CareerClusters™ PATHWAYS TO COLLEGE & CAREER READINESS
Transportation, Distribution & Logistics

Learning that works for Colorado CTE®

Colorado CTE Course – Scope and Sequence

Course Name	**Principles of Flight**		**Course Details** **Course = 0.50 Carnegie Unit Credit**	**Credit= 1.0** **Prerequisites: Introduction to Aviation and Aerospace** **CTE Credential: CTE Transportation Operations**	
Course Description	Principles of Flight builds on the fundamental knowledge and skills learned in Introduction to Aerospace while teaching students the essential competencies needed for flight under normal conditions. Upon completion of this course, proficient students will be able to apply knowledge, skills, and procedures in a variety of simulated flight environments. Moreover, students who complete this course will have the opportunity to move on to advanced study in Advanced Flight, where they will continue to prepare for the FAA Private Pilot written exam.				
Note:	This is a suggested scope and sequence for the course content. The content will work with any textbook or instructional resource. If locally adapted, make sure all essential knowledge and skills are covered.				
SCED Identification #	20053	Schedule calculation based on 60 calendar days of a 90-day semester. Scope and sequence allows for additional time for guest speakers, student presentations, field trips, remediation, or other content topics.			
All courses taught in an approved CTE program must include Essential Skills embedded into the course content. The Essential Skills Framework for this course can be found at **https://www.cde.state.co.us/standardsandinstruction/essentialskills**					
Instructional Unit Topic	Suggested Length of Instruction	CTE or Academic Standard Alignment	Competency / Performance Indicator	Outcome / Measurement	CTSO Integration
Safety		Understand and apply concepts related to the safe operation of an aircraft. Understand the regulatory structure for aviation and air control.	Apply concepts of safety to aircraft operations. Student is expected to: (A) Comprehend and apply air safety requirements; (B) Comprehend the airport layout, inclusive of safety elements; (C) Comprehend airspace control; (D) Demonstrate procedures of	Gather information from a variety of print and digital sources (such as textbooks, aviation magazines, publications, and industry websites) and write a report based on what the aviation industry is doing to enhance aviation safety. Discuss takeaways to incorporate into future decision making and thought processes that would help in preparation to be a safer pilot or mechanic.	

			radio communications during conduct of a flight; (E) Understand how to locate and apply FAA regulations; (F) Understand the effects on the body in the flight environment and identify potential hazards; (G) List and describe the safety procedures to prevent aviation accidents due to physical distress; (H) Explain key elements of aeronautical decision-making and safety data analysis; (I) Evaluate the nature of accidents and the role of the accident investigation process; and (J) Describe how safety management systems (SMS) work to decrease	Gather information from a variety of print and digital sources (such as textbooks and online industry publications) on the National Transportation Safety Board (NTSB), its purpose, and how the organization performs its duties. Explain how aviation safety is enhanced by NTSB investigations of aircraft accidents. Read and evaluate at least one aviation NTSB accident report and share with the class the NTSB findings, probable causes of the accident, and any NTSB recommendations based on their findings. Students should personalize what they learned from their research to devise strategies for being a safer pilot or mechanic based on what they learned.	

			airport and aircraft accidents.		
Career Development		Integrate multiple sources of career information from diverse formats to make informed career decisions, solve problems, and manage personal career plans.	The student demonstrates professional standards/employability skills as required by business and industry. The student is expected to: (A) identify employment opportunities, including entrepreneurship opportunities, and certification requirements for the field of aircraft operations or maintenance and repair; (B) demonstrate the principles of group participation and leadership related to citizenship and career preparation; (C) evaluate employers' expectations and appropriate work habits; (D) discuss the competencies related to resources, information systems, and technology;	Research collegiate websites and affiliated publications to create a list of postsecondary educational opportunities that prepare students for careers in aviation. Evaluate personal career goals and desires, then determine which opportunity would provide the best preparation for the desired career. Develop a timeline detailing the postsecondary path that will lead to career goals. Interview a professional working in an aviation-related occupation or visit an industry related to aviation and/or unmanned flying objects. Shadow an aviation engineer or designer, or a pilot of unmanned flying object and report on the requirements and technical skills needed. Research aerospace career opportunities of interest by participating in career exploration activities. Explore the requirements, skills, wages, education, and geographic opportunities in one career associated with aerospace. Identify	

			(E) demonstrate awareness of the technical knowledge and skills related to human factors in health and safety in the workplace, as specified by appropriate governmental regulations and an understanding of personal responsibility in this area; (F) demonstrate awareness of the technical knowledge, skills, and attitudes related to human factors in a successful and profitable workplace and the role of the employee in creating that success, including personal responsibility; and (G) Apply reasoning skills to a variety of simulated workplace situations in order to make ethical decisions.	employability skills preferred by different aviation occupations.	
Aerodynamics		Understand the principles of aerodynamics and how they are used in normal flight conditions.	Apply scientific concepts of aerodynamics to flight operations. Student is expected to:	Research industry manuals and course materials to explain the interrelationships among aerodynamics forces that affect an aircraft on the ground and in flight.	

