

Cooperative Learning &
Mathematics
High School Activities



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Table of Contents

<i>Chart of Structures</i>	<i>.III</i>
<i>Pre-Algebra Overview</i>	<i>.IV</i>
<i>Algebra 1 Overview</i>	<i>.VI</i>
<i>Geometry Overview</i>	<i>.VIII</i>
<i>Algebra 2 & Trigonometry Overview</i>	<i>.X</i>
<i>Pre-Calculus Overview</i>	<i>.XII</i>
<i>Foreword</i>	<i>.1</i>
<i>Introduction</i>	<i>.5</i>

Structures for Mathematics

1 Mix-N-Match

Pre-Algebra	
• Activities .....	.15
• Blackline Masters .....	.23
Algebra 1	
• Activities .....	.27
• Blackline Masters .....	.33
Geometry	
• Activities .....	.37
• Blackline Masters .....	.41
Algebra 2	
• Activities .....	.45
• Blackline Masters .....	.55
Trigonometry	
• Activities .....	.45
• Blackline Masters .....	.59
Pre-Calculus	
• Activities .....	.65
• Blackline Masters .....	.69

2 Line-Ups

Pre-Algebra	
• Activities .....	.77
• Blackline Masters .....	.81
Algebra 1	
• Activities .....	.87
• Blackline Masters .....	.91
Geometry	
• Activities .....	.97
• Blackline Masters .....	.99
Algebra 2	
• Activities .....	.103
Trigonometry	
• Activities .....	.103
• Blackline Masters .....	.111
Pre-Calculus	
• Activities .....	.115
• Blackline Masters .....	.119

3 Inside-Outside Circle

Pre-Algebra		Algebra 2	
• Activities .....	.127	• Activities .....	.169
• Blackline Masters .....	.135	• Blackline Masters .....	.177
Algebra 1		Trigonometry	
• Activities .....	.143	• Activities .....	.169
• Blackline Masters .....	.147	• Blackline Masters .....	.177
Geometry		Pre-Calculus	
• Activities .....	.157	• Activities .....	.193
• Blackline Masters .....	.161	• Blackline Masters .....	.197

Table of Contents cont.

4 RallyCoach	
Pre-Algebra	
• Activities	209
• Blackline Masters	215
Algebra 1	
• Activities	219
• Blackline Masters	225
Geometry	
• Activities	229
• Blackline Masters	233
Algebra 2	
• Activities	237
• Blackline Masters	245
Trigonometry	
• Activities	237
• Blackline Masters	255
Pre-Calculus	
• Activities	259
• Blackline Masters	263

5 RoundTable	
Pre-Algebra	
• Activities	271
• Blackline Masters	275
Algebra 1	
• Activities	281
• Blackline Masters	287
Geometry	
• Activities	299
• Blackline Masters	303
Algebra 2	
• Activities	309
• Blackline Masters	313
Trigonometry	
• Activities	309
• Blackline Masters	319
Pre-Calculus	
• Activities	325
• Blackline Masters	331

6 Mix Pair RallyCoach	
Pre-Algebra	
• Activities	341
• Blackline Masters	345
Algebra 1	
• Activities	351
• Blackline Masters	355
Geometry	
• Activities	361
• Blackline Masters	363
Algebra 2	
• Activities	369
• Blackline Masters	375
Trigonometry	
• Activities	369
• Blackline Masters	375
Pre-Calculus	
• Activities	381
• Blackline Masters	387

7 More Mathematics Structures	
• Fan-N-Pick	396
• Find Someone Who	397
• Activity	398
• Mix-Freeze-Group	399
• Numbered Heads Together	400
• Pairs Check	401
• Showdown	402
• Telephone	403
• Activity	404
• Timed Pair Share	405

Chart of Structures



Structures	Pre-Algebra		Algebra I		Geometry		Algebra II Trigonometry		Pre-Calculus	
	Activities	Blacklines	Activities	Blacklines	Activities	Blacklines	Activities	Blacklines	Activities	Blacklines
Mix-N-Match	15	23	27	33	37	41	45	55	65	69
Line-Ups	77	81	87	91	97	99	103	111	115	119
Inside-Outside Circle	127	135	143	147	157	161	169	177	193	197
Rally Coach	209	215	219	225	229	233	237	245	259	263
Round Table	271	275	281	287	299	303	309	313	325	331
Mix Pair Rally Coach	341	345	351	355	361	363	369	375	381	387

Introduction

Why Use Cooperative Learning?

