iFLY Education Program Teacher Guide Grades 7-10

Program focus The Middle School Education Program at iFLY uses iFLY's unique vertical wind tunnel facility to make STEM exciting, relevant, and accessible to students. Our curriculum has been designed by STEM educators and scientists to support STEM learning in your classroom. Every iFLY field trip includes:

- Interactive STEM presentation, delivered by iFLY STEM Educator
- Physics demonstration in the wind tunnel
- Classroom experiment to investigate the effects of parachute parameters on flight performance
- Flying instruction & safety training
- Flying time, with one-on-one supervision from a highly-trained and certified instructor
- Pre and post-field trip activities to conduct in your classroom
- Photos and videos for the students to keep

Learning objectives

- Increasing awareness of exciting STEM careers
- Learning how STEM is used in the real-world
- Understanding the nature of fluids and how they exert forces on solid objects
- Using algebraic thinking to understand proportional relationships
- Using decimal, scientific notation, and unit conversions to do calculations
- Graphing and interpreting results
- Understanding variability, uncertainty, and error in experimental results

Program synopsis

Lecture and Demonstration

The program begins with a lecture and discussion with iFLY STEM Educators to introduce STEM concepts related to the wind tunnel. Students will discuss the differences between solids and fluids. They will identify air as a fluid and learn that air can exert a force on objects. The STEM Educator will discuss the different forces at work in the wind tunnel, and how changing the shape or "frontal area" of an object will affect its speed in the wind tunnel. Educators will also introduce engineering careers and how engineers use wind tunnels to test their designs.

The wind tunnel demonstration segment uses various objects such as inflatable balls to show how the "terminal velocity" (the air velocity required to "fly" the object) depends on an object's size, shape, and weight. Students will predict which balls fly at the fastest speeds, then see if their predictions were correct.

Classroom Experiment

Students move into a classroom and break into 2's and 3's to carry out an investigation. Students use scales and measuring tapes to measure the masses and surface areas of the demonstration balls using SI units. iFLY Educators help the students create an Excel graph of the relationships between mass, frontal area, and velocity. The class analyzes the data together, then uses it to make connections to other applications of wind tunnel testing

Modification for advanced students: Each student will predict his/her own terminal velocity in the wind tunnel. In other words, how fast must the air in the wind tunnel move to make each student "float"? The students will use algebraic reasoning to solve the air drag equation for

"v". The groups will then use measuring tapes and scales to determine their weight and frontal area. During their flights, an instructor will be recording their actual terminal velocities.

Afterwards, the students will compare their actual velocities to their predicted values. The Educator will lead them through a discussion of error and the class will brainstorm possible reasons for the error. If time is running short, the classroom teacher will be given all the materials necessary to conduct this discussion back at school.

Flight Experience

All students are given flight instruction by a certified flight instructor, including an individual flight experience in the iFLY tunnel.

Grade level appropriateness

Our curriculum has been specifically designed to support the following standards:

Science

Year	Science Understanding	SU sub strands	*Science inquiry skills*
7	Change to an object's motion is caused by unbalanced forces, including Earth's gravitational attraction, acting on the object (ACSSU117)	Scientific knowledge has changed peoples' understanding of the world and is refined as new evidence becomes available (ACSHE119) & (ACSHE134) Solutions to contemporary issues that are found using science and technology, may impact on other areas of society and may involve ethical considerations (ACSHE120) & (ACSHE135) People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity (ACSHE121) & (ACSHE136)	Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge (ACSIS124) & (ACSIS139) Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed (ACSIS125) & (ACSIS140) Measure and control variables, select equipment appropriate to the task and collect data with accuracy (ACSIS126) (ACSIS141) Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships in data using digital technologies as appropriate (ACSIS129) & (ACSIS144) Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence (ACSIS130 & ACSIS145) Reflect on scientific investigations including evaluating the quality of the data collected, and identifying improvements (ACSIS131) & (ACSIS146) Use scientific knowledge and findings from investigations to evaluate claims based on evidence (ACSIS132) & (ACSIS234) Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations, using digital technologies as appropriate (ACSIS133) & (ACSIS148)
8	Energy appears in different forms, including movement (kinetic energy), heat and potential energy, and energy transformations and transfers cause change within systems (ACSSU155)		
10	Energy conservation in a system can be explained by describing energy transfers and transformations (ACSSU190) The conservation in a system can be explained by describing energy transfers and transformations (ACSSU229)	Scientific understanding, including models and theories, is contestable and is refined over time through a process of review by the scientific community (ACSHE157) & (ACSHE191) Advances in scientific understanding often rely on technological advances and are often linked to scientific discoveries(ACSHE158 & ACSHE192)	Formulate questions or hypotheses that can be investigated scientifically (ACSIS164) & (ACSIS198) Plan, select and use appropriate investigation types, including field work and laboratory experimentation, to collect reliable data; assess risk and address ethical issues associated with these methods (ACSIS165) & (ACSIS199) Select and use appropriate equipment, including digital technologies, to collect and record data systematically and accurately (ACSIS166) & (ACSIS200) Analyse patterns and trends in data, including describing relationships between variables and identifying inconsistencies (ACSIS169) & (ACSIS203) Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170) & (ACSIS204)

Maths

Year	**Number and Algebra**	**Measurement and Geometry**	**Statistics and probability**
7	*Real numbers* Round decimals to a specified number of decimal places (ACMNA156) Find percentages of quantities and express one quantity as a percentage of another, with and without digital technologies. (ACMNA158) *Patterns and algebra* Introduce the concept of variables as a way of representing numbers using letters (ACMNA175) Extend and apply the laws and properties of arithmetic to algebraic terms and expressions (ACMNA177)	*Using units of measurement* Establish the formulas for areas of rectangles, triangles and parallelograms, and use these in problem-solving (ACMMG159)	*Data representation and interpretation* Identify and investigate issues involving numerical data collected from primary and secondary sources (ACMSP169)
8	*Number and place value* Carry out the four operations with rational numbers and integers, using efficient mental and written strategies and appropriate digital technologies (ACMNA183)	*Using units of measurement* Choose appropriate units of measurement for area and volume and convert from one unit to another (ACMMG195) Investigate the relationship between features of circles such as circumference, area, radius and diameter. Use formulas to solve problems involving circumference and area (ACMMG197)	
10	*Patterns and algebra* Apply the four operations to simple algebraic fractions with numerical denominators (ACMNA232) Substitute values into formulas to determine an unknown (ACMNA234)	*Using units of measurement* Solve problems involving surface area and volume for a range of prisms, cylinders and composite solids (ACMMG242)	

Making the most of your field trip

1. Deliver the “Pre Field Trip” pdf slides to your students (This is also available in .pptx format. Contact us and we can email you this file). This presentation will show students what to expect when they arrive at the wind tunnel. It will also introduce some of the vocabulary and STEM concepts we will cover in the field trip. At the end of the slides, you will find a page containing a “script” that you can read word-for-word to your students. No preparation necessary!
2. If you have questions before, during, or after your field trip, please do not hesitate to contact iFLY staff. We are happy to answer any questions that will make your students’ better!
3. Arrive on time. Students’ flight times are prescheduled and cannot be rearranged. Arriving promptly will ensure that your students do not miss any portions of their education experience.
4. During the classroom activity, the STEM Educator may ask for your assistance to help students with certain portions of their investigation. Please encourage parents and other field trip chaperones to jump in and lend a hand!
5. Please help us improve and strengthen our program by completing the Teacher Survey. We value your feedback! 6. You will receive materials and suggested activities to complete back in the classroom. Having a follow-up discussion or activity with your students after the field trip will help support the concepts they learned during their visit.