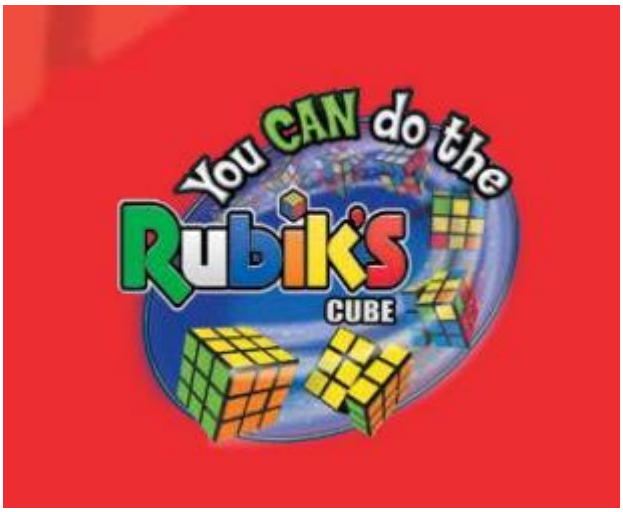
TESOL 502 Methodologies

Assessment 2

CLIL Unit: You Can Do the Rubik's Cube

Lesson 1: Meet the Cube



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Scope and Sequence Chart of 10 lesson Unit of Work : You Can Do the Cube

Scope and Sequence : You Can Solve the Cube							
Main Student tasks (content knowledge)	**Language Skills L: Listening S:Speaking R: Reading W:Writing**	**Language Functions (students use language to…)**	**Specific language competence (communicative competence)**			**Strategic competence (metacognitive, cognitive, social/affective)**	**Assessment**
			Grammatical / Lexical	**Discourse**	**Socio-linguistic**		
Lesson 1 : Meet the Cube Identify the common parts of the Rubik's Cube including faces, edges, corners and colour pairs Recognize the letter representations for the position of the Rubik's Cube and employ them with respect to Cube manipulation Know the meanings of the important	L: listening to demonstrations from teacher describing properties, listening to WAM videos of vocab, and videos of cube properties and directional turns made by teacher in class and at home S: Repeating the instructions while performing the algorithms with their own cube when demonstrated by teacher, and saying out loud	Describe the properties of the Rubik's Cube Follow instructions /algorithms Create algorithms Solve problems Use first algorithm to create 'The white daisy'	Vocab: Cube, Face, Centre, Edge, Corner, Thumb, Index finger, middle finger, right, left, up, down, front, back, quarter, turn, clockwise, inverted (counter-clockwise) Imperative Formula / sequence of instructions Vocab in Chant : (To Military Cadence tune) LEFT LEFT LEFT RIGHT LEFT , UP UP UP DOWN UP, FRONT FRONT FRONT FRONT BACK FRONT	How words are used to form algorithms to solve problems	Understanding these words have specific meanings in the Math Context, and the Rubik's Cube Culture, but are used in other everyday contexts (this is to be built on each lesson).	Rubik Trivia each week will tap into Social /Affective Competence Use the teacher made videos available at home (YouTube) to remember how to say things, and practice saying / doing them	Identify the faces, edges, and corners by colour and position Make and recognize ¼ turns with relationship to the ¼ turn letter representations (ie. R Ri L Li) Understand that the Rubik's Cube is a geometrical cube with 6 faces, 8 corners, and 12 edges. Understand that each small cube within the cube represents units of measurement (3 units long and 3

instructional words relating to solving the Rubik's Cube and their application to basic geometrical concepts	the vocab in WAM videos both in echo form, and recall form. Singing out loud the chants. R: reading the powerpoint slides accompanying the class demonstrations, reading the instructions of pattern algorithms on the practice sheets and solve manual. W: Writing their own pattern algorithms on activity sheet.						units wide)
Lesson 2: The White Cross Solve the White Cross on the White Face of	All LSR as per lesson 1 W: Writing sequences of random turns	Follow instructions /algorithms Create algorithms	Vocab: Scramble, random, Layer, Bottom, middle, top, If…then…(**If** cube	Throughout unit, teacher will help students to make connections	Understanding that an algorithm like LEFT LEFT LEFT RIGHT LEFT is the same as a	Create mnemonics of the algorithms, combining both cognitive and metacognitive	Solve the white cross Understand the meaning of algorithms and

the Cube Understand that sequences or algorithms can be used to acheiee a similar goal Implement the ¼ turns to scramble the cube in order to solve it	W: Cloze exercises with missing words of describing the turns and of strategies to troubleshoot.	Solve problems Ask and answer 'If not…then, if yes…then' questions to troubleshooting and choose appropriate algorithm	looks like this (visual) **then** do this (algorithm). Vocab of the Inversion Move Chant Song: You put your right toward your ear (repeat) And the top to the left (repeat) And the front to the left (repeat) And the top to the right (repeat)	with how words in Maths are used in other contexts and their world : This and next week 'Face' – To face, body part face, save face, Facebook, about face, two-faced, face up, face value, in your face etc.	set of steps to calculate a multiplication problem and can be used to solve many problems	Rubik Trivia each week will tap into Social /Affective Competence Use the teacher made videos available at home (youtube) to remember how to say things, and practice saying / doing them	relate them to the Rubik's Cube Understand the use of ¼ turns to create algorithms that will solve the white cross
Lesson 3: Solve The White Corners Understand the algorithms used to solve each whte corner Identify and correlate the correct corners with corner placements Understand the	All LSR as per lesson 1 W: Use selected words from Vocab to fill in blanks about description of white corner patterns and algorithm choices,	Follow instructions /algorithms Create algorithms Solve problems Ask and answer 'If not…then, if yes…then' questions to troubleshooting and choose appropriate	Vocab: algorithm, permutation White Corners Chant Song: Right down (repeat) Bottom Left (repeat) Right Up (repeat) Bottom Right (repeat)		Repeating patterns or algorithms as many times as needed is similar to solving long division problems		Use the vocabulary word, algorithm, comfortably when speaking of sequences to solve the white corners Solve the white corners (Advanced) Understand the similarities between long division and 'Ri Di R D'

sinilarities between algorithms for the white corners and long division		algorithm					
Lesson 4: The Middle Layer Understand the algorithms to solve the middle layer Identify the direction of rotation an edge piece needs to move Apply the knowledge of clockwise and counter-clockwise moves to manipulate the unit pieces of the cube	All LSR as per lesson 1 W: Use selected words from Vocab to fill in blanks about description of middle layer patterns and algorithm choices,	Follow instructions /algorithms Create algorithms Solve problems Ask and answer 'If not…then, if yes…then' questions to troubleshooting and choose appropriate algorithm	Horizontal, Vertical , line, row, parallel Middle Layer Chant Songs Vocab: Superman Move (move a piece to the right) Hey, hey, bo-diddly-bop I'm gonna get this to the right spot With an upside down T in my hand I'm gonna flip like Superman! Top Left Right Up Top Right Right Down Top Right Face Left Top Left Face Right Jackie Chan Move (Move a piece to the left) Hey, hey, bo-diddly-bop I'm gonna get this to	Throughout unit, teacher will help students to make connections with how words in Maths are used in other contexts and their world : This and next week 'Corner' – To corner something in, street corner, corner (soccer), corner shop, blind corner,			Solve the middle layer of the Rubik's Cube Identify direction of rotation a piece needs to move to be placed in its correct position Apply the previous concepts of clockwise and counter-clockwise movements to directions of rotation Understand the difference between vertical and horizontal lines

			the LEFT spot With an upside down T in my LEFT hand I'm gonna flip like Jackie Chan! Top Right Left Up Top Left Left Down Top Left Face Right Top Right Face left				
Lesson 5 The Yellow Cross Solve the Yellow cross on the Yellow face of the Rubik's Cube Identify common pattern images in order to follow directions Understand the meaning of symmetry	All LSR as per lesson 1 W: Use selected words from Vocab to fill in blanks about description of yellow cross patterns and algorithm choices,	Follow instructions /algorithms Create algorithms Solve problems Ask and answer 'If not…then, if yes…then' questions to troubleshooting and choose appropriate algorithm	Angle, Right angle, 90 degree angle, symmetry Vocab to Yellow Cross Chants :F.U.R.U.R.F. Move (To the Mexican Hat Dance Tune) Front Right Top Left Right Up (clap, clap) Top Right Right Down Front Left (clap, clap) F.R.U.R.U.F. (when you have a yellow 'belt') Front Right Right Up Top Left (clap, clap) Right Down Top Right Front Left (clap, clap)				Solve the yellow cross Recognize pattern images in order to follow the steps to solve for the yellow cross Understand the meaning of symmetry and identify symmetry within the yellow cross

