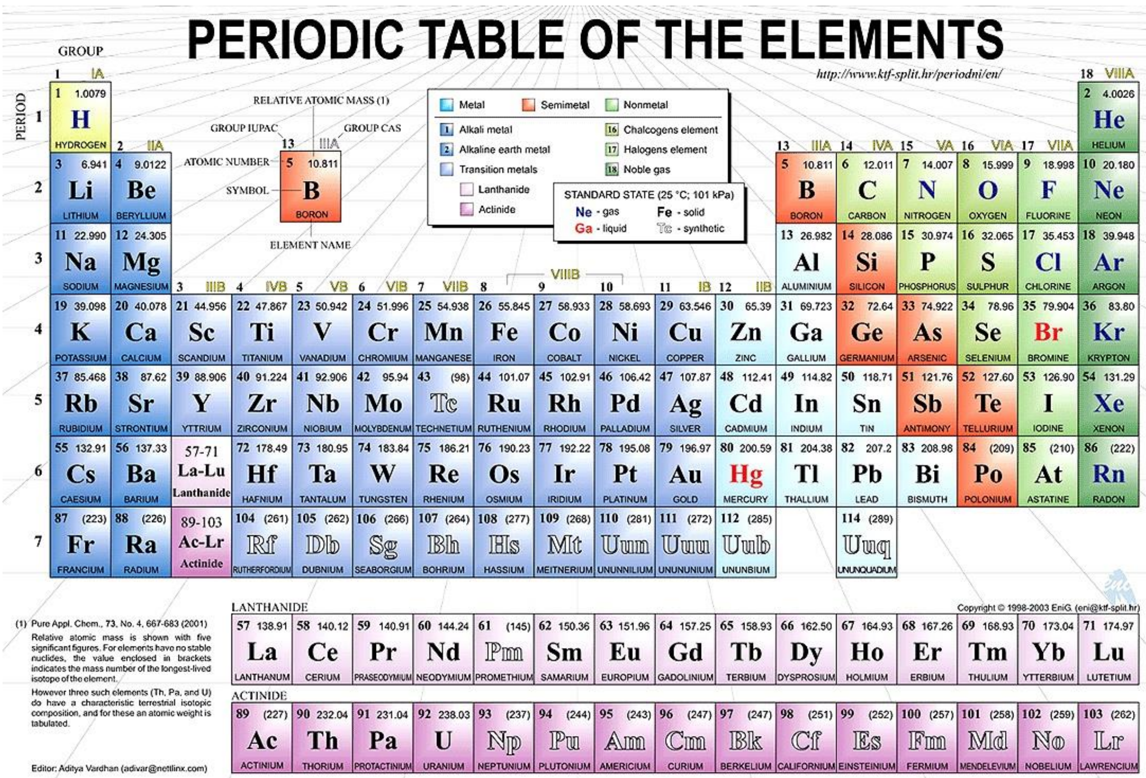
Troubleshooting:

If you don't see bubbles, that probably means that the water isn't conducting electricity very well. You could try reducing the distance between the pencil tips to ½ inch.

If that doesn't work, add salt to the water. The salt will help conduct the electricity. However, the tiny bubbles you will see around the pencil tips will consist of chlorine gas and hydrogen gas. Why? Salt is sodium chloride (NaCl). When the H_2O molecules are split, the oxygen atoms combine with the salt to form hydroxyl ions, which stay in the solution. Chlorine gas is released, however, from the NaCl molecules.

The Periodic Table

All solids, liquids, and gases are composed of elements. Some are made of only one kind of element (helium in lighter than air balloons for example.) Others are compounds of several elements, such as water, a combination of hydrogen and oxygen.



To help us understand the similarities, differences, and relationships between the elements, they are arranged in boxes in columns and rows in the Periodic Table. The number at the upper left corner of each box tells how many pairs of electrons and protons each element has. Elements with only a few electron-proton pairs are very light, while those with many electron-proton pairs are quite heavy. The lightest is Hydrogen (H) with only one electron-proton pair. It has the atomic number of 1. Atomic number 2 (2 pairs) is Helium (He).

Others are:
6 Carbon (the black stuff left after something has burned), 7 Nitrogen (the most common gas in the air), 8 Oxygen, 10 Neon (the gas that glows in fluorescent lights), 11 Sodium (salt), 13 Aluminum, 14 Silicon (what computer chips are made of),
15 Phosphorus (match heads), 17 Chlorine (put in pools to kill germs), 18 Argon (another gas used in fluorescent lights), 20 Iron, 28 Nickel, 29 Copper, 47 Silver,
79 Gold, 82 Lead, and 92 Uranium.

In Star Challengers: Moonbase Crisis, elements and compounds are sometimes mentioned as the characters struggle to solve their problems.

Find each element on the Periodic Table. Write its chemical symbol and atomic number. Then search for the elements in the following chapters. Tell how each is involved in or related to a problem the characters are trying to solve.