Why is it important to use cooperative learning? You are, after all, a busy maths teacher. You barely have enough planning time to make your worksheets and tests, let alone develop a whole mess of new “cooperative learning activities”. And you have a curriculum to get through, for crying out loud! There’s no time for silly “feel good” games and activities! Besides, doesn’t “cooperative learning” mean that a few kids do all the work while others just leech off of their efforts and hard work? Won’t the high achievers be held back by the slower students? What are we really gaining by using these strategies anyway?

There are many misconceptions about a) what cooperative learning is and b) how to effectively use cooperative strategies in the classroom. There are teachers who agree that cooperative learning is beneficial in theory, but that it takes a tremendous

amount of extra planning and materials to put it into practice. I would like to briefly address some of these misconceptions and share with you some of the benefits of cooperative learning.

Let's first address why cooperative learning is important. We are certainly in the midst of the "information age", an era in which analysing and communicating information plays a vital role in the economy and the world at large. Unfortunately, you cannot communicate information alone. Interaction is required. In many workplaces today, employees work in teams to generate data, solve problems, and develop strategies for success. Our students need to be prepared for this type of environment if they are to compete in the job market. Not only do they need to learn the social and communication skills necessary to work with others, they also need to develop higher level thinking skills. It can no longer be presumed that social and communication skills are taught at home. Today, many of our young people face the challenges of single parent homes or homes where both parents work full time. Many families relocate, often more than once, tearing students away from the familiar stabilising influences they once too relied on. With less contact and guidance from concerned adults, students are spending more time than ever in front of the television. Their values and self images are being shaped by poor role models and the advertising spin doctors. They are continually exposed to violent, racist, or overtly sexual content. Schools need to do something to teach students how to get along together, tolerate differences, feel good about themselves, and help one another. Cooperative learning is one solution to our socialisation problem. Numerous studies show that students involved in cooperative learning develop a wider variety of social skills, are better able to

work with others in solving problems, and are more willing to help and praise others.

No other educational innovation has been more intensely researched than cooperative learning. In addition to improved social skills, cooperative learning strategies produce many other positive outcomes. Studies show that students involved in cooperative learning activities enjoy improved relations between races and ethnic groups. These students had a greater tendency to choose friends from an ethnic group other than their own. Students in cooperative classrooms also demonstrate greater self-esteem and tend to like class more. Cooperative activities also tend to lower students' anxiety level, since students have more peer support and opportunities to receive praise.

"But what about scholastic achievement?" you ask. Research proves that cooperative learning produces higher academic achievement than individualistic or traditional teacher-centred methods. This is true at all levels and across all subject areas. Minority groups and low achievers tend to experience the greatest gains, but this has no negative impact on the higher achieving students. In fact, high achievers perform just as well, if not better, in a cooperative environment than in a traditional one. Cooperative learning activities produce greater achievement results because they create more opportunities for peer tutoring than do traditional classroom methods. A well-structured cooperative lesson also forces students to spend more time on task and to have more interaction in regards to the academic content. In a cooperative classroom, the teacher actually spends less time lecturing and is therefore able to give more individual attention to the neediest students.

