TIM^2 – Teaching mathematics Using Drama

Toolkit: activities and exercises

Part 1 | Social Community Theatre and Mathemart

Co-funded by
the European Union

1.DISCLAIMER

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2.INTRODUCTION

Welcome to the TIM^2 Toolkit: Teaching Mathematics Using Drama.

This toolkit is the operational heart of the TIM^2 Project, an Erasmus+ project dedicated to overcoming the obstacles that often stand in the way of teaching and learning mathematics.
In a fast-changing world, mastering mathematics is a key competence for personal fulfilment and active citizenship. Yet, international surveys (such as PISA) reveal that a considerable share of students in the European Union struggle to reach basic levels of mathematical literacy. This struggle is often not due to a lack of potential, but is hindered by anxiety, a fear of mistakes, and a perception of mathematics as an abstract, unreachable subject .
The TIM^2 Project builds on the success of the previous "TIM - Theatre in Mathematics" project. While the first project focused on fostering a positive emotional climate and student wellbeing, TIM^2 takes a significant step forward: it shifts the focus to the active empowerment of mathematical skills .
This toolkit provides teachers with a set of activities, directions and suggestions to make mathematics accessible, engaging, and "learnable" for all students, including those who do not naturally feel inclined towards STEM subjects.

Structure of the Toolkit

This manual is designed to guide you through a complete pedagogical progression, divided into four distinct sections:

1. Group Building and Theatre Literacy Exercises
Before diving into math, we must prepare the ground. These activities are designed to build a safe, non-judgmental group environment, and get acquainted with theatre. They train the necessary "pre-requisites" for learning through drama: concentration, sensory awareness, body control, and the ability to work as an ensemble
.
2. Mathemart Activities
This section addresses specific mathematical topics—from arithmetic and fractions to geometry and algebra. Based on the Mathemart approach , these activities translate abstract mathematical concepts into physical experiences. By involving the student's body, mind and emotions these exercises train fluency, reasoning, and conceptual understanding.

3. Process Drama
This section offers guidelines to conduct a Process Drama: a structured, improvised acting form where teachers and students agree to examine a fictional world together. . By shifting the focus from "giving the right answer" to "exploring the argument," Process Drama creates a student-active learning environment where critical thinking is prioritized.

4. Role Categories
This section guides teachers on how to change the traditional "teacher-student" communication pattern by using different Role Categories that students can adopt. The roles allow the students to explore mathematical concepts from different perspectives, encouraging students to argue and reason mathematically rather than just calculate.

2. GROUP BUILDING AND THEATRE LITERACY EXERCISES

2.1. THE IMAGINARY BALL – NAMES

PURPOSE: Work on the coordination of voice, movement and thought. Train concentration. Reflect on concentration and the fear of mistakes. Team building and achieving a goal as a team. Preparation for the exercises 'The ball - colours'. and 'The ball - numbers'.

DRAMA (KEYWORDS): Coordination of voice and movement, Eye contact, Impulse, Rhythm, Energy

LIFE SKILLS (KEYWORDS): Effective communication, interpersonal relationships, coping with emotions, self-awareness

DURATION: 10 Minutes

DESCRIPTION:

The group stands in a circle. The activity consists in having an input being passed across the circle by the participants, as if a ball was being thrown. The input passed is the name of the participant while doing a specific gesture.
Participant A starts, and "throws" the imaginary ball by clapping hands horizontally in B's direction: the top hand quickly slides on the bottom hand's palm, aiming at B. While throwing the ball, A says his/her own name (not B's name!) to participant B. Before throwing, eye contact must be established, so that B understands he/she has been chosen as the recipient. After that, B quickly makes eye contact with someone else, and in the same way, sends the ball saying his/her own name. The activity goes on until the group is able to maintain a good pace and the input flows

smoothly. As the ability of the group increases, the facilitator can challenge the participants by encouraging them to move the "ball" faster and faster.

The teacher gives the following **DIRECTIONS:**

- Remember to **make eye contact first**, so that it is clear **who is your target**, than the gesture
- Let's keep a **constant pace** and **high energy**
- When there is a **mistake** we stop and restart immediately
- **Try to not laugh/blame/**... when a mistake occurs, otherwise we lose the pace
- **If you make a mistake don't worry**, it's part of the learning process. Just restart immediately the game

VARIATIONS: While throwing the ball A says B's name

OBSERVATIONS: The enjoyment of the activity strongly depends on the rhythm and the energy conveyed through the voice, the "impulse" and the clapping, as well as through movement and speed. This activity can improve the level of energy and concentration of the group at any given moment.