			(A) Investigate the four forces of flight; (B) Investigate basic aerodynamics; (C) Investigate airplane stability; (D) Examine the utilization of airfoil, wings, tail and propeller; (E) Apply Newton's Three Laws of Motion to flight; (F) Understand the impact of the Bernoulli Effect and Venturi Effect; (G) Compare Static versus Dynamic Pressure; and (H) Explore concept of pitch, roll, yaw.	Aerodynamic forces include, but are not limited to: ground effect, torque and P-factor, load factor, and aircraft stability. In addition, be able to explain the effects of frost, the significance of angle of attack as it relates to stalls and spins, and how load factors are affected by airplane turns. Utilizing aeronautical charts, use vectors to model magnitude and direction of flights. Incorporate wind velocity vectors to determine the effect on the flight plan.	
Aircraft Systems		Investigate the basic parts and control surfaces on aircraft. Identify the six basic aircraft instruments (Airspeed indicator, attitude indicator, altimeter, turn coordinator, heading indicator, and vertical speed indicator).	The student understands the technical knowledge and skills of aircraft systems for flight operations. The student is expected to: (A) Apply and understand the principles of simple machines, basic aerodynamics, aircraft	Describe the characteristics and functions of an airplane's aileron, elevator, and rudder, including the trim system if appropriate, citing technical manuals and industry guidelines. Detail the varying effects of changes in airspeed, density altitude, frost, snow, or ice on each of these functions. Illustrate the operation of aircraft slats,	

		Interpret the reading of each instrument to confirm an accurate 'instrument scan'. List the basic flight control systems (mechanical, hydromechanical and fly-by-wire). Demonstrate a basic working knowledge of the FAA regulations governing aircraft conditions and aircraft operations.	structures, and theory of flight; (B) Demonstrate knowledge of aircraft categories as used with respect to the certification, ratings, privileges, and limitations of airmen, including airplane, rotorcraft, glider, and lighter-than-air; (C) Demonstrate knowledge of airframe construction and basic repair methods and techniques, including wood structures, metal tubular structures, fabric coverings, sheet metal, and composite structures; (D) Demonstrate knowledge of airframe systems and components, their functions, and basic operating principles, including landing gear, hydraulic power, cabin atmosphere control systems, and electrical systems;	spoilers, speed brakes, and thrust reversers. Compare and contrast the characteristics and operating principles of both a normally aspirated and turbocharged aircraft reciprocating engine, and relate the advantages and disadvantages of each. Explain how a turbine engine operates, including the different sections within the engine, and relate the advantages and disadvantages between a turbo jet, turbo fan, and turbo prop engine. Draw on technical manuals and manufacturers' guidelines to describe the characteristics and chief functions of the following aircraft systems or instrumentation systems: pitot-static system, vacuum system, flight gyros, navigation radios (such as VOR, ADF, and GPS), and aircraft communications radios. In the context of a specific aircraft, explain the advantages and disadvantages of a glass cockpit versus steam gauges. Deliver an oral presentation or guided explanation of the fuel system in a typical training	

			(E) Demonstrate knowledge of aircraft reciprocating and turbine engines, their operating theory, functions, and basic repair methods and techniques; (F) Demonstrate knowledge of power plant systems and components, their functions, and basic operating principles, including engine instruments, electrical systems, lubrication systems, ignition and starting systems, cooling systems, exhaust systems, and propellers; and (G) Demonstrate knowledge of aircraft common terminology and standard practices required for flight operations.	aircraft, highlighting at minimum the following elements: fuel tanks, fuel selector valve, fuel drains, fuel pump(s), carburetor, and fuel injected systems. Distinguish between different types of aviation fuels by sight, color, and/or smell, and determine which type of fuel would be acceptable to use in a reciprocating and/or turbine aircraft engine. Deliver an oral presentation or guided explanation of the electrical system in a typical training aircraft, highlighting at minimum the following elements: battery, alternator/generator, circuit breakers (CBs), and 12-volt and 24-volt systems. Describe how a retractable landing gear system operates in a typical training aircraft, citing aircraft handbooks and other manuals for illustration during normal operation procedures as well as emergency operation procedures. Describe or illustrate the differences between pump versus hydraulic pump systems.	