Most of the teachers I have talked to say that their worst discipline problem is students

talking or engaging in off-task behaviours. Cooperative strategies work with students' natural tendencies rather than against them. Students need to communicate, and to stifle that natural tendency is virtually impossible. Yet traditional classroom techniques require students to sit quietly for large blocks of time and absorb everything the teacher says. As teachers, we get frustrated when this doesn't happen, yet the traditional classroom structure predisposes us to failure! Cooperative activities channel the students' need to socialise in a positive direction, rather than attempt to stifle it all together. If you do not give students a chance to interact with their peers, they will take the opportunity anyway, usually in the form of "disobedience". The cooperative structures presented in this book build in "individual accountability", so there is little opportunity for students to engage in off-task behaviour.

Is It Difficult To Incorporate Cooperative Learning Into My Teaching Repertoire?

In my opinion, one of the best features of the structural approach is that you do not have to scrap everything you are already doing in order to use cooperative learning. Think of the structures as though they were tools in a tool box. A carpenter doesn't use a hammer for every carpentry job. He selects the tool that is most appropriate for the task at hand. Think of a lesson as a carpentry project for which you will use many different tools. In a cooperative learning lesson, the structures are your tools. There will be times when direct teaching or lecturing is the most appropriate tool to use, but you will also reach into your "structure tool box" to achieve various objectives. Cooperative activities can be used to

help students practise newly learned material and achieve mastery. They can also be used to go over homework or generate discussion on the best way to study for a test. A lesson might consist of a Round Robin, some direct teaching, a Timed Pair Share, some more direct teaching, and finally an Inside-Outside Circle activity. Depending on your objectives, the structures can be used in many different ways. In my classroom, I use a blend of direct teaching and cooperative structures. Not only is this blend fitting to my learning objectives, it also helps kids learn to adapt to a variety of different social situations.

You can try cooperative learning in small doses at first in order to get comfortable with a classroom set up in teams. Select a structure or two that you feel confident using and play around with them in the classroom. The structures themselves are content free, so once you learn a structure you can use it in an infinite number of ways! Some of the easiest structures to get started with are presented in this book, along with many ideas on how to use them in the mathematics classroom. As you practise using the various structures, you will be able to determine which ones work best for you and you will be able to refine them to meet your particular needs. One thing is certain, however: you will see kids get excited and involved! The achievement gains of your students will encourage you to try more structures more often.

Is It Very Time Consuming To Use Cooperative Learning?

I have found that planning a cooperative learning lesson does not take any more time to plan than a traditional lecture-style

lesson. I simply spend my time differently. Previously, I spent a lot of time planning out what notes I would write on the board for students to copy down in their notebooks. Of course I still do some of that, which is entirely appropriate, but I have cut down considerably. The students did not benefit much from watching me do 5 sample problems on a single topic. They learn much more by watching two or three examples, followed by a cooperative activity which gives them a chance to practise. What time I used to spend writing notes I now spend making flashcards, for example, or writing a Round Table record sheet.

One of the misconceptions I had about cooperative learning was that I would have to write a million worksheets and keep track of all kinds of fancy score cards. Fortunately, the Kagan model does not require any more paperwork than traditional teaching methods. It will require more thought, however, as you familiarise yourself with the structures and determine the best way to use them in your classroom. In the end, you will find that your efforts have paid off in terms of students' academic achievement, development of social skills, reduction in discipline problems, and a positive classroom climate.

Cooperative activities do not necessarily take up a lot of classroom time. A Timed Pair Share might take one minute, while a Rally Table might take 5 or 10 minutes. You can design cooperative activities to be as short or long as you need them to be. A Mix-n-Match activity can take anywhere from 3 minutes to 15 minutes depending on how many new partners you allow the students to match up with. The structures presented in this book are flexible enough to use under any time constraint.

How Do I Manage a Cooperative Classroom?

When I first began using cooperative techniques in my classroom, I admit I was scared!! I was afraid things would get out of control and I would never be able to get back the attention of the students. All my life I had been taught in a traditional classroom, so there was no role model for me to follow. To my knowledge, no one else in my school was using cooperative strategies, so I felt I was experimenting on my own. I was really competent when it came to managing 30 kids sitting in rows, but managing teams was another story!