Lesson 6: The Yelllow Face Correctly identify LEFT/FRONT/UP corner with regards to image matching Utilize the algorithm multiply times, if necessary, to manipulate the corner pieces of the yellow face. Understand the variation of geometric shapes with respect to translation, reflection, and rotation		Follow instructions /algorithms Create algorithms Solve problems Ask and answer 'If not…then, if yes…then' questions to troubleshooting and choose appropriate algorithm	Translation, reflection, rotation	Throughout unit, teacher will help students to make connections with how words in Maths are used in other contexts and their world : This and next week 'centre – shopping centre, city centre, centre forward (sport), centre of the earth, left right and centre, centre stage etc			Match and rematch the yellow cross image repeatedly to solve the yellow face Identify LEFT/FRONT/UP corner without the use of the colour face names Understand the meaning of translation, reflection, and rotation with respect to their definitions and applications to the Rubik's Cube
Lesson 7: The Yellow Corners Solve the yellow corners	All LSR as per lesson 1 W: Use selected words from Vocab to fill in	Follow instructions /algorithms Create algorithms	Bottom left corner, Top right corner, Diagonal, adjacent, non-adjacent Vocab to yellow			Solve a problem – in math if you cant sole a problem then a different approach might help you solve it	Each student should be able to: Solve the yellow corners Match and rematch the yellow face

Understand the image matching with respect to the corners of the yellow face. Recognize the relationship between solving the yellow corners and problem solving in maths.	blanks about description of yellow corner patterns and algorithm choices,	Solve problems Ask and answer 'If not…then, if yes…then' questions to troubleshooting and choose appropriate algorithm	corners chant songs: The Easy Peasy Move (Yellow Corners on Top) Right Up Top Left Right Down Top Left Right Up Top Left Top Left Right Down The Persevere Song (You're Almost There!) Right Down Front Right Right Down Back, Back Right Up Front Left Right Down Back, Back Right Up, Right Up Top Right			better (guess and check, diagrams, lists, tables, write out equation…	image repeatedly to solve the yellow corners Understand the relationship between solving the Yellow corners and problem solving in math
Lesson 8: The Yellow Edges Solve the yellow edges Correctly position the cube with regard to image matching of the yellow edges Apply the	All LSR as per lesson 1 W: Use selected words from Vocab to fill in blanks about description of yellow edges patterns and algorithm choices,	Follow instructions /algorithms Create algorithms Solve problems Ask and answer 'If not…then, if yes…then' questions to troubleshooting	Vocab to chant songs for yellow edges: The Final Moves Chant (pat, clap, pat, clap) Front, Front Top to the Left (or right) Left Down, Right Down Front, Front Left Up, Right Up Top to the Left (or right) Front, Front			Problem solving takes steps, we followed the algorithms of each step to solve the whole cube	Solve the yellow edges Be confident with image matching Utilize the algorithms based on clockwise and counter-clockwise movements

knowledge of clockwise and counter-clockwise movements		and choose appropriate algorithm					
Lessons 9 & 10 Students make a bilingual video of how to solve the Rubiks Cube – small groups work together to make a video of one stage each, then each stage put together to make one whole class collaborative video to solving the whole cube.	L: listening to the teacher made videos to revise and help with their own speech recordings R: reading solve manual and practice sheets as reference to create their speech and subtitles for the video S: Students record in speech algorithm instructions in both Chinese and English W: Students add subtitles to video in both Chinese and English	Share their learning with the School, local, and Australian community. To demonstrate what they have learned.	All vocab/grammar from the unit	How words are used to form algorithms to solve problems, and to use these to share with others in the local and wider community	Using the vocab and language from an instruction manual to create their own 'how to' manual but in a visual media format, so adapting in any way needed to reflect this media of communication, and their audience (school, other teachers, parents, Australian kids)	Applying content learned from the unit to create their own solve the cube manual in the form of a video to share. They will not have explicitly been taught every word in the manual, but will have to decipher from what they know. Creating and sharing - work together in small and large group, to share with wider community for Social/Affective Competence.	Complete a section of video to contribute to a whole class video

Rationale

This unit of work 'You can solve the Cube' is designed for a year 5/6 public primary school class in Taiwan. The Taiwan Ministry of Education as part of their 'Bilingual Nation by 2030' goal has prescribed CLIL as the preferred method for teaching English (Ministry of Education, 2018 and National Development Council 2020). I used the teacher materials and resources from 'You can do the Rubik's Cube – Original Rubik's Website', free to help teachers in the USA integrate primary school Math outcomes by learning how to solve the Rubik's Cube. I then adapted the resources to use 'You Can Solve the Rubik's Cube' as a CLIL unit in the Taiwan EFL context.

I believe that the most important thing when planning a unit of work for primary level EFL students is to create a motivational orientation: a love of learning another language. Brown (2007 p.168-175) explains the 'needs' concept of motivation, in cognitive terms children have a need for exploration, manipulation activity, stimulation, knowledge, and ego-enhancement. The Rubik's Cube is loved by many children because of the satisfying, manipulating, cognitively challenging nature, and the 'ego-enhancement' it can bring out, not only by celebrating the solving of each of many steps, but by competing with other children, or by beating their own personal best time of a step or the whole cube. Brown continues that the constructivist view of motivation is solidly grounded in community and belonging, the Rubik's Cube having forged timeless local and worldwide 'communities' and 'culture' amongst children (and adults!). So to provide an intrinsic motivational orientation to learning English (and Maths), the Rubik's Cube definitely taps into these underlying drives.

The unit of work 'You can solve the Rubik's Cube' weaves both Slater's (2011) Knowledge Framework for integrating language and content, and Mano's (1993) 'Into, Through and Beyond' strategy. Taking students '*into'* the world of the Rubik's Cube, the first lesson provides much of the grounding for '*classification'*, providing the general reference using 'being' verbs, e.g. 'this *is* a corner, this *is* an edge, the cube *has* 8 corners'. Taking students '*through'* the world of the Rubik's cube, they start to explore '*principles'* by learning the language of 'moving' or manipulating the cube in its various directions, how to display this language visually, and how patterns of these movements create algorithms. They '*choose'* by creating and writing their own algorithms, describing, comparing and contrasting the patterns created by their movements, and using their knowledge of '*sequence'* to identify the path or algorithm they will need to write to return to the 'solved' cube. They start to '*evaluate'*, learning how to ask and answer 'If not…then…, if yes…then…' questions to troubleshoot and choose appropriate algorithms. Students have the opportunity to go '*beyond'* by using their new language to share 'how to do the cube' with their parents, school community and other English/Mandarin speaking children of the world by creating a collaborative instructional bilingual video. After sharing the video with their school community, there would be opportunities for the students to implement a club or school competitions, further enhancing that sense of community.