				Research studies on the effectiveness of anti-skid brake systems. Craft an original argument comparing the advantages and disadvantages of these systems, providing a precise explanation of how they operate and whether they conform to industry safety regulations. Share findings in a written or oral format.	
Flight Environment		Explain how weather patterns are produced. Understand the relationship between weather patterns and flight risks. Demonstrate ability to use mathematic concepts to calculate stability/instability of an air mass.	Understand concepts related to weather and flight environment for the safe operation of an aircraft. Student is expected to: (A) Explain weather theory and patterns and weather sources; (B) Understand the effect of weather conditions on flight; (C) Describe weather patterns and clouds; (D) Explain weather hazards and its impact on flight; (E) Interpret weather data; (F) Identify sources of weather information;	Gather information from a variety of print and digital sources (such as textbooks, aviation magazines, publications, and industry websites) to synthesize concepts related to the formation of weather, convective currents, fronts, and associated meteorological dangers. Discuss the explicit dangers, causes, and effects of thunderstorms; discuss airframe and carburetor icing; mountain waves; wind shear; and temperature/dew point. Describe the factors involved in the formation and dissipation of fog, temperature inversions, and clouds. Apply mathematics concepts to determine the stability or instability of an air mass.	

			(G) Explain how temperature variation influences flight performance; (H) Understand effects of density altitude on takeoff and climb performance; (I) Analyze pressure systems at different attitudes on a surface map; (J) Compare and contrast the common weather hazards when flying; (K) Recognize critical weather situations from the ground and in flight, wind shear avoidance, and use of aeronautical weather reports and forecasts; (L) Identify safe and corrective actions for common weather hazards as suggested by the Federal Aeronautics	Outline the restrictions associated with each classification of airspace: Class A, B, C, D, G, Airport Advisory Areas, prohibited or restricted airspace, alert areas, warning areas, and MOCAs. Articulate what relevant laws and regulations govern and apply to airspaces as set forth by the Federal Aviation Regulations. Describe the functions of and explain the differences between each of the following aspects of the flight environment: ATIS, AWOS, Clearance Delivery, Ground Controls, Towers, Approach/Departure Controls, Terminal Radar Programs, Air Traffic Centers (ATC), and Flight Service Stations (FSS). Demonstrate different ways to obtain a weather briefing while on the ground (phone call to FSS, internet, TV, etc.), and explain what a pilot should do to get an updated weather briefing while airborne (FSS, Flight Watch, ATC, XM Weather, etc.). Analyze the following texts, synthesize the information found, and demonstrate the ability to retrieve the correct information in a timely fashion	

			Administration (FAA); (M) Interpret current weather conditions using a weather map; (N) Collect and analyze local weather data; (O) Understand Significant Meteorological Information Service (SIGMET); (P) Describe and decode aviation meteorological products such as METARs, TAFs, etc.; and (Q) Define the role of Aviation Data Service (ADDS).	to aid in aviation decision making: Aviation Routine Weather Report (METAR)s, Pilot Weather Reports (PIREP)s, Aviation Area Forecast, Terminal Aerodrome Forecast (TAF)s, Weather Depiction Charts, Radar Summary Charts and Radar Weather Reports, En route Flight Advisory Service (EFAS), Wind and Temperature Aloft Forecasts (FB), Significant Weather Prognostic Charts, AIRMETs and SIGMETs. Given a scenario designed by the instructor, make the appropriate go/no go decision based on the information retrieved.	
Complex and Abnormal Procedures		Describe aircraft maneuvers such as takeoffs, landings, stalls, spins, ground reference maneuvers, unusual attitude recoveries and basic instrument flight maneuvers. Describe basic risk management and aeronautical decision making related to collision avoidance, runway incursion avoidance, controlled flight into terrain, wake	Understand and apply basic risk management and knowledge of flight operations related to unusual and emergency conditions. Student is expected to: (A) Apply aeronautical decision making and judgement for the safe and efficient operation of aircraft under	Demonstrate understanding of various complex and abnormal procedures and be able to accurately perform the correct procedures given a particular set of conditions, including but not limited to procedures relating to stalls and/or spins recovery, engine failures, engine fires, abnormal combustion, carburetor icing, loss of oil pressure, low oil pressure, high oil and/or CHT temperature(s), aircraft wake	