2.2. THE IMAGINARY BALL – COLOURS

PURPOSE: Work on the coordination of voice, movement and thought. Train concentration. Reflect on concentration and the fear of mistakes. Team building and achieving a goal as a team. Preparation for the exercise 'The ball - numbers'.

DRAMA (KEYWORDS): Concentration, Rhythm, Eye contact, High energy, Pace

LIFE SKILLS (KEYWORDS): Effective communication, interpersonal relationships, coping with emotions, self-awareness

DURATION: 10 Minutes

DESCRIPTION:

The activity is similar to "The ball - names". Instead of saying the names while throwing the ball the participant says a colour that has been decided at the beginning of the activity.
For example it is decided that RED is the colour that will be used to play. While throwing the ball, A says RED (imagining that that is the colour of the ball). Then B quickly makes eye contact with someone else and, in the same way, sends him/her the ball saying RED and so on until there is a mistake or the facilitator stops the game.
The activity goes on until the group is able to maintain a good pace and the input flows smoothly. As the ability of the group increases, the facilitator can challenge the participants by encouraging them to move the "ball" faster and faster.

The teacher gives the following **DIRECTIONS:**

- Remember to **make eye contact first**, so that it is clear **who is your target**, than the gesture
- Let's keep a **constant pace** and **high energy**
- When there is a **mistake** we stop and restart immediately
- **Try to not laugh/blame/**... when a mistake occurs, otherwise we lose the pace
- **If you make a mistake don't worry**, it's part of the learning process. Just restart immediately the game

VARIATIONS:

- As the RED BALL is being thrown across the circle, the facilitator can introduce a second ball, the BLUE BALL (only the facilitator can introduce a new ball), so to have multiple balls being thrown in the circle at the same time. The rule to be followed by the participants is: << The color I get is the color I throw>>
- Three or more balls are added to the game.

OBSERVATIONS:

The variations require a great level of concentration. It might happen that some of the balls disappear and the game needs to be stopped and restarted. If the group does not succeed in keeping all the balls in the game, the facilitator can encourage the participants to discuss and find common strategies to make it work. Generally, all groups need to try the activity multiple times and in different moments in order to make it work. This usually leads to improvements, which can positively affect the sense of empowerment and self-confidence of the group.

2.3. JAPANESE GREETING

PURPOSE: Opening and/or closing ritual, listening, working in group, concentration

DRAMA (KEYWORDS): Neutral posture, Peripheral vision, Unison (Chorus), Ritual, Focus, Energetic gesture

LIFE SKILLS (KEYWORDS): Self awareness, effective communication

DURATION: From 5 to 25 minutes (including all possible variations)

DESCRIPTION:

The group stands in a circle. The facilitator helps participants to focus and find concentration by bringing the attention to the posture, which should be relaxed and neutral. Gazing ahead, they should also try to use their peripheral vision to glimpse what is on their sides.

Once the group is focused, the person who conducts the activity (the facilitator or a participant) starts by making a wide, fast, energetic gesture bringing one arm and hand ahead toward the center of the circle, and saying a loud, energetic "Ha!". At the same time, this person takes one step forward with the same side leg. The movement is controlled, and the arm and hand are both stretched forward.

As soon as the facilitator starts the movement, the whole group has to perform the same gesture at the same time and speed, so as to produce the sound and the movement in unison. If everyone is focusing, the group's reaction will be immediate. After the movement has been performed, the whole group simultaneously goes back to a neutral posture, ready to perform a new "greeting".

The teacher gives the following **DIRECTIONS:**

- Observe your **posture**, it should be **neutral**
- While waiting the starter, **don't move**
- Breath deeply and slowly in order to **stay focused**
- Look in front of you and widen your vision to **perceive the whole group**
- If you are the starter, before starting try to **sense if the group is focused** enough to properly react

VARIATIONS:

- the participants start the activity with their eyes closed and thus be even more perceptive.
- the participants start the activity facing outwards and performing the movement toward the centre of the circle, by rotating by 180°. In this way, they are not able to see each other when the starter starts moving.
- don't declare who is conducting the activity: whoever wants to do it starts, and the group will follow her/him.

OBSERVATIONS:

To engage the group and make the activity effective, the facilitator can invite the participants to perform all movements in a sharp, clean way, including going back to neutral position.
The Japanese greeting is a simple activity but quite effective to help the group become focused and strengthen the sense of belonging to the group.
Because of its ritualistic nature, it can be used both to open and close a session (entering and exiting the extra-ordinary place/time of drama).