The unit integrates all four skills of listening, speaking, reading and writing. Students will *listen* to demonstrations from the teacher introducing the properties, directional movements and then the algorithm sequences of the cube. My children (who are Rubik's Cube fanatics too) and I (who am not so much a fanatic☺) have made a series of videos, which will be uploaded to YouTube so that students can access at home. Videos that accompany lesson 1 are already uploaded to accompany this lesson plan. Lesson 1 videos include:

Video 1 : Vocabulary for the properties of the cube
https://www.youtube.com/watch?v=zmy4DX5UF4k&t=26s

Video 2: Vocabulary for the directional movements of the cube
https://www.youtube.com/watch?v=faQxC8jNhlo&t=1s

Video 3: The language for following a simple algorithm to create Multi-Coloured Cross or 'The Daisy' from a solved cube, to inverting the algorithm to revert back to the solved cube. https://www.youtube.com/watch?v=Tc7QuHk5n4k&t=16s

Video 4: A WAM session (Words / Action / Music). These sessions are carried out in class. The teacher, to a song with a rhythmic instrumental beat, says a word accompanied by a sign/gesture/or visual with the cube. The students echo the word and gesture/sign to the next beat of the song. Once students have had several practice sessions, the teacher can change the dynamics, sometimes only doing the gesture on the beat, so that the students have to recall the 'word' on the next beat. Sometimes the teacher may say the word on the beat, and the students have to use their listening and thinking skills to perform the appropriate sign/gesture on the next beat. This activity integrates kinaesthetic / linguistic/ and musical intelligences. A video of the vocabulary for each class will be available for the students to access at home, so that they can practice repeating the word in time to the beat, and then practice recalling the word, unlimited times and with no pressure at home. (These videos were made with one child gesturing the vocabulary in relation to the cube, one child with (Auslan) sign language gesture of everyday life (Auslan 2020) – so that students can eventually make the sociolinguistic connections of how words can be used similarly in different cultural contexts i.e. Maths context / Rubik's Cube Culture / Everyday life. See sociolinguistic competence below).
https://www.youtube.com/watch?v=ohQwVc3_NAs

Students will practice their *speaking* by repeating the vocabulary and algorithms in class demonstrations, and through the WAM activities in class and at home. There is also a chant song for each step/algorithm of solving the cube that students will chant as they practice. Part of their final project is recording audio of the steps to solving the cube for their video.

Students will see visuals of the written words and practice *reading* through PowerPoint slides that contain labelled visuals and that accompany each stage of

the lessons in class. They will *read* the activity sheets and algorithms for each stage of the lessons. They can *read* the words of the chants. They will be given access to the manual 'You can solve the cube' which the lesson plans have come from, so that they can *read* at any time as they take their solving journey. They will need to *read* their home connection sheets and the manual to help them to add subtitles to their final project video.

Students will *write* their own pattern algorithms, and in the '*through'* stage complete many cloze activities that not only help them consolidate the language but help them think about the math concepts. Students will need to compose and *write*/type subtitles (in both English and Mandarin) on their final project video.

The unit has tried to ensure that all components of Canale and Swain's (as cited in Brown 2007 p.219-220) *communicative competences* are included. Of course the students will need to consolidate the vocabulary (*grammatical* competence) to achieve the basic *discourse* competence of the unit: how words are used to form algorithms to solve problems. Understanding that these words have specific meanings in the Math Context and the Rubik's Cube Culture, but are used in other everyday contexts has been one of the biggest adaptations to these lesson plans for the EFL context in order to include *sociolinguistic* competence. In the WAM videos, my kids and I included the signs/gestures that we would use if we were telling a story or, as well as using a Rubik's Cube in the video as a visual to how the word would relate to the cube. E.g. '*Face'* of a cube is also a *face* on a body, the words '*quarter'* and '*turn'* are used specifically for a '*quarter turn'* in cube culture (demonstrated as such with the cube as we say it), but are also words that are used in everyday life, so the general gesture for '*quarter'* and '*turn'* is also learned, so that students can make those connections when used in other contexts, or in previous or future English classes. Students are also helped to understand that an algorithm like 'LEFT LEFT LEFT RIGHT LEFT' is the same concept as a set of *steps* used to solve many kinds of problems, not just the math kind…so this *sociolinguistic* connection is also made. *Sociolinguistic* competence is also practiced when the students have to use the vocab and language from an instruction manual to create their own 'how to' manual but in a visual media format, so adapting in any way needed to reflect this media of communication, and their audience (school community, other teachers, parents, Australian kids etc.).

Strategic competence is practiced by learning to access the teacher made videos available at home to remember how to say things, and practice saying / doing them. Students will create mnemonics using English words of the algorithms, combining both the *cognitive* and *metacognitive* forms of *strategic* competence. They will learn that if they can't solve 'the yellow cross' for example, using a particular algorithm, then a different algorithm (strategy) is needed, maybe a guess and check approach, or writing out the algorithm in a table might help them to solve it better. This will be scaffolded further to use all forms of *strategic* competence by applying content

learned from the unit to create their own 'How to solve the cube' manual in the form of a video to share tapping into the *social/affective* form of *strategic* competence.

Some anticipated problems and strategies.

- CLIL methodology has been criticised as anxiety provoking for students that feel 'lost' in the foreign language. The videos have been made to help students who feel lost in class to revise both the English and Math content at home at their own consolidation pace. Most of the *foundation* language is introduced in the first lesson, and even though new vocab and concepts are introduced each lesson, the 'language' used to give the instructions is repetitive and therefore is recycled and consolidated deeper each lesson.
- Solving the Rubik's Cube can be seen a daunting task even when the instruction is in your first language (this is the case for me ☺) . Alternatively it could be seen that the 'CUBE' is something the children can explore and manipulate in a fun and safe environment, through which both Maths and English outcomes can naturally be achieved (this lesson unit is probably most daunting for the teachers!!).
- Some students will take longer to consolidate steps, and some will be move ahead faster. Differentiation: During practice time groups can be formed on their level of consolidation. The videos and plenty of algorithm activity sheets will help the students that need it to practice more. The more confident students can spend some time helping out, and some time organising 'beat the clock' competitions amongst themselves, or try juggle 3 cubes and solve them at the same time (this is a thing ☺)
- Even though many children, both girls and boys, love the satisfying challenging nature of the cube, it may not be every student's 'thing'. The cube does seem to have a magic ability to bring children together in a Rubik's 'craze' community. Little things like letting students take turns choosing their favourite instrumental fast beat song to do our WAM sessions to. And each week a motivational / inspirational video can be shown, to maintain the feeling of community the cube can bring.

Examples:

Scrambled – Animation – no language – just a lovely animation to motivate when you feel like giving up ☺ https://www.youtube.com/watch?v=kmrZyByO8Qc

Motivation how the skills can lead to anything you can do in life :
https://www.youtube.com/watch?v=zk7CP9n4PSo

Speedcube motivation: There are lots of videos of speed-cubers and competitions (Movie documentary 'Speed Cubers' just been released too)
https://www.youtube.com/watch?v=hyimUwZbWpc

A Ted Ed Video to advanced students and teachers to show how advanced Math skills are learned from solving the cube (and how music fits in to it all☺)
https://www.youtube.com/watch?v=FW2Hvs5WaRY

A CGTN news story (narrated in Mandarin / subtitles in English), from perspective of young student and parent, of the Juggling Cuber Guinness Record holder story
https://www.youtube.com/watch?v=sXvs2v-Zjs8

Asia's Got Talent – juggling cuber
https://www.youtube.com/watch?v=8Z64ObLyo30

And many more from Rubik's Official You Tube Chanel (You can Do the Cube)
https://www.youtube.com/channel/UC8QaHaSt_yV909cTFnJdGXA

Description of student profile and context

I am not currently teaching English, but hope to teach in the Foreign English Teacher program in Taiwan in the future. This program is for Foreign Teachers to work in public schools to give students a higher level of communicative competence to reach the goal of a Bilingual Nation.