By and large, many of your classroom management problems will decrease as a result of switching to cooperative learning.

Cooperative strategies are more in line with students' basic need to interact with each other, so you will spend less time trying to keep kids quiet and in their seats. Students are encouraged to talk and move around, so what was once a "discipline problem" can actually become an asset to students' learning!

However, managing a cooperative classroom does involve a different set of skills than a traditional classroom. Most of the students in your class may have no experience in working with teams, so remember that they may be uncomfortable adjusting, too!! Some concerns that you will need to address are appropriate noise level, active listening techniques, managing materials and seating arrangements. When students are in groups and involved in a learning activity, there is a natural tendency for the classroom to get too noisy. As the teacher, you may want to reduce the noise level, or perhaps you need the undivided attention of the class so you can give further in-

structions. For years I would yell, “Can I have your attention please?” or “Ladies and gentlemen, I need you to be quiet now.” I would get little or no response, which irritated me, and I was only adding more noise to an already loud classroom! Instead, the Kagan model suggests the use of a “quiet signal”. When a teacher needs students to be quiet, (s)he raises his/her hand. The students in turn raise their hands to signal others and give the teacher their attention. There are many variations of quiet signals. You can develop your own! Another way to keep noise level down is to assign one person on each team the role of “Quiet Captain”. It is this person’s job to alert teammates if they are too loud.

As you introduce a structure to students, they will need to be very clear on the directions. It is recommended that directions be given both verbally and visually to accommodate different learning styles. As you say the directions, you can simultaneously write them on a chalkboard or overhead. Most of the structures involve several steps. Give directions only one step at a time, and make sure everyone understands each individual step before moving on to the next one. You can check for understanding in a variety of ways. Students may respond in unison to questions posed by the teacher, or they may do a Thumbs Up/Thumbs Down response to statements given by the teacher. When finished, leave the steps posted so students can refer back to them if necessary. It is also beneficial to model the steps of a structure with the students. You may choose a student or team and role play an activity in front of the class. This is also a great way to model the social skills you want them to develop, such as praising, active listening, respecting other’s opinions and offering help.

For a more thorough overview of management techniques, refer to chapter 7 of Spencer Kagan’s book *Cooperative Learning*. In this chapter, you will read about these and many more powerful management techniques.

How Do I Get Started? How Do I Use This Book?

As explained in the Foreword, there is a big difference between “cooperative learning” and “group work”. In order for an activity to be considered cooperative learning, it must meet four criteria, commonly referred to as “PIES”...

Positive Interdependence—a gain for one student is a gain for other students; students need each other to complete the given task.

Individual Accountability—individual public performance is required.

Equal Participation—no one “sits out”, and no one can dominate the activity

Simultaneous Interaction—getting as many students overtly active as possible at any given time.

The good news is that you do not need to translate these abstract concepts into classroom practice because they are already inherent in the structures. PIES is already built in to every activity presented in this book.

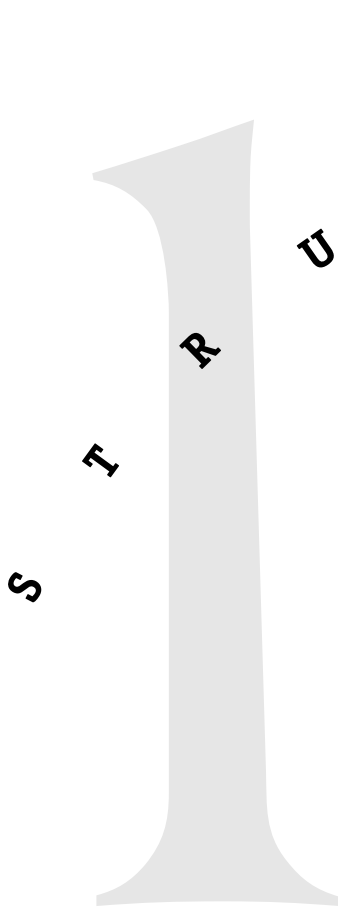
Each chapter in this book is devoted to a single structure. First, a description of the structure is given, along with some helpful hints on how to implement that structure in the classroom. While structures can be used to achieve many different objectives, the activities in this book are designed to help students master mathematical content. Following the