2.4. THROWING STICKS

PURPOSE: Ability to focus and to react to an external stimulus, open view, group building, warm up

DRAMA (KEYWORDS): Grounding (Roots), Stability, Presence, Body impulse, Complicity, Eye contact

LIFE SKILLS (KEYWORDS): Self awareness, coping with stress

EQUIPMENT: Wooden sticks (length of the sticks: from 1 to 1,50 meters)

DURATION: From 20 to 40 minutes

DESCRIPTION:

The group stands in a circle, with participants at 1m distance from one another. The facilitator stands at the centre of the circle holding the stick at the middle of its length, vertically, in front of his/her chest. The facilitator throws the stick to a participant. The participant catches the stick and throws it back to the facilitator by using only one hand. The facilitator throws the stick to the next participant in the circle until all the participants have been engaged.
Throwing, catching and rethrowing is repeated until participants acquire readiness in receiving and throwing, without making the stick fall to the ground.

The teacher gives the following **DIRECTIONS:**

- **Before** throwing the stick, **make eye contact** with the recipient so that they understand that it is their turn.
- The **body is rooted on the ground**: find your stability by placing one foot forward and slightly bending both legs.
- **Use the body**: the throw of the stick is accompanied by an impetus that starts from the feet.

- While throwing, **the arm** stretches slightly upward and forward to **accompany the stick** so that it performs a parabola before getting to the recipient.
- During the throw, **the stick must not rotate in the air**, but keep the same vertical position. To do so, hold the stick in its centre

VARIATIONS:

- The facilitator throws the stick randomly, without following the order of the participants in the circle.
- The facilitator asks participants to take his/her place at the center of the circle.
- With two sticks: two participants (or facilitator + one participant) stand in the center of the circle. Simultaneously, they both throw one stick to another participant. Then they switch places and have to catch the stick thrown back by their mutual recipients. (for example: A and B are in the center of the circle. C and D are two participants in the circle. A throws to C, B throws to D, then C throws back to B and D throws back to A).
- Training in pairs. To reach a good level of practice, you can first do a two-person workout: participants are arranged in pairs, in two rows. At the facilitator's signal, one row throws the sticks, the other one catches and throws it back. Subsequently, the pairs will use two sticks that will be launched simultaneously. Participants always throw with the same hand and catch with the other one.
- The group participants throw and catch a stick around while walking in the room as in the activity 'The raft'.

OBSERVATIONS:

The exercise offers the opportunity to reflect on trust, care and attention toward the other, as weel as on complicity. It works well as body and mind warm-up and as a way of working on the presence of the body on the scene.

2.5. THE RAFT

PURPOSE: Body awareness, space awareness, moving in the space as an individual within the group.

DRAMA (KEYWORDS): Space awareness, Balance, Stage composition, Peripheral vision, Freeze (Stillness)

LIFE SKILLS (KEYWORDS): Self-awareness, effective relationships, coping with emotions

EQUIPMENT: Paper tape, percussion or music player

DURATION: From 10 to 25 minutes

DESCRIPTION:

The facilitator delineates a space on the floor (with paper tape or other material) which is referred to as a "raft". The participants walk within the perimeter of the raft trying to remain evenly distributed within the space (if we don't keep the raft in balance it might capsize!). While walking, arms and hands are resting at the sides of the body in a relaxed manner, and participants look ahead (not at the ground). The facilitator can guide the participants verbally with a stop and go or with a percussion instrument or piece of music: when the music is playing they walk, when it stops they remain still.

The teacher gives the following **DIRECTIONS:**

- **Avoid** walking in a **circle**
- **Spread out** evenly in the **space**
- **Look ahead** and widen your vision
- Keep the **body relaxed**
- Be **aware** of every part **of your body**
- Keep **high energy** in your body even if you walk slowly

VARIATIONS:

- Participants are asked to change speed from 1 to 10
- Participants are asked to change speed way of walking
- At the "stop" signal, the facilitator can ask to form groups of 2, 3 or 4 made of people who are in physical contact with each other (the facilitator can also say what part of the body is the point of contact). At the facilitator's signal (or at the start of the music) the subgroups formed start walking again in the space without losing contact.
- At the "stop" signals, the facilitator can ask participants to make statues with their bodies representing objects, people, animals, abstract concepts, etc..