		turbulence, Land and Hold Short Operations and emergency landing procedures.	abnormal conditions, including collision avoidance, and recognition and avoidance of wake turbulence; (B) Understand stall awareness, spin entry, spins, and spin recovery techniques; (C) Understand radio communications and processes related to delay and holding procedures; and (D) Understand radio communications and processes for emergency situations.	turbulence, deteriorating weather conditions, low fuel situations, and medical issues with pilot and/or passengers. Synthesize guidelines from piloting manuals to explain and demonstrate the operation of a constant speed propeller system, compass turning, correction of acceleration/deceleration errors, correction of altimeter errors, proper use of EGT for accurate leaning purposes, and navigation at different types of altitudes. Explain the terminology, outline basic procedures, and demonstrate the ability to perform procedures related to the following: a. Visual Approach Slope Indicators (VASI) b. Runway markings c. Taxiway and destination signs d. Beacons and taxiway lights e. ATC traffic advisories f. ATC light signals g. ELT's and VHF/DR steers h. Land and Hold Short Operations (LAHSO) i. Flying rectangular courses j. Flying S-turns across a road	
Communications		Understand the role of pilots and air traffic control in	Apply effective communications for the	Role-play the protocol required for both air and	

		communication of flight operations and status. Understand and apply terminology and phraseology appropriate for flight operations and control.	operation of an aircraft. Student is expected to: (A) Understand and apply radio communication procedures; (B) Understand and apply terminology and phraseology for flight operations; (C) Demonstrate effective communications in the air traffic environment; (D) Understand FAA procedures related to Instrument Flight Rules (IFR) and Visual Flight Rules (VFR); (E) Understand and use pre-flight communication and procedures; (F) Understand the order of procedure related to clearance and use appropriate phraseology; (G) Identify procedures related to gate	ground communications. Communications include normal, abnormal, and emergency situations for the following: departing and arriving at non-controlled airports, departing and arriving at controlled airports, communicating with ATC, and requesting and receiving en route weather from a Flight Service Station or Flight Watch. Explain each ATC light signal and the significance to the pilot. Role-play use of the correct aviation terminology and radio phraseology required during all aspects of a flight, including but not limited to: receiving the current aircraft weather before starting the engine(s); calling ground control for a taxi clearance before taxiing, or advising traffic on the common traffic advisory frequency; and requesting a takeoff/landing clearance.	

			departure including ground stop and ground delay; (H) Explain how clearance for IFR Flight plan is granted; (I) Understand pushback request and clearance; (J) Identify procedures related to aircraft holding and use appropriate phraseology; and (K) Understand concepts related to final approach, parallel approach, and normal operating zone.		
Navigation		Understand and apply concepts of aviation navigation to flight operations. Demonstrate knowledge of flight operations under visual and instrumentation flight rules.	Understand and apply concepts of aviation navigation to flight operation and control. Student is expected to: (A) Define and understand the terminologies associated with basic navigation; (B) Understand the flight computer and aeronautical charts;	Accurately describe how to use the communication radios, navigation radios, ADF, DME, transponder, ELT, and autopilot (if aircraft so equipped), and be able to list any limitations as to their useful range. Explain the process around confirming that each radio or equipment is in working condition per the manufacture's operating manual or normal operation procedures. Student will also	

			(C) Comprehend radio navigation and phraseology used with air traffic control; (D) List and describe the essential navigational information a pilot needs to know (starting point, ending point, direction, distance, speed, fuel capacity, and weight and balance); (E) Understand the basic concepts of a flight computer; (F) List the advantages and disadvantages of Visual Flight Rules (VFR) flying. Define dead-reckoning and pilotage; (G) Calculate a flight course using the elements of course line, airspeed, course heading and elapsed time; (H) Plot a course using an	understand and explain the following transponder codes (1200, 7700, 7600, and 7500) and be able to list what each code communicates to ATC, as well as the function of Mode C and "Ident" button. Accurately express how the basic GPS system works in an aircraft, and cite specific principles of operation to determine the advantages and disadvantages of GPS navigation over the VOR and NDB systems. Clearly explain how to use sectional and world aeronautical charts during a cross country flight to determine aircraft's position by use of pilotage and dead reckoning (DR). Given an appropriate scenario provided by the instructor, demonstrate proficiency in the use of lines of longitude and latitude to determine checkpoints or landmarks on a sectional and/or world aeronautical chart, and be able to input that information into a GPS for navigation purposes. Analyze the information retrieved to determine the necessary radio frequencies listed, the	