Therefore, this unit of work is designed for an imaginary year 5/6 class in a public school in Taiwan. Some things to note when creating student profile:

- Students in Taiwan over the last few years have commenced English in grade 3. Some schools are now starting in grade 1 to start the foundation earlier. But for the purpose of this assignment, I will presume the students have started in year 3, and have had 2 years of English Language introduction. They will have been introduced to basic vocabulary typical of English text books for beginners, and classroom instructions.
- Some students will probably attend private after-school English classes.
- Some students may school in Mandarin, and speak Taiwanese or other local dialect at home.
- Most foreign teachers are instructed to teach with CLIL methodology, but this has had challenges being implemented (Tsou 2018 and Ying 2019). CLIL classes will have a local Taiwanese English or content teacher in the classroom with the foreign teacher. This can help, and can also be a problem if they translate every instruction into Mandarin for the students. Being able to speak Mandarin, I hope to be able to introduce some 'fun rules' for both students and teacher, with some kind of symbol (maybe an arm or head band) to create a safe and fun (low anxiety), and using (mostly) English environment, with pared down language (initially) that can commence once we wear the bands.
- The unit offers many possibilities of differentiation (some noted in rationale) after first few weeks of student observation and evaluation.
- The Taiwan 12 year curriculum guidelines have responded well to researchers such as Huang (2002) recommending student centred needs, spontaneity, and 'fun' for deeper communicative competence. But there are still embedded perceptions of learning by books and imitation (Tian 2020). This unit can embrace the transitioning context and CLIL prescribed methodology, and the WAM sessions and the clear pathway for using algorithms to solve the cube can integrate imitated instruction with MI thinking.
- ACARA's (2020) and the Taiwanese Maths Primary School Years Curriculums (MOE 2020) are not identical but follow similar outcomes paths. This unit covers geometry and number outcomes from Grade 1- 6 (and beyond if you want to delve into advanced mathematics ☺ So students will be consolidating past alongside new outcomes as relative to their outcome to

solve the cube. Over the unit the following outcomes can be measured, in conjunction with the Taiwan Math Curriculum:

Investigate and describe number patterns formed by skip-counting and patterns with objects

Measure and compare the lengths and capacities of pairs of objects using uniform informal units

Recognise and classify familiar two-dimensional shapes and three-dimensional objects using obvious features

Recognise and interpret common uses of halves, quarters and eighths of shapes and collections

Compare and order several shapes and objects based on length, area, volume and capacity using appropriate uniform informal units

Describe and draw two-dimensional shapes, with and without digital technologies

Describe the features of three-dimensional objects

Identify and describe half and quarter turns - predicting and reproducing a pattern based around half and quarter turns of a shape and sketching the next element in the pattern

Make models of three-dimensional objects and describe key features

Identify angles as measures of turn and compare angle sizes in everyday situations

Compare objects using familiar metric units of area and volume

Compare the areas of regular and irregular shapes by informal means

Use efficient mental and written strategies and apply appropriate digital technologies to solve problems

Calculate perimeter and area of rectangles using familiar metric units

Connect three-dimensional objects with their nets and other two-dimensional representations

Describe translations, reflections and rotations of two-dimensional shapes. Identify line and rotational symmetries

Estimate, measure and compare angles using degrees.

LESSON PLAN COMPONENTS

Unit of Work: You can solve the Rubik's Cube

Lesson One: Meet the Cube

Student objectives	SWBAT
Content	• Identify the common parts of the Rubik's Cube • Recognise the letter representations for the faces and employ them with respect to cube manipulation • Know the meaning of important instructional words relating to solving the Rubik's Cube and their application to geometrical concepts.
Curriculum Links	The Taiwan Math Curriculum is linked (MOE K-12 Education Administration) but is in Mandarin. The primary Math outcomes are similar to the Primary ACARA (2020) outcomes as follows: (The whole unit covers a variety of geometry and number oucomes from grade 1-6) Describe the features of three-dimensional objects Identify and describe half and quarter turns - predicting and reproducing a pattern based around half and quarter turns of a shape and sketching the next element in the pattern TESOL Standards (Tesol International Org 2020) Standard 1: English language learners communicate for social, intercultural, and instructional purposes within the school setting. Standard 3: English language learners communicate information, ideas, and concepts necessary for academic success in the area of mathematics.
Language	**Revision** of Numbers, Colours: (Blue, Red, Green, Yellow, Orange, White) Verbs: to be, to have (this is…it has… **New Vocab**: cube, face, centre, edge, corner, thumb,

	index finger, middle finger, right, left, up, down, front, back, quarter, turn, clockwise, inverted, (counter-clockwise), opposite Vocab in Chant : (To Military Cadence tune) LEFT LEFT LEFT RIGHT LEFT , UP UP UP DOWN UP, FRONT FRONT FRONT BACK FRONT Questions: How many? (How many corners?) Which colour? (Which colour face is opposite to the blue face?) Imperative (instructions). Discourse structure To describe the properties of a shape To create algorithms based on these properties To follow algorithms to solve a problem

Skills	Four Skills Integration Listening: • to description of the cube through modeling and group discussion questions and responses exploring the properties • to the WAM – Words Action and Music (kinesthetic/musical/linguistic) videos • to the chants of the algorithms • to and responding to the TPR requests eg. 'Put your thumb and finger on the White and Green edge' • to the instructions for the pattern creations activities Speaking: • Participating in the group discussion to answer exploratory questions about the properties of the cube • Repeating the vocab in the kinesthetic/musical/linguistic review activities • Repeating after a TPR request 'This is the White and Green edge, place your thumb and index finger along the white and green edge'. • Singing the chants for the algorithms Reading: • The colours in words on the Cube Net • Reading the instructions alongside the visuals and demonstrations off the Powerpoint when learning about the properties and directions of the cube. • Reading the instructions off the powerpoint for the pattern creation activities • Reading the instructions in their 'Solve the Cube' manual (This will take the whole 8 sessions using the 'into, through and beyond' strategy, being introduced visually to the key words in this first lesson) Writing: • Writing the words to their 'Pattern Creations' as an algorithm eg. Up Up Up Down Up, Left Left Left Right Left

Resources and materials	Resources How to solve the Rubik's Cube Booklet (for students) Teachers Guide to solving the Cube Rubik's Cube Mat (one per student) Materials • Rubik's Cube Student Solving Booklet 1 per student (From You can Do the Cube Site) • Class set of Rubik's Cubes • Coloured Pencils • Scissors and tape • Rulers • 'You can do the cube' Rubik's video https://www.youtube.com/watch?v=Ewygo0Fv6Jo • PowerPoint slides of properties, directional vocab, algorithms for pattern activities • Song to do WAM activity to • ¼ turn practice sheets (x3 activities) • Home Connection Handout • Net of Cube handout • Pattern Creation/Writing Handout • Teacher made videos: (for home access) Video 1 : Vocabulary for the properties of the cube) https://www.youtube.com/watch?v=zmy4DX5UF4k&t=26s Video 2: Vocabulary for the directional movements of the cube https://www.youtube.com/watch?v=faQxC8jNhlo&t=1s Video 3: The language for following a simple algorithm 'The Daisy' (Multi-coloured Cross) and invert back. https://www.youtube.com/watch?v=Tc7QuHk5n4k&t=16s Video 4: WAM Video https://www.youtube.com/watch?v=ohQwVc3_NAs

PROGRESSION OF ACTIVITIES

Time/ Duration	Activities	Grouping	Skills	Materials
5min	Springboard (Into) Show Students Video of You Can do the Cube Intro https://www.youtube.com/watch?v=Ewygo0Fv6Jo	T-Ss	L	Rubik's video