OBSERVATIONS:

This activity can be used to start working on body awareness, which will be useful for the following activities. For example, it trains the ability to not bump into each other while moving in space, or to avoid walking in circles, or to freeze the body completely when stopping. Developing body awareness ensures a better aesthetic quality of the activity, which determines the pleasure - and therefore the engagement - of the participants.

Despite seeming simple, this activity can be quite complex, as it requires participants to handle multiple tasks simultaneously. Therefore, directions need to be introduced gradually, giving the participants time to familiarise with the different tasks

2.6. THE MIRROR

PURPOSE: Training the ability to observe others and observe details. Practice cooperation and a deeper contact with others.

DRAMA (KEYWORDS): Mimesis (Imitation), Cooperation, Peripheral vision, Eye contact, Synchrony, Detailed observation

LIFE SKILLS (KEYWORDS): Self-awareness, effective relationships, coping with emotions, empathy

DURATION: 10 to 15 minutes approximately

DESCRIPTION:

The exercise is carried out in pairs. Each pair decides who is A (the person who leads the movement) and who is B (his/her reflection in the mirror). Participants stand or sit one in front of the other. When all the pairs in the room are ready and quiet, the activity starts: A begins to move parts of his/her body slowly. B follows her/him by copying the movements accurately. As the exercise progresses, A can explore more complex movements. After a given time, the facilitator asks the pairs to trade roles and start again.

The teacher gives the following **DIRECTIONS:**

- Keep your **gaze open**, don't focus only on a single part of the body
- **Start** with **slow movements**
- It's a **cooperation**, not a challenge
- When watching the couple one should **not understand who is leading** and who is the mirror

VARIATIONS:

- Nobody is leading, nobody is following, A and B move together without deciding who is the leader
- Same activity done while moving around in the room

OBSERVATIONS: The exercise should be carried out slowly: the participants' aim is to make it impossible for an external observer to establish who is A and who is B in the pair. To achieve this result, the facilitator can stress that the focus of the activity is cooperation between the two participants. A way to bring attention to this, is to ask the participants "what is the strategy you found?". Answers that might come out are "making simple movements", "make sure I make movements the other can see", "observing the other", etc.

The facilitator may ask the participants to look in the other participant's eyes for the whole duration of the exercise. This is an excellent way of training peripheral vision, perception and concentration. However, it is important to make sure that participants are comfortable with this, as deep eye contact involves a high level of intimacy (e.g. asking this to teenagers, if not previously trained, might compromise the success of the activity).

This activity requires a level of complicity that might generate embarrassment, inducing participants to giggle or talk while accomplishing the task. Addressing the issue by making them notice the difficulty of the activity and reflecting on how we handle embarrassment can be a way to undertake the challenge with self awareness.

2.7. THE BLIND GUIDE

PURPOSE: Develop trust in the group, build the perception of a safe environment

DRAMA (KEYWORDS): Trust, Non-verbal communication, Sensory awareness, Physical listening, Care, Leading and Following

LIFE SKILLS (KEYWORDS): Self awareness, empathy, effective communication, interpersonal relationships

EQUIPMENT: Music player

DURATION: 15 to 30 minutes

DESCRIPTION:

The participants stand in the space in pairs. Each pair decides who is A (the person who leads, with open eyes) and who is B (the person who follows with closed eyes). A and B face each other. B places the palm of his/her hand on A's palm. B closes eyes. A and B take a few breaths together. When the facilitator starts the music, the pairs start moving in the space: A leads B in the space walking backward, with the idea of accompanying B across the space to explore it. B follows A's lead with his/her eyes closed and holding his/her partner's hand.
When the facilitator lowers the music volume, A gently ends the walking and stops. B opens his/her eyes. A and B switch roles without talking. The music starts again.
At the end of the second round, each pair takes a few moments to discuss the experience: they both tell each other what they felt while leading and while being led.

The teacher gives the following **DIRECTIONS:**

- **Take care of your partner**, make sure that they are safe
- Remain **concentrated**
- **Observe** your companion, which **non verbal messages** is he/she sending?
- When it's time to **share the experience** with your companion **take your time**, don't rush

VARIATIONS:

- Instead of being in touch with the palm A and B are in touch with the tip of the index finger
- A (the leader) guides B by repeating a sound and without touching B

OBSERVATIONS:

During the activity the facilitator observes the group and makes sure that all leaders are taking good care of their partners and that nobody gets hurt.
This activity can create intimacy and involve the themes of trust and reliability. This must be kept into consideration: all distress should be listened to and participants should not be forced to take part.
The activity works on non-verbal communication and empathy abilities: while explaining the activity it is important to encourage the participants who lead to observe their companion: what does his/her body communicate to me? Does he/she feel comfortable? If he/she is reluctant to move, how can I make her/him feel at ease? What is the best pace to keep for my companion to feel safe?
B's hand should not cling to A's, but only slightly touch it. This allows A to immediately perceive changes in what B's body is communicating.
The intimacy involved in the activity might lead to embarrassment and cause some giggling or chatting during the activity. It is important to encourage participants to observe any light discomfort, and try to engage in the activity quietly, by focusing on the idea of the sensory journey and the care for the other.