description of the structure, you will find extensive lists of the ways that structure can be used to teach high school mathematics. The lists are categorised according to the various levels of mathematics taught in most high schools: Pre-Algebra, Algebra 1, Geometry, Algebra 2 and Trigonometry, and Pre-Calculus. At the end of each list, you will find blackline masters for one or more of the activities mentioned, usually one for each course level. You are free to reproduce these and use them in your classroom.

You can do an awful lot of cooperative learning just by reproducing the blackline masters given in this book, but my hope is that this book will be a launching pad for your own ideas. A structure can never be exhausted, because it is content-free. A structure only becomes an activity after you add in the content. The first thing I suggest that you do is read through the descriptions of all the

structures presented in this book. It won't take long, since the structures are uncomplicated and easy to understand. Then, think about what topics you are teaching in the next few days and ask yourself which structure seems fitting to your topic and objectives. You might find that topic is already listed several times in the book under different structures. (A topical index is included at the end of the book.) If it's not, you yourself might come up with your own new idea! Remember, a structure is only a "tool" and it's up to you to decide how, when, why, and for how long to use it. The art of using cooperative learning is knowing which structure to use when, and this art is developed through practice.

So go ahead...turn the page and start reading! As you read the descriptions of the structures, you will be surprised how many times you say to yourself, "Hey! I can really use this!"



STRUCTURE

Mix-N-Match

Steps at a Glance

1. With a card in their hand, each student mixes around the room. Each finds a partner, and quizzes him or her by asking a question relating to their card.
 2. Partner answers. Praise or coaching is given.
 3. Switch roles: The other partner asks then praises or coaches.
 4. Partners trade cards.
 5. Partners split up and repeat Steps 1 through 4 a number of times. Teacher calls "Freeze!"
 6. Students freeze, hide their cards, and think of their match.
 7. Students move to the centre of the room, find their match, and quickly move away from the centre of the room with their new partner.
- Optional: Teacher may post a class graph to record the time it takes for students to find their matching partners. Students try to beat their class record.

In this structure, each student is given a card with some type of problem or information on it. Each student should be certain as to the correct answer to his or her problem before beginning the "Mix-N-Match". You may want to give students some time in their teams to ascertain the solutions to their problems or teachers can hand out the cards in matched pairs, so students are already sitting with a "match". Once this is done, students are to "mix" (that is, mingle about the room) and find the person with a card that "matches" theirs. For example, if each card has an equation on it, students would have to find the person whose solution is the same as theirs. As students pair up, they should move to the outside perimeter of the classroom and stand together as a pair. Once everyone has found their match, students can confer with another nearby pair to double check that they do indeed make a match. When everyone is satisfactorily paired up, the teacher can then collect the cards and redistribute them

M I X - N - M A T C H

for another round (if desired). The possibilities for this structure in the maths classroom are endless!

One possible pitfall to this structure is that an unmotivated or struggling student may simply stand around and wait for his match to find him, thus managing to get through the activity without really doing any work. (Remember the “E” in “PIES”: Equal participation is the goal!) One way to avoid this is to have the students do several “quiz and swaps” before finding their match. Students would mingle and form random pairs and quiz each other regarding the content on their cards. If both partners get the correct answers, they swap cards, and then find another random partner. If anyone gets an incorrect answer, their partner should re-teach him before swapping cards. After several swaps, the teacher

would yell, “Freeze! Find your match!” At this point students would purposely seek out the person whose card is equivalent to theirs.