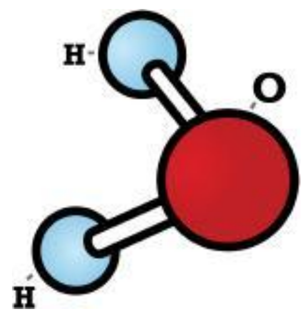
Chapter 5 – helium

Chapter 8 – gold, platinum, hydrogen, oxygen

Also in Chapter 8, three compounds are mentioned and their freezing/melting points compared.

A water molecule looks like this:

At 32 degrees F (0 degrees C)
it changes from
liquid to solid (freezing)
and from solid to liquid (melting).



The other two compounds, Ammonia (NH_3) and Carbon Dioxide (CO_2), freeze at about minus 108 degrees F (- 78 degrees C). Above that temperature, Ammonia becomes a liquid while Carbon Dioxide sublimates directly into a gas.

Draw and label ammonia and carbon dioxide molecules.

Other chemistry activities:

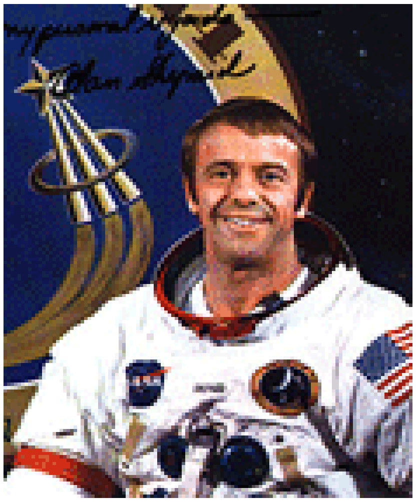
- Make models of atoms. Either glue items representing protons, neutrons, and electrons to cardboard backing, or make hanging mobiles.
- Two top websites for teaching chemistry to children are:
  American Chemical Society – Education – Science for Kids and
  Periodic Table of Videos – University of Nottingham

Moonwalkers

Between 1969 and 1972, six Apollo missions, carrying twelve astronauts, landed on the Moon. To this day, these twelve are the only humans to have set foot on the Moon. Nine are still alive. Three more Apollo missions were planned but were canceled due to lack of public interest in continuing to fund them. The men who walked on the moon are:

Apollo 11: Neil Armstrong and Buzz Aldrin

Apollo 12: Pete Conrad and Alan Bean

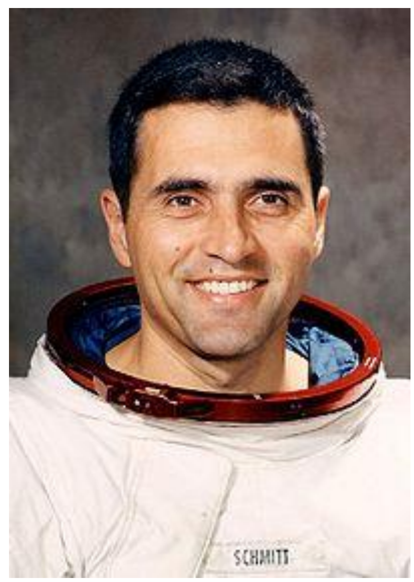
 

Apollo 14: Alan Shepard and Edgar Mitchell

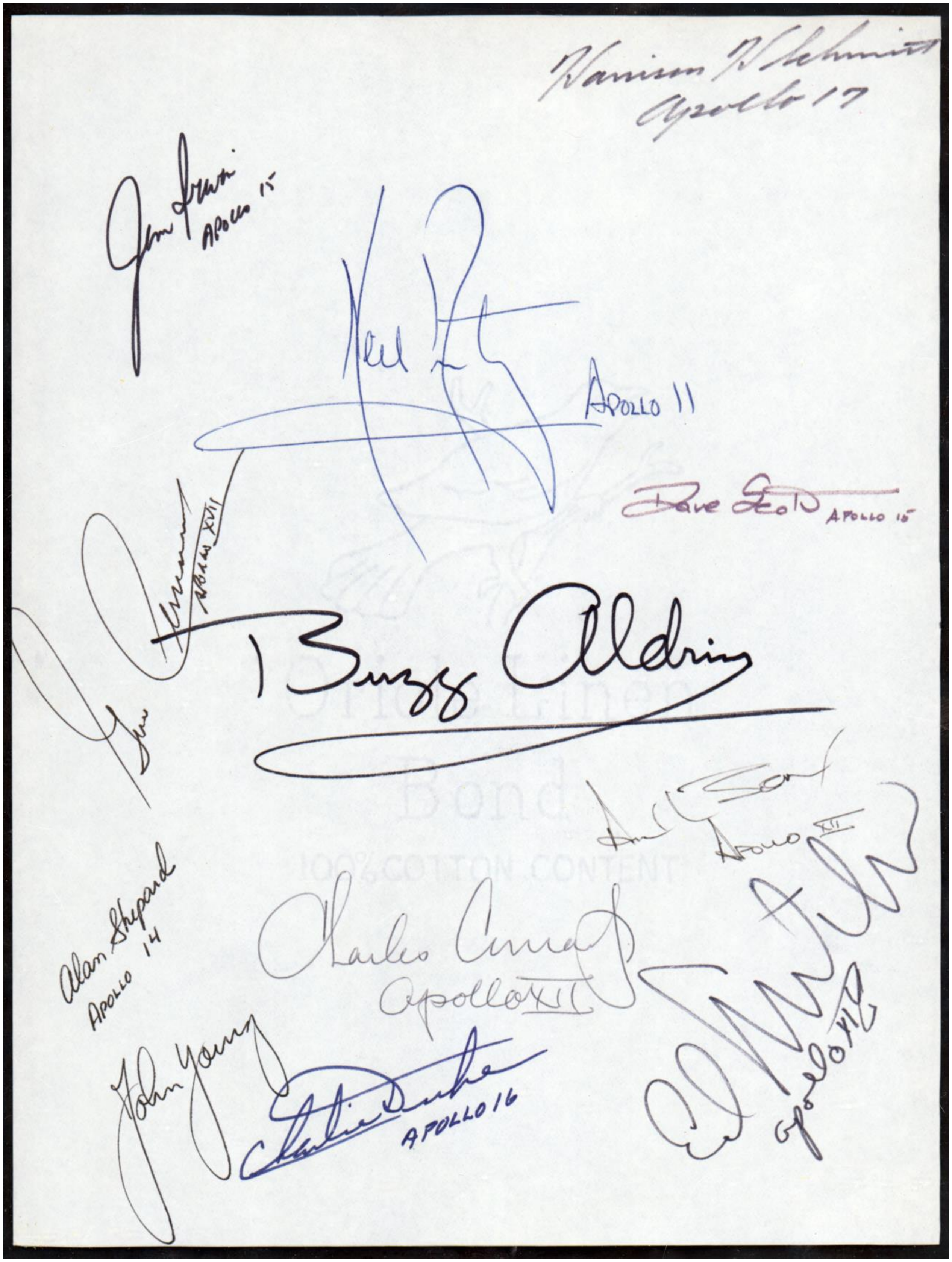
Apollo 15: David Scott and James Irwin

Apollo 16: John Young and Charles Duke



Apollo 17: Eugene Cernan and Harrison Schmitt

In 2010 the Constellation Program to return to the Moon was cancelled due to insufficient funding and public support. Instead, priority has been given to keeping the International Space Station in orbit five more years, robotic exploration, development of new propulsion technologies, and encouraging private space ventures. An Ares rocket (right) will be completed, however, to replace the space shuttle. Several countries send robotic probes to the Moon. China may eventually launch another human mission.


Harrison H Schmitt
Apollo 17
Jim Irwin
APOLLO 15
APOLLO 11
Dave Scott
APOLLO 15
Buzz Aldrin
Bond
100% COTTON CONTENT
APOLLO XII
Alan Shepard
APOLLO 14
Charles Conrad
Apollo XII
John Young
Charlie Duke
APOLLO 16

ABOUT THE AUTHORS

STAR CHALLENGERS: MOONBASE CRISIS CO-AUTHORS:

Rebecca Moesta is an award-winning, New York Times bestselling young adult author who has written for Star Wars, Buffy the Vampire Slayer, Star Trek, as well as the original trilogy "Crystal Doors," co-authored with Kevin J. Anderson. **Kevin J. Anderson** is the #1 international bestselling author of nearly a hundred novels, best known for his Dune novels coauthored with Brian Herbert, his Star Wars or X-Files novels, or his Saga of Seven Suns series. (photo by Sweet T Photography)

June Scobee Rodgers is the widow of Challenger Space Shuttle Commander Dick Scobee. A tireless proponent of the space program, June is intent on fostering a new generation of students in science, technology, engineering, and mathematics. She serves as the Founding Chairman of the Board and as a Founding Director for [Challenger Center for Space Science Education]. Holding a Ph.D. from Texas A&M University and a Master's from Chapman College, both in Curriculum and Instruction, she has taught in every grade-level classroom from Kindergarten through college. June will oversee the creation of free lesson plans and other materials to support each *Star Challengers* novel, allowing this entertaining series to be used as an engaging teaching tool inside the classroom.

STAR CHALLENGERS: MOONBASE CRISIS TEACHER'S GUIDE AUTHOR

Susan Weikel Morrison was born and mostly grew up in Berkeley, California, where she had many strange experiences in the 1960's before graduating from the University of California and getting a teaching credential. She moved to the central San Joaquin Valley, where she taught primarily Mexican farmworkers' children for 35 years. She has continued to have strange and wonderful experiences all over the planet and a bit above it. She is now a program specialist and GEMS teacher trainer at the Challenger Learning Center of the San Joaquin Valley. When she isn't traveling, she lives in Fresno with her son, grandson, and two very strange cats.