2.8. MOVEMENTS AND SOUNDS

PURPOSE: Activate creativity and body expression, explore the use of body and voice together

DRAMA (KEYWORDS): Voice and movement coordination, Rhythm, Ensemble work, Precision, Replication

LIFE SKILLS (KEYWORDS): Creative thinking, effective communication, coping with emotions, self-awareness

DURATION: Approximately 10 minutes

DESCRIPTION:

The participants stand in a circle. One participant makes a movement accompanied by a sound. The sound should involve the vocal cords as well as the mouth (i.e. finger snaps or lips smacking are not suitable). As soon as the first person completes the action, all the other participants replicate the movement and the sound as accurately as possible. Then, the person standing next to the first makes another movement+sound and all participants replicate that too. The activity goes on until all participants have performed their movement+sound.

The teacher gives the following **DIRECTIONS:**

- Make **clear and precise** movements and sounds
- **Use your voice** to make the sound (not by clapping hands, etc…)
- Try to **find a common pace**: imagine you are one orchestra
- Keep the **energy high**

VARIATIONS: This is a variation that emphasizes the performative aspect. Participant stands in two lines. One line faces the other, so that the two participants at the front of each line (participant A and participant B) face each other. They are 2 meters distant. Participant A makes a step and a movement with a sound. Participant B responds with his/her own movement and sound. As soon as the action is completed, both A and B walk to the end of their line, behind everyone else. Now there are two new participants at the head of the two lines, facing each other. Just like A and B did, they perform their own movements+sounds (one in response to the other). Then they walk to the end of their line too. The activity goes on until all participants have performed their movement+sound.

OBSERVATIONS: The movement should be made as neatly as possible (in order to allow the other participants to try to replicate it accurately). Pace and the level of energy are very important in this activity: the movements/sounds should be sharp and energetic, and a good pace in the sequence should be kept constant (participants should not be urged, but moments of silence should be avoided as well).
"Movements and sounds" can be a suitable preparatory activity for the "Rhythmic machine".

2.9. RHYTHMIC MACHINES

PURPOSE: Train body, rhythm, sound and cooperation, explore a given topic

DRAMA (KEYWORDS): Rhythm, Synchronization, Rehearsal process, Staging, Group creativity, Repetition

LIFE SKILLS (KEYWORDS): Self awareness, coping with emotions, creative thinking

DURATION: At least 30 minutes, depending on the number of subgroups

DESCRIPTION:

The rhythmic machine is the representation of a "machine" composed by a group of participants. Every member of the group acts as a part of the machine making gestures and sounds in a synchronized and repeated way.

The group is divided into subgroups of 4-5 people. Each group builds a rhythmic machine inspired by a keyword or topic.
The construction of the machine has different phases: brainstorming, rehearsals, finalisation. During the brainstorming the participants choose which machine they want to create and which movement and sound they want to make and how to link them with the others. During the rehearsals the participants enter the stage one by one and start to make their rhythmic movement and sound, which they must repeat until the entire machine stops. The machine is performed repeatedly by the participants until they find a common rhythm and they feel comfortable in it.
Then, the machines are shown to the rest of the group. The facilitator divides the space in two parts: the audience and the stage. The first participants to present the machine enter the stage one by one until they are all in and run the machine until the facilitator stops it.

The teacher gives the following **DIRECTIONS:**

- Keep a **constant pace**
- Make **clear and precise gestures**
- Make **clear sound** by using the voice (not clapping, snapping fingers, …)
- **Start with a slow pace** and only when you **feel comfortable as a group increase it**

VARIATIONS:

- In order to train the execution of a movement and a sound connected with others in a group, the rhythmic machine can also be improvised. In this case, up to 10 participants enter the stage one by one and improvise a movement and a sound in relation to the ones already on the scene. At the end the rest of the group can give a title to the machine that they have just seen.
- During the improvisation the facilitator can ask the participants to animate the machine with a particular mood, emotion, or accent (e.g. tired, hungry, or Russian) in order to make the activity funnier.