15 mins	**Intro Vocab: (Into)** FACE – Point to the blue face say 'This is the Blue face' – repeat all colours, Ask students: 'How many colours are there?' 'How many faces are there?' (PP slide 2) OPPOSITE – Ask Students: 'Which colour is opposite to the blue face?' Tell students the BLUE and GREEN faces are always opposite to each other. Keep repeating 'opposite' questions till students have an idea of what 'opposite' means. Tell students to twist top row of cube so that the blue top row is now on the green face (demonstrate while asking). Ask: 'Are the Green and Blue still opposite?' (Yes). Twist back to original place. Repeat all colours. (PP slide 3) CENTRE: Find the blue face and point to the centre piece. Say 'This is the blue centre piece, it does not move, it represents the blue face'. Repeat, students can repeat. Ask 'How many centre pieces are on the Rubik's Cube? (PP slide 4) EDGE: Tell students to place thumb and index finger on the WHITE and GREEN edge. Say: This is an edge. Repeat all edges, students repeat. Ask: How many edges are on the Rubik's Cube? (PP slide 5) CORNER: Tell students to: Place your left thumb, index finger and middle finger on the BLUE, RED and WHITE corner. Say: This is a corner. Students repeat, repeat with all corners. Ask: How many corners are on the Rubik's Cube? (PP slide 6)	T-Ss	L, S, R	Rubik's Cube each PP Slide 2 PP slide 3 PP slide 4 PP slide5 PP slide 6

	RIGHT: Show PP slide 7 (point to relevant parts of PP while demonstrating). Say: 'From now on the RIGHT face will be represented with a capital R. The right face is always the face on the right, where your right hand touches, it doesn't matter what colour it is'. Demonstrate: 'Twist the right face of the cube with your right hand to the orange face, so that the 3 blue pieces of the right are facing UP'. Say: 'This is a ¼ turn rotation. (Can add This is a 90 degree turn for advanced students) Say: 'The 'R' means that the RIGHT face always moves ¼ turn CLOCKWISE. Ask: 'What is clockwise?' Check students are turning their right side clockwise 1 ¼ rotation. Tell students to turn back the RIGHT face to its original position. (Back to a solved cube). Ask: 'What is counter-clockwise? Show students a counter-clockwise ¼ turn of the right face. Check. Show on PP7 – an 'i' means 'inverted' or counter-clockwise R means a ¼ turn clockwise, Ri means a ¼ turn counter-clockwise. Demonstrate and repeat lots of times checking students are turning their right side and then undoing with the Ri move. Repeat above demonstration and language with the LEFT face (PP8), Up face (PP9), DOWN face (PP10), Front Face (PP11) and BACK face (PP12). Use PP screens for each to point to visual and language, while demonstrating and having students practice.			PP slide 7 PP slide 8,9,10,11,12

	Activities/tasks (Through)			
4 mins	WAM (words/action/music) – Play rhythmic beat song and cover all intro vocab with sign having students echo. Repeat.	T-Ss	L,S	
1 min	Put cubes aside. Hand out ¼ turn practice sheets. Chant to tune of 'Military Cadence'		L,R, S	
	'LEFT LEFT LEFT RIGHT LEFT'			
	Students repeat chant.	T-Ss		
5 mins	Once students have the hang of the chant, pick up cube with White face up, Yellow face down, Blue Face Front, chant song and use cubes to practice the ¼ turn algorithms on the practice sheet 1 (also on PP13).		R,S	Practice algorithm sheets PP13
	Repeat with practice sheets for UP UP UP DOWN UP and FRONT FRONT FRONT BACK FRONT algorithms and chant while practicing (PP14&15).	T-Ss		PP14/15
	Repeat with inverted (counter-clockwise) practice sheet. Chant: LEFT INVERTED, LEFT INVERTED, LEFT INVERTED, RIGHT INVERTED, LEFT INVERTED and then with the FRONT/BACK/UP/DOWN Inverted algorithms (PP16,17,18).			PP 16/17/18
10 mins	Hand out Rubik's Cube Net so that students can colour, and make their own cube to be able to talk about the faces, edges, corners, and opposite colours at home if they do not own a cube.	Ss (self but can discuss together)	R	Net handout, colour pencils, scissors
10 mins	Hand Out Pattern Creation Sheet. The sheet has all the different ¼ turn moves the students have practiced. Ask students to create their own pattern (algorithm) writing each move on the lines, then the REVERSE pattern to make sure the cube returns to a solved cube. Demonstrate a pattern and reverse pattern algorithm on the board.	Ss (self but can discuss together)	R,W	Writing algorithm pattern sheet

5 mins	Closure –Beyond Tell the Rubik's Cube was invented in 1974. Write on the board. Ask: How old is the Rubik's Cube? Students can work out together. (PowerPoint 24) Tell students that now we know most of the language that they will be using the 'How to Solve the Rubik's Cube' booklet in English to solve the cube – ready for the next stage.	T-Ss	L,R,S	PP24

Evaluation:

- **Student:**

For this first lesson – mostly observing and evaluating the responses, abilities, reactions of the students to the content and language as a gauge for future lesson pacing. Complete the rubric attached just to assess overall effort and participation, with notes on anything that stands out, and a mark on the writing activity.

Diagnostic – in the introduction of vocab, observe students' responses to see what they already know, how comfortable they feel, as a gauge to assess how to pace the rest of the unit

Formative – Observe and assess participation in the activities, communicative competencies, and helping them with language in the 'through' stage to assess if and how to adjust future pace of lessons.

Summative – for this first lesson using the writing activity as a gauge to how the students are finding the easiness/difficulty of the lesson.

Teacher self-evaluation:

As per evaluation attached to assess how the lesson went and how to improve.

Follow up:

Students will take a 'home connection' sheet, and have access to the videos of the properties, directions, white daisy algorithm, and WAM video.

This will form the foundation of future steps/algorithms of solving the cube, towards finally creating their own video of 'How to solve the Cube'.

Student Assessment Rubric – Lesson 1 Meet the Cube (example as I do not know the students)

Student Name	Overall effort and participation			Writing algorithms /10 + comment
	Intro to Vocab	WAM	Practice algorithms	
Student 1				
Student 2				
Student 30				

Teacher Self-Evaluation

Activity	Rate /10	Positives	Negatives
Intro to Vocab			
WAM			
Practice algorithms			
Net of Cube			
Writing algorithms			

Other	Rate /10	Positives	Negatives
Language Dev			
Student Engagement			
Timing			
Behaviour			

How could I improve?