On the next several pages, you will find a list of ideas for incorporating the Mix-N-Match structure into your teaching repertoire.

Following this list are several sets of Mix-N-Match cards that are ready to use. Simply reproduce one set of cards for the class, pass them out, and let students search for their matches. If you have an odd number of students, have two students walk around with one card, or the teacher can participate in the activity. Each set in this book contains 30 cards (15 matching pairs). You may have to remove a matching pair or two to account for smaller class sizes. Just make sure that whatever cards you remove are indeed a “match”.

Mix-N-Match Contents

PRE-ALGEBRA

- *Activities* 15
- *Blackline Masters* 23

ALGEBRA 1

- *Activities* 27
- *Blackline Masters* 33

GEOMETRY

- *Activities* 37
- *Blackline Masters* 41

ALGEBRA 2

- *Activities* 45
- *Blackline Masters* 55

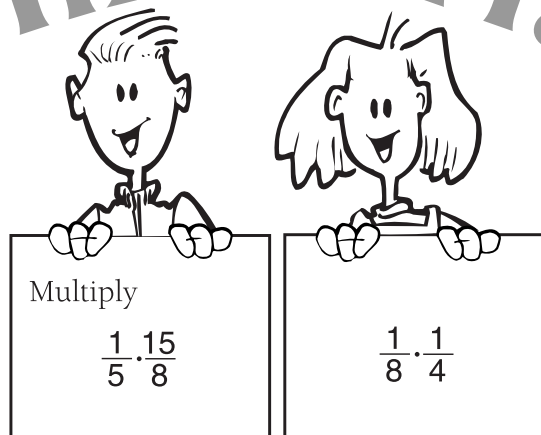
TRIGONOMETRY

- *Activities* 45
- *Blackline Masters* 59

PRE-CALCULUS

- *Activities* 65
- *Blackline Masters* 69

Mix-N-Match

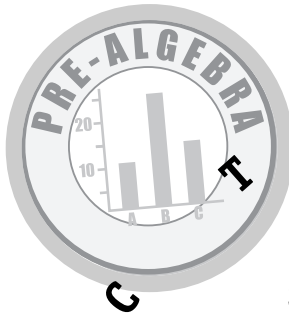


Management Tips

- 1 This structure works best with short answer questions or problems that only require one or two steps.
- 2 If a set of Mix-N-Match cards is divided into “A cards” and “B cards”, use a different colour card stock for each.
- 3 Students put a hand up as they mix to find a partner; hands go down when a partner is found.
- 4 Students move to the perimeter of the room when they find their match.
- 5 Allow students to carry notebooks or clipboards with paper to do scratchwork.
- 6 Pass out cards in matched pairs to partners on a team. If students know they are sitting next to a match before mixing, it prevents wrong answers from circulating through the class.

Social Skills

- 1 Greeting someone
- 2 Giving and accepting praise
- 3 Giving and accepting constructive criticism
- 4 Coaching others (rather than giving the answer)
- 5 Departing gambits
- 6 Appropriate noise level



A

C

Mix-N-Match

Pre-Algebra

1. OPERATIONS ON FRACTIONS

Students are to evaluate a problem involving addition, subtraction, multiplication, or division of fractions. Students are to match up with the person whose problem yields the same answer. A similar Mix-N-Match can be done for *Operations on Decimals* or *Operations on Integers*. It is recommended that students be allowed to carry notebooks with them for this activity.

Multiply

$$\frac{1}{5} \cdot \frac{15}{8}$$

$$\frac{1}{8} + \frac{1}{4}$$

2. ORDER OF OPERATIONS

Students are to evaluate an expression involving several binary operations, which may also include parentheses. Students are to match up with the person whose problem yields the same answer. It is recommended that students be allowed to carry notebooks with them for this activity.

$$\frac{70 - 5 \cdot 2}{3^2 - 4}$$

$$(2 + 3)^2 - 13$$