OBSERVATIONS:

In order to make the machine work properly it is very important that the facilitator helps the participants keep the pace of their movements and sounds.

It is useful start from machine that do concrete things (e.g. a coffee, a chair, …) and only after some training move to machine that can create also abstract concepts (e.g. peace, awareness, hate, …)

2.10. IMAGE THEATRE

PURPOSE: Train non verbal communication, train observation, explore a given topic

DRAMA (KEYWORDS): Still image, Statue, Non-verbal expression, Physical representation, Observation

LIFE SKILLS (KEYWORDS): Self-awareness, creative thinking, effective communication

DURATION: 10 to 15 minutes

DESCRIPTION:

Participants stand in a circle, facing outward. The facilitator says a word and immediately counts to three. On 'three' all participants turn around and, now facing each other, each "creates a statue" with his/her body representing the first thing that came to their mind when they heard the word. Everybody stays still for a few moments. The facilitator can invite the participants to move their eyes - and only the eyes - to look at the other statues in the circle.
The activity can be repeated with many different words.

The teacher gives the following **DIRECTIONS:**

- Choose a **comfortable position** that allows you to stay still for some time

VARIATIONS:

- The facilitator can ask the "statues" to place themselves in the circle next to the other "statues" they think look similar to the ones they made, creating groups of statues that might represent an idea of the group related to the theme of the word given by the facilitator. This variation shows the participants the similarities existing in the group.
- The facilitator can ask the statues to make one sound each, in relation to their pose and to the given word.

OBSERVATIONS:

If they want, participants can wait to hear the word with their eyes closed, as this helps imagination to flow.
This activity can be simply used to activate creativity but it also allows the introduction and exploration of a theme in a non-verbal way: the statues being created impulsively can be a truthful representation of the participants' ideas and feelings. For this reason, it is helpful to start the activity by using simple words, related to concrete concepts, that usually don't imply emotional involvement (e.g. summer, sport, TV). Only after, when they have become familiar with the activity, the facilitator can use words that they want to explore (e.g. studying, learning, school, mathematics, friendship, etc.). At the end of the activity, the group can reflect on the representations that were made (i.e. How was the word "Math"/"school"/"learning" represented in the statues? What does this say about us?).
By involving all participants at the same time, this activity helps familiarize with performing without the pressure of an audience (all participants perform their statues at the same time).
To train expressiveness, the facilitator can encourage participants to focus on expressing an idea with a statue instead of a movement. What is the posture that better captures and communicates that idea to me?

2.11. TABLEAUX VIVANT (STILL IMAGE)

PURPOSE: Train non verbal communication, train observation, explore a given topic

DRAMA (KEYWORDS): Tableau Vivant, Composition, Stage picture, Gaze, Improvisation, Meaning making

LIFE SKILLS (KEYWORDS): Self-awareness, effective relationships, creative thinking, coping with emotions

DURATION: Approximately 20 to 25 minutes

DESCRIPTION:

Participants stand on one side of the room, as spectators. On the other side is the space of the scene. One of the participants goes into that space and creates a statue with his/her body, holding any posture he/she wishes.
The rest of the group observes. One by one, more participants are invited to join the first one, adding new shapes that interact with the ones already there, completing the meaning of the scene that is being built. In this way, they are forming a Tableau vivant (a still image) where everyone gives a piece of significance to one picture.

The teacher gives the following **DIRECTIONS:**

- Choose a **comfortable position** that allows you to stay still for some time
- Decide **where your gaze is directed** and keep it
- When it's time to choose your position **don't overthink**. Just **improvise and trust your body**.

VARIATIONS:

- The participants who are not creating the Tableau can observe and be asked to give a title to the still image or derive a story from it.
- To start introducing the use of the voice, the facilitator can ask the participants in the scene to say a word/sentence/make a sound related to the character/piece of image they are performing, which is going to be "activated" by the facilitator's touch.
- The 'Image Theatre' activity can be used to prepare the group for this 'Tableaux vivants'.

OBSERVATIONS: The facilitator can decide to limit the number of people that will form the Tableau, by establishing it at the beginning or by stopping the creation process. To get the participants acquainted with the activity, the first Tableau can be composed by only a few participants.