_____
_____
_____
_____
_____

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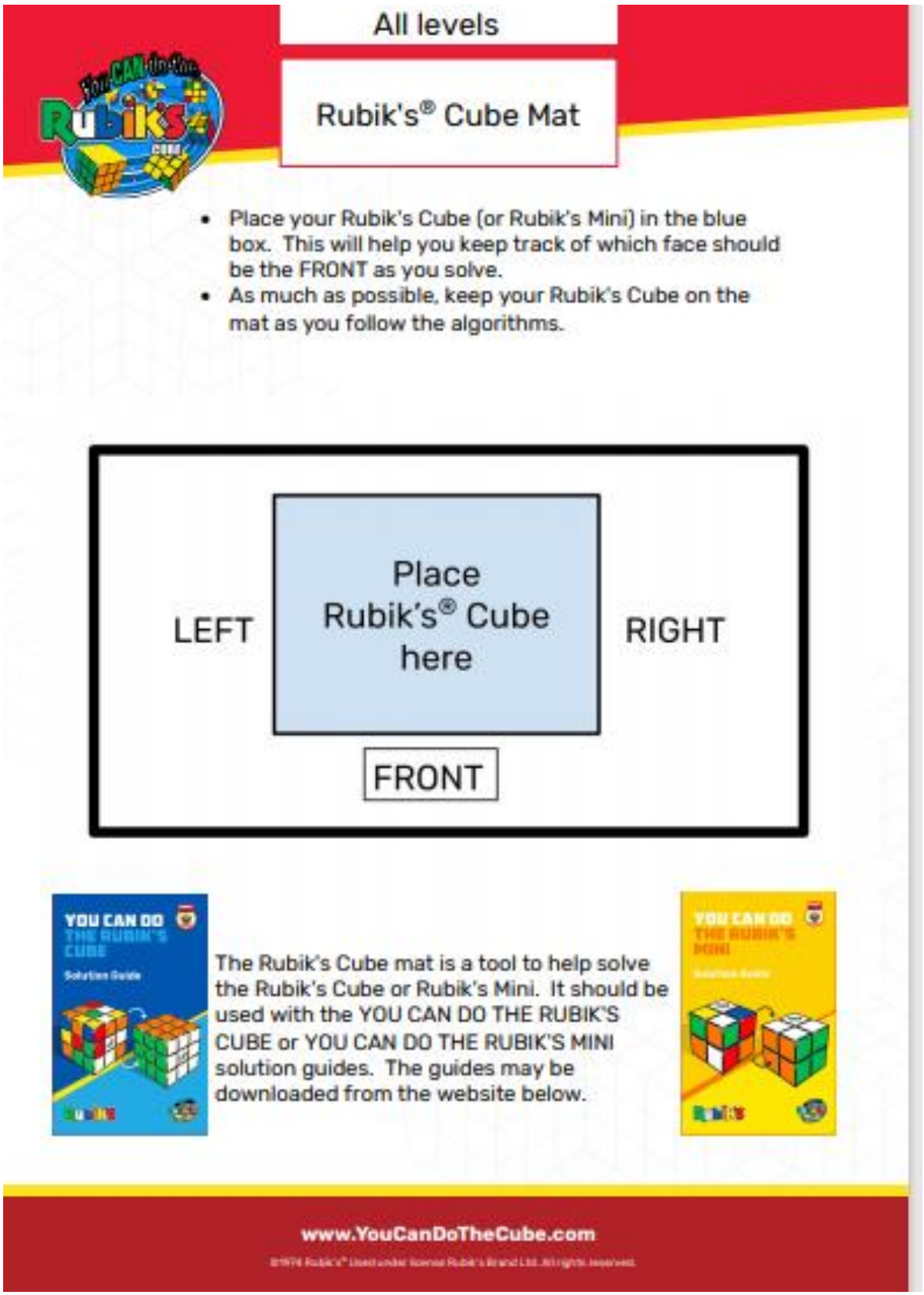
Appendices


All levels
Rubik's® Cube Mat
• Place your Rubik's Cube (or Rubik's Mini) in the blue box. This will help you keep track of which face should be the FRONT as you solve.
• As much as possible, keep your Rubik's Cube on the mat as you follow the algorithms.
LEFT
Place Rubik's® Cube here
RIGHT
FRONT
YOU CAN DO THE RUBIK'S CUBE
Solution Guide
The Rubik's Cube mat is a tool to help solve the Rubik's Cube or Rubik's Mini. It should be used with the YOU CAN DO THE RUBIK'S CUBE or YOU CAN DO THE RUBIK'S MINI solution guides. The guides may be downloaded from the website below.
YOU CAN DO THE RUBIK'S MINI
www.YouCanDoTheCube.com

Meeting the Cube

Lesson 1

AT HOME CONNECTION

Important Vocabulary

This vocabulary is necessary to understand the instructions to solve the Rubik's Cube.

FACE - Faces are the flat area of one side. The color of the face is based on the color of the center square.

EDGE - Edge pieces are where two faces (where two colors) meet.

CORNER - Corner pieces have three colors and form a point where the three colors meet.

CENTER - Center pieces are pieces that have only one color. They are found in the center of each face.

SIDES - Sides are represented by a specific letter.

R = Right face - Right side of the cube.

L = Left face - Left side of the cube.

U = Up face - Top side of the cube.

D = Down face - Bottom side of the cube.

F = Front face - Front side of the cube.

B = Back face - Back side of the cube.

INVERTED - Opposite.

CLOCKWISE - The direction the hands on a clock move.

COUNTER-CLOCKWISE - The opposite way the hand on a clock move.

WHAT WE LEARNED

The parts of the Rubik's Cube

The letter representations for the sides of the Rubik's Cube

The meaning of mathematics words that are used in the instructions to solve the Rubik's Cube

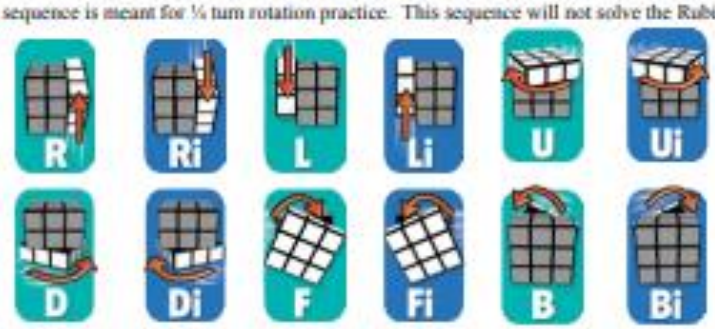
Corner Center Edge

At Home Connection

Practice Activity

Use the letter representations to make ¼ turn rotations on the Rubik's Cube.

(Note: This sequence is meant for ¼ turn rotation practice. This sequence will not solve the Rubik's Cube.)



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Meeting the Cube

Lesson 1

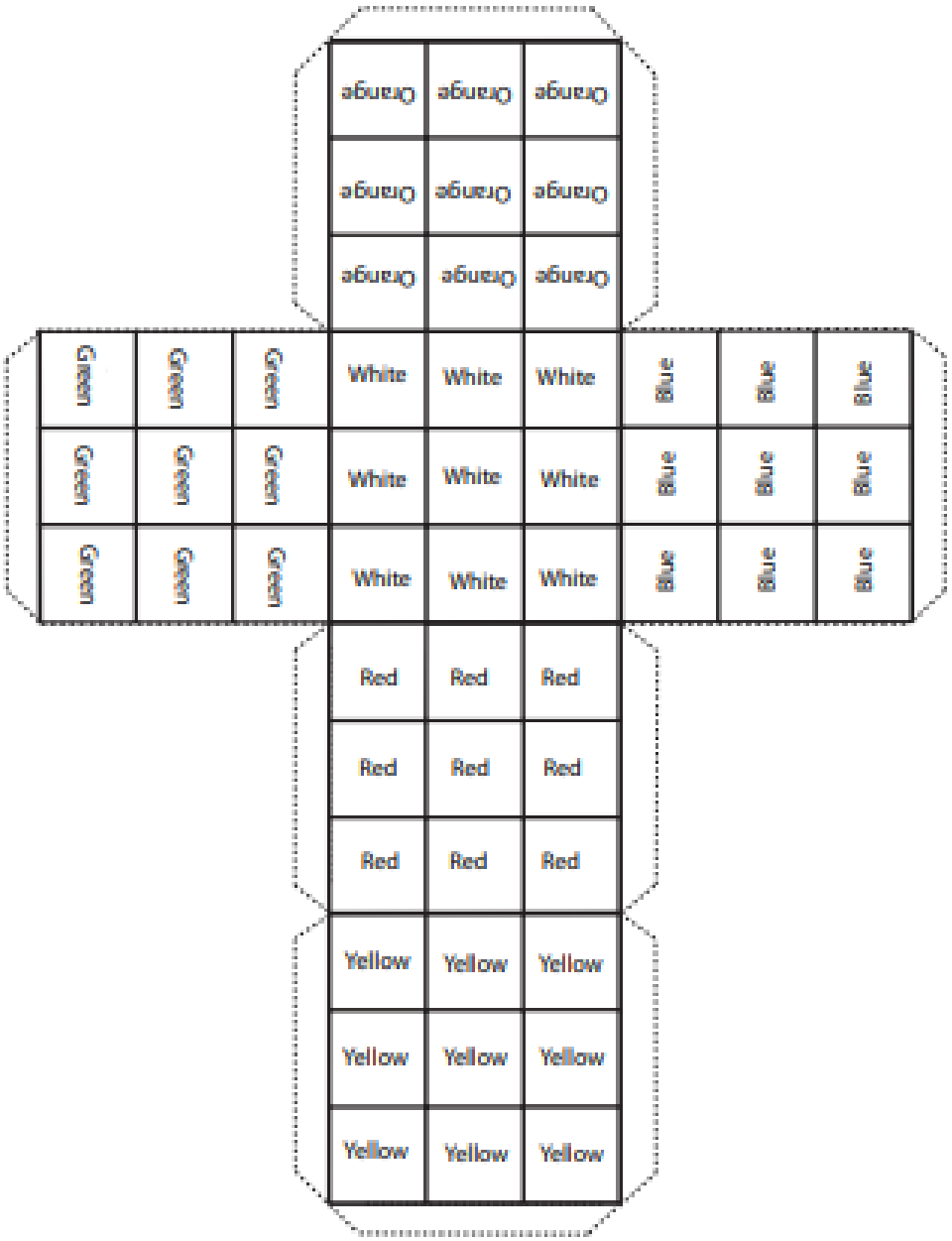
Differentiation Activities

Appendix 1.M

Rubik's Cube Net

Directions:

1. Cut along the dotted lines.
2. Fold on the bold lines and fold tabs inward.
3. Tape or glue the edges together using the tabs to form a cube.