			aeronautical chart; (I) Evaluate flight plans for improved efficiency; (J) Distinguish between the types of Radio Navigation: Very High Frequency Omnidirectional Range (VOR), Distance Measuring Equipment (DME), Instrument Landing System (ILS), Global Positioning System (GPS), Inertial Navigations Systems (INS); and (K) Understand the Approach light systems and identify airport lighting aids.	different types of airspace, and the altitudes of that airspace by using a sectional and/or world aeronautical chart. Gather information from a variety of publications such as FAA Advisory Circulars, Airport/Facility Directories, and Notices to Airmen Publications (NTAP) and be able to communicate that information to other crew members in order to successfully plan and fly to a desired cross-country destination safely. Understand and be able to clearly explain how to use a VOR for navigation purposes, determine an aircraft's position, and determine the radial distance from a VORTAC facility. Additionally, determine when an aircraft crosses over a VOR station. Apply this knowledge to use a VOT and/or a VOR in the process of determining whether the VOR is within the accuracy requirements in the FARs.	
Predicting Aircraft Performance and Weight & Balance		Determine the weight and the balance of the flying object.	Understand the physical effects of the flight environment on an aircraft to evaluate	Describe the effects of density altitude on aircraft performance, drawing on technical aids and course	

		Calculate the effect of environment of the flight. Solve percentage, ratio and proportion problems related to aviation operations. Compute the loaded weight and loaded weight center of gravitation of an aircraft.	performance and operation. Student is expected to: (A) Determine the weight and the balance of the flying object; (B) Calculate the effect of environment of the flight; (C) Predict an unmanned flight performance; (D) Calculate the speed and direction of wind and its effect on the flight; (E) Describe the latest innovations in fly-by-wire flight control systems; (F) Solve percentage problems (percent of power for turbine engines, flap position percent indicators); and (G) Solve ratio and proportion problems (compression ratios of an	materials. Given a particular set of conditions, determine and accurately perform density altitude computations. Consult aircraft manuals, tables, and charts to accurately determine aircraft cruise power settings. Explain in a mock communications scenario with a superior how different cruise power settings were determined, citing the advantages and disadvantages of each. Consult aircraft manuals, tables, and charts to accurately determine the headwind/tailwind and crosswind components. Report on how each component was determined; based on the analysis, evaluate if the crosswind component is within the manufacturer's approved or demonstrated crosswind component. Consult aircraft manuals, tables, and charts to accurately determine the required takeoff run distance based on projected aircraft weight, headwind/tailwind component, density altitude, and surface conditions;	

			aircraft, glide ratios)	demonstrate to peers how the takeoff distance was determined. Consult aircraft manuals, tables, and charts to accurately determine the required takeoff distance to clear a fifty-foot obstacle based on projected aircraft weight, headwind/tailwind component, density altitude, and surface conditions; demonstrate to peers how the takeoff distance was determined. Consult aircraft manuals, tables, and charts to accurately determine the required landing roll distance based on projected aircraft weight, headwind/tailwind component, density altitude, and surface conditions; demonstrate to peers how the landing distance was determined. Consult aircraft manuals, tables, and charts to accurately determine the required landing distance to clear a fifty-foot obstacle based on projected aircraft weight, headwind/tailwind component, density altitude, and surface conditions;	

				demonstrate to peers how the landing distance was determined. Consult aircraft manuals, tables, and charts to accurately confirm that the projected weight is within the manufacturer's approved maximum takeoff weight and that the center of gravity is within the manufacturer's approved takeoff CG envelope. Citing examples drawn from textbooks and manuals, explain weight and balance definitions and relate how to reduce the payload as needed to bring the aircraft within the manufacturer's approved maximum takeoff weight. Additionally, determine how to move passengers and/or cargo to bring the center of gravity within the manufacturer's approved takeoff CG envelope. Consult aircraft manuals, tables, and charts to accurately confirm that the projected weight is within the manufacturer's approved maximum landing weight and that the center of gravity is within the manufacturer's approved landing CG	

				envelope. Citing examples drawn from textbooks and manuals, demonstrate how to reduce the payload before takeoff as needed to bring the aircraft within the manufacturer's approved maximum landing weight. Additionally, determine how to move passengers and/or cargo to bring the center of gravity within the manufacturer's approved landing CG envelope.	