2.12. STATUES ON THE WALL (BAS-RELIEF)

PURPOSE: Train non verbal communication, train observation, explore a given topic

DRAMA (KEYWORDS): Physical contact, Body architecture, Composition, Bas-relief, Interaction

LIFE SKILLS (KEYWORDS): Self-awareness, effective relationships, creative thinking, coping with emotions

DURATION: Approximately 20 to 25 minutes

DESCRIPTION:

This exercise is a variation of 'Tableaux vivants'. Participants stand on one side of the room, as spectators. On the other side there is an empty wall. One of the participants positions her/himself against the wall and creates a statue with her/his body (by being against the wall it will resemble a bas-relief). One by one, more participants are invited to quickly join the first one and create new statues that will complete the scene. They must find a contact point with another statue.

The teacher gives the following **DIRECTIONS:**

- Choose a **comfortable position** that allows you to stay still for some time
- Decide **where your gaze is directed** and keep it
- When it's time to choose your position **don't overthink**. Just **improvise and trust your body**.

VARIATIONS: The facilitator (or one of the participants) can say a word to inspire the first shape. Also, after being in the bas-relief for a while, participants can decide to come out of it and go back to the audience, in order to be able to observe the action from outside, thus allowing the scene to change and to create new meanings as new statues add on.

OBSERVATIONS: This exercise can involve physical contact among the participants.

2.13. IMAGINARY OBJECT

PURPOSE: To stimulate creativity, familiarise with a creative process

DRAMA (KEYWORDS): Mime, Object transformation, Physical imagination, Staging action, Non-verbal sound

LIFE SKILLS (KEYWORDS): Creative thinking, coping with emotions, effective communication

EQUIPMENT: An object to be transformed (e.g. a roll of tape, a frame drum, a plastic bottle, …)

DURATION: Approximately 15 minutes

DESCRIPTION:

The group stands/sits in a circle. The facilitator gives an object (any object) to one of the participants and asks her/him to show the group how to use that object as if it were something else (for example, a roll of tape can be used as a magnifying glass, a dish, a clock, etc.). The participant who holds the object cannot talk, but he/she can make sounds to help the group understand what the imaginary object is.
Once the action is completed, the object is passed on to the next participant, who will transform the object into a different imaginary object. The same imaginary object can only be proposed once, and participants cannot mime the action of using the object with its ordinary function (i.e. using a book as a book). The game continues until everyone has created an imaginary object with the same object.

The teacher gives the following **DIRECTIONS:**

- Look at the **object you want to transform** and hold it. Its shape, materials, weight, etc.. will inspire you to do something
- **Take your time**, the group is waiting for you calmly.
- **Use sounds** to better stage your action

VARIATIONS:

- It is interesting to perform many rounds with the same object. After the first two rounds almost all the more obvious actions have been shown. It is now that the participants are obliged to look for more creative transformations
- After as many rounds as the group wants to perform, the object is left at the center of the circle. Whoever has a new idea about what imaginary object it can be transformed into goes into the circle and mimes it.

OBSERVATIONS:

This activity offers a great opportunity to reflect on creativity and the emotions that contrast or promote it. The first round of 'Imaginary object' will involve the participants in a rather simple task which triggers the creative use of the object (which might be partly predictable). This will allow the group to familiarize with the activity and warm up creative thinking.
If the same object is used in a second round, the group might start to experience the next level of the creative process: ideas on how to transform the object take some time to come. If a participant is stuck and is stressing about finding an idea, encourage her/him to look at the object more carefully, moving it in his/her hands, being optimistic about the fact that an idea will eventually come, because stress and anxiety can inhibit the creative process. Despite the difficulties, this round (and a third one if you are going to do it) will allow the most exciting and brilliant idea to appear, and this will bring a high level of energy and enjoyment to the group.
This activity also offers an opportunity to work with patience and mutual support within the group. Participants should be able to create a supportive atmosphere promoting the creative process for everyone.
In order to use this activity as a preparation for 'A stick story', a stick can be used as object to transform.