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Lesson 1 **Meeting the Cube**

Appendix 1.A

¼ Turn Practice Sheet

Section A
Multi-colored Cross

Return to a solved cube:

Section B
Square in the Middle

Return to a solved cube:

Differentiation

Meeting the Cube

Lesson 1

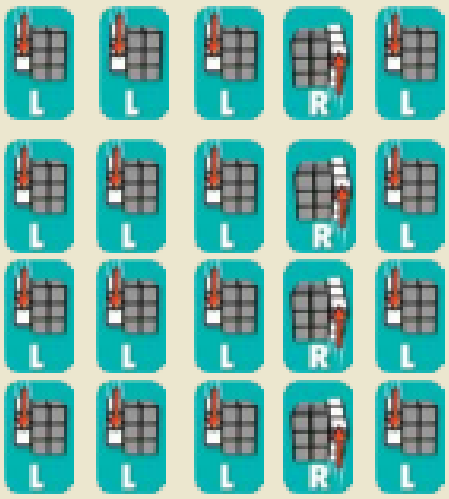
Appendix 1.Ta ¼ Turn Practice Sheet (Regular Moves)

Differentiation Activities

Start with a solved cube

To practice the **L** and **R** ¼ turn moves:
Follow the picture instructions. ➔

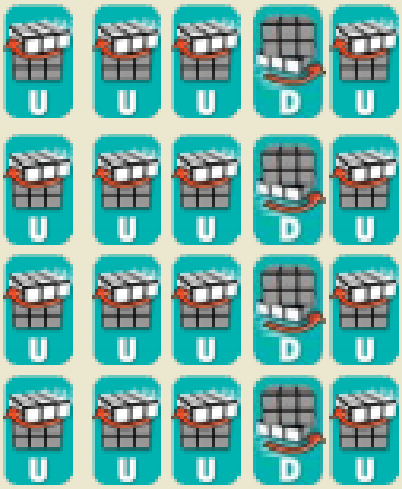
You should have a solved Rubik's Cube after completing all 4 rows.



Start with a solved cube

To practice the **U** and **D** ¼ turn moves:
Use the Military Cadence chant learned in the lesson and follow the picture instructions.

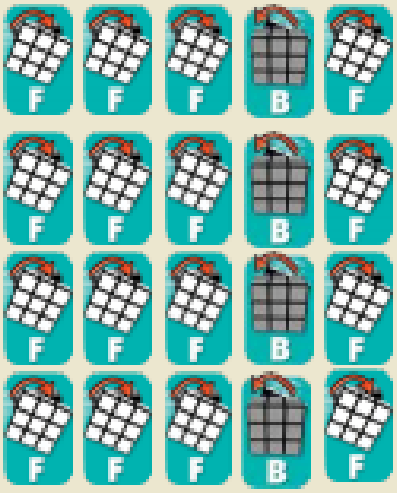
You should have a solved Rubik's Cube after completing the chant 4 times.



Start with a solved cube

To practice the **F** and **B** ¼ turn moves:
Use the Military Cadence chant learned in the lesson and follow the picture instructions.

You should have a solved Rubik's Cube after completing the chant 4 times.



Lesson 1

Meeting the Cube

Appendix 1.Tb

¼ Turn Practice Sheet (Inverted Moves)

Start with a solved cube

To practice the **Li** and **Ri** ¼ turn moves:
Follow the picture instructions. ➔

You should have a solved Rubik's Cube after completing the chant 4 times.

Differentiation Activities

Start with a solved cube

To practice the **Ui** and **Di** ¼ turn moves:
Follow the picture instructions below.

You should have a solved Rubik's Cube after completing the chant 4 times.

Start with a solved cube

To practice the **Fi** and **Bi** ¼ turn moves:
Follow the picture instructions below.

You should have a solved Rubik's Cube after completing the chant 4 times.

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Appendix 1.H

Pattern Creation

Use the following ¼ turn moves to design your own pattern on the Rubik's Cube, similar to the multicolored cross and the square in the middle. Write down each move on the lines provided. Your patterns must be reversible to return to a solved cube.

Pattern:

Reverse Pattern:

Meeting the Cube
Lesson 1
PP2
• Cube – Three-Dimensional
• RED, YELLOW, BLUE, GREEN, WHITE, ORANGE
• RED is opposite ORANGE
• WHITE is opposite YELLOW
• BLUE is opposite GREEN
• 3 units long; 3 units wide
• 8 units (perimeter of a face)
• 9 units (area of a face)
You CAN do the Rubik's Cube
Shape
Colors
Opposites
Length
Perimeter
Face
Vocabulary
Lesson Focus
Lesson Review
Rubik's Trivia
PowerPoint Presentation
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Lesson 1
Meeting the Cube
PP3
Back Face
Right Face
Front Face
Up Face
Down Face
Left Face
Rubik's Trivia
Lesson Review
Lesson Focus
Vocabulary
PowerPoint Presentation
You CAN do the RUBIK'S CUBE
FACES
The flat (two-dimensional) square, on each surface of the cube. There are six (6) faces on the cube, each with a directional name.
23

Meeting the Cube
Lesson 1
PP4
WHITE Face
ORANGE Face
BLUE Face
You CAN do the Rubik's CUBE
CENTER Pieces
Pieces with one color. There are six (6) center pieces, one in the center of each face. Center pieces DO NOT MOVE. They represent the color of their face.
Vocabulary
Lesson Focus
Lesson Review
Rubik's Trivia
Unit Presentation PowerPoint
24

Lesson 1
Meeting the Cube
PP5
Red/WHITE
Edge
YELLOW/RED
Edge
You CAN do the
RUBIK'S
CUBE
EDGE Pieces
Pieces with two colors.
There are twelve (12) edge
pieces located in the
middle rows.
Vocabulary
Lesson Focus
Lesson Review
Rubik's Trivia
PowerPoint
Presentation
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Meeting the Cube
Lesson 1
PP6
GREEN/ORANGE/YELLOW Corner
You CAN do the Rubik's CUBE
CORNER Pieces
Pieces with three (3) colors. There are eight (8) corner pieces located on the corners.
Vocabulary
Lesson Focus
Lesson Review
Rubik's Trivia
PowerPoint Presentation
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Lesson 1
Meeting the Cube
PP7
Ri
R
You CAN do the Rubik's CUBE
RIGHT Face Move
To "undo" a "R" ¼ turn, make a "Ri" ¼ turn.
• Inverted means opposite.
• By inverting a move, the move can be undone.
Vocabulary
Lesson Focus
Lesson Review
Rubik's Trivia
PowerPoint Presentation
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Meeting the Cube
Lesson 1
PP8
Li
L
LEFT Face Move
To "undo" a "L" ¼ turn, make a "Li" ¼ turn.
Inverted means opposite.
By inverting a move, the move can be undone.
Vocabulary
Lesson Focus
Lesson Review
Rubik's Trivia
You CAN do the Rubik's CUBE
Powerpoint presentation
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Lesson 1
Meeting the Cube
PP9
Ui
U
UP Face Move
To "undo" a "U" ¼ turn, make a "Ui" ¼ turn.
• Inverted means opposite.
• By inverting a move, the move can be undone.
You CAN do the Rubik's CUBE
Lesson Vocab
Lesson Focus
Lesson Review
Rubik's Trivia
PowerPoint Presentation
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Meeting the Cube
Lesson 1
PP10
Di
D
DOWN Face Move
To "undo" a "D" ¼ turn, make a "Di" ¼ turn.
Inverted means opposite.
By inverting a move, the move can be undone.
Vocabulary
Lesson Focus
Lesson Review
Rubik's Trivia
You CAN do the Rubik's Cube
PowerPoint Presentation
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Lesson 1
Meeting the Cube
PP11
Fi
F
FRONT Face Move
You CAN do the RUBIK'S CUBE
To "undo" a
"F" ¼ turn,
make a "Fi" ¼ turn.
Inverted means opposite.
By inverting a move,
the move can be undone.
Vocabulary
Lesson Focus
Lesson Review
Rubik's Trivia
PowerPoint Presentation
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Meeting the Cube
Lesson 1
PP12
Bi
B
BACK Face Move
To "undo" a "B" ¼ turn, make a "Bi" ¼ turn.
Inverted means opposite.
By inverting a move, the move can be undone.
Vocabulary
Lesson Focus
Lesson Review
Rubik's Trivia
You CAN do the RUBIK'S CUBE
PowerPoint Presentation
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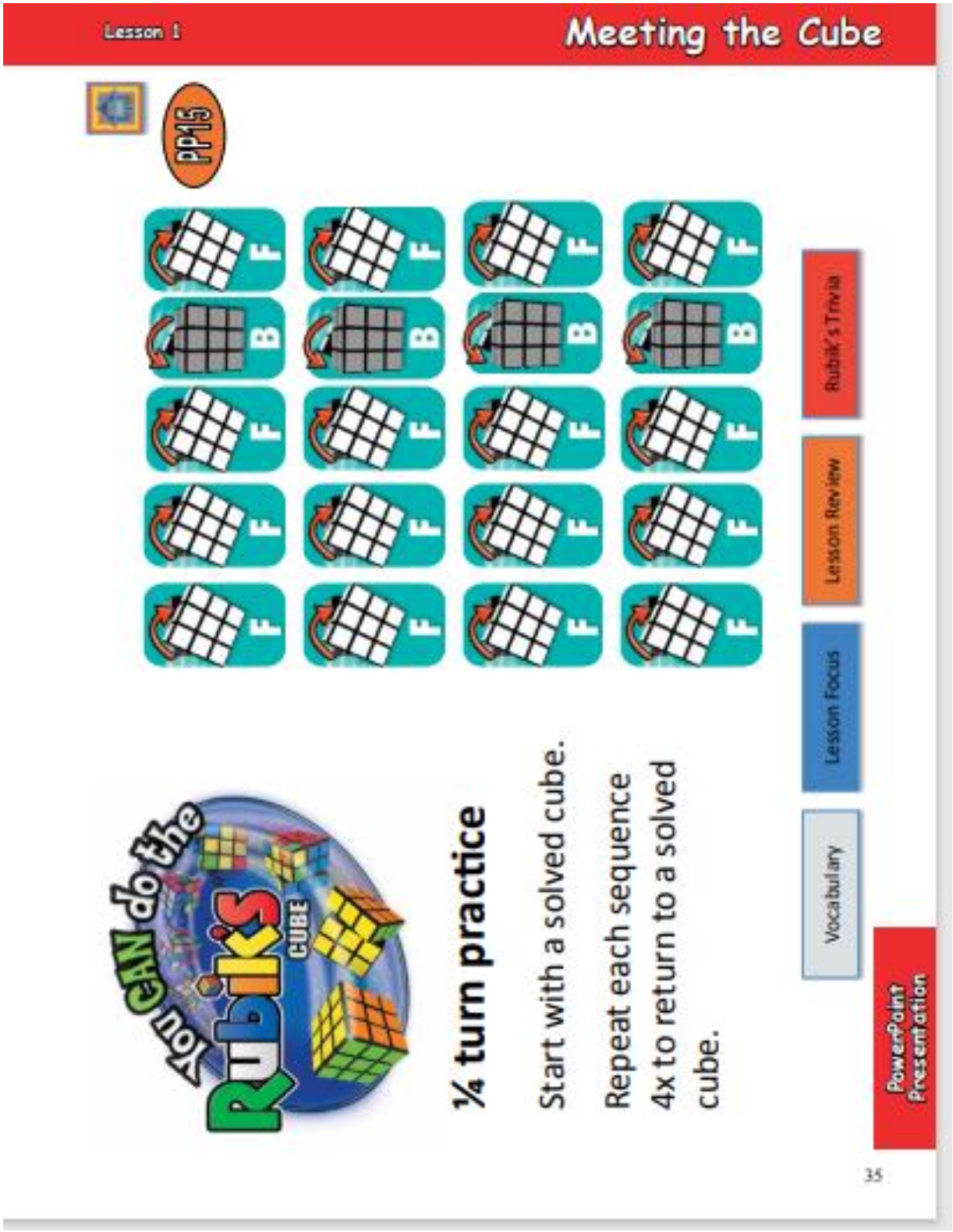
Lesson 1
Meeting the Cube
PP13
L
R
Rubik's Trivia
Lesson Review
Lesson Focus
Vocabulary
PowerPoint
You CAN do the Rubik's CUBE
¼ turn practice
Start with a solved cube.
Repeat each sequence 4x to return to a solved cube.
33

Meeting the Cube
Lesson 1
PP14
U
D
Rubik's Trivia
Lesson Review
Lesson Focus
Vocabulary
You CAN do the Rubik's CUBE
¼ turn practice
Start with a solved cube.
Repeat each sequence 4x to return to a solved cube.
34


Lesson 1
Meeting the Cube
PP15
F
B
F
F
F
F
F
F
F
F
F
F
F
F
F
F
F
F
F
F
Rubik's Trivia
Lesson Review
Lesson Focus
Vocabulary
PowerPoint Presentation
You CAN do the Rubik's CUBE
¼ turn practice
Start with a solved cube.
Repeat each sequence 4x to return to a solved cube.
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Meeting the Cube
Lesson 1
PP16
Li
Ri
Rubik's Trivia
Lesson Review
Lesson focus
Vocabulary
¼ turn practice
Start with a solved cube.
Repeat each sequence 4x
to return to a solved cube.
You CAN do the Rubik's CUBE
Powerpoint presentation
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Lesson 1
Meeting the Cube
PP17
Rubik's Trivia
Lesson Review
Lesson Focus
Vocabulary
PowerPoint Presentation
¼ turn practice
Start with a solved cube.
Repeat each sequence 4x to return to a solved cube.
You CAN do the Rubik's CUBE
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Meeting the Cube
Lesson 1
PP18
Fi
Bi
Rubik's Trivia
Lesson Review
Lesson Focus
Vocabulary
¼ turn practice
Start with a solved cube.
Repeat each sequence 4x to return to a solved cube.
You CAN do the Rubik's CUBE
PowerPoint Presentation
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Meeting the Cube
Lesson 1
PP24
You CAN do the Rubik's CUBE
Question: The Rubik's Cube was created in 1974. How old is the Rubik's Cube now?
Answer: As of 2013, the Rubik's Cube was 39 years old. (In 2014, 40; in 2015, 41...)
Vocabulary
Lesson Focus
Lesson Review
Rubik's Trivia
PowerPoint Presentation
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