2.14. IMPROSTOP

PURPOSE: Improvisation, cooperative problem solving

DRAMA (KEYWORDS): Improvisation, acceptance (Saying Yes), narrative building, freeze-frame, action

LIFE SKILLS (KEYWORDS): creative thinking, problem solving, effective communication, interpersonal relationships, self-awareness

DURATION: From 15 to 30 minutes

DESCRIPTION:

Participants stand in a circle. One of them (participant A) goes into the circle, and assumes a posture of his/her choice. The group observes the "statue" in the center of the circle as if it were a freeze-frame from a situation, and imagines what that situation could be. Another participant (participant B - whoever feels ready to do it) goes into the circle and immediately starts to improvise on the situation he/she imagined, giving A a hint of what the situation is. A immediately starts to play along.
(E.g. A is standing still, slightly bent toward the floor, staring at the ground. B enters the scene, places hands on his/her hips, looks at the same spot on the ground and says "This ants' nest sure is impressive!". A, who now has elements about B's interpretation on the situation, starts improvising along.)
At a certain point, the facilitator gives a signal to freeze the scene (by saying "stop" or by clapping hands). Both A and B freeze in whichever position they are in that moment. A exits the scene; B holds position. The group observes B's "statue" as if it were a freeze-frame from a different situation, and imagines what that situation could be. Participant C enters the circle and starts improvising on the new situation with B. When the freeze signal is given again, B exits the scene, C stays in, and someone new enters.

The teacher gives the following **DIRECTIONS:**

- **AGREE:** anything that is proposed during the improvisation should be accepted. The golden rule of improvisation is "Say YES to your partner".
- **DO NOT OVERTHINK:** when looking at the "statue" and imagining the situation, do not overthink and just "have a go". The idea for the new scene might as well arrive when you have entered the scene.
- **PERFORM ACTIONS:** During improvisations include actions in the scene instead of just talking. This will allow more ideas to come and make the scene more interesting.
- **DO NOT STOP:** you cannot leave the scene until the freeze signal is given. This means that the action needs to be carried on at any cost!

VARIATIONS: As the students gain confidence with the exercise, the duration of the improvisation within the circle can be increased, allowing the pair to explore a wider range of creative choices

OBSERVATIONS: Some important improvisation rules should be applied for the success of the activity (they can be slowly introduced as the game goes on, when the situation makes it necessary):

Participants might tend to interpret the posture of the "statue" as a scene from sport or dancing. To make the activity more interesting and challenging, the facilitator can ban this kind of theme.
If the scene includes objects, the facilitator can encourage participants to engage physically so that the audience gets to "see" the objects, even if they are just being mimed.
If the scene is interesting, participants will all become engaged: the accuracy of the movements, a high tone of the voice, being immersed and believing in the situation, these are all elements that contribute to the aesthetic quality of the scenes, thus making them pleasant and interesting to watch.

3. MATHEMART ACTIVITIES

3.1. THE BALL - NUMBERS

PURPOSE: Work on the coordination of voice, movement and thought. Train concentration. Reflect on concentration and the fear of mistakes. Team building and achieving a goal as a team. Playing with numbers

DRAMA (KEYWORDS): Coordination of voice and movement, Rhythm, Focus, Energy, Pace

COGNITIVE DIMENSIONS: Quantitative Literacy, Body Control and Awareness, Metacognition, Social aspects

MATHEMATICAL LITERACY (KEYWORDS): Fluency with Number Sequences, Understanding Number Properties (Multiples), Algebraic Thinking (Substitution), Logical Reasoning and Set Intersection, Pattern Recognition

MATHEMATICAL CONTENTS (KEYWORDS): Counting Sequences, Multiples, Common Multiples, Times Tables

DURATION: Approximately 10 minutes

DESCRIPTION:

The activity has the same structure of the activity 'The imaginary ball - names' (see paragraph 2.1).
The difference with "The ball - names" is that while throwing the imaginary ball, the participants don't say their names but count from 1 to 10 and then backwards from 10 to 1. Every time they say the wrong number, the counting starts over (from number 1). The game ends when the participants are able to count from 1 to 10 and back again without making mistakes.

The teacher gives the following **DIRECTIONS:**

- Remember to **make eye contact first**, so that it is clear who is your target, than the gesture
- Let's keep a **constant pace** and **high energy**
- When there is a **mistake we stop and restart** immediately
- **Try to not laugh/blame/**… when a **mistake occurs**, otherwise we lose the pace
- If you **make a mistake don't worry**, it's **part of the learning process**. Just restart immediately the game

VARIATIONS:

- Numbers 5 and 10 are replaced by the thrower's name. Then, numbers 3 and
- 7 are replaced by the name of a fruit (e.g: one, two, apple, four, Anne, six, strawberry, eight, nine, Miriam, nine, eight, lemon, …)
- Multiples of 2 are replaced by the word "apple". Multiples of 3 are replaced by the word "pie". Multiples of 3 AND 2 are replaced by the word "apple pie", and the game continues up to a target number decided at the beginning of the game (e.g. up to 20 or 30).
- Instead of counting in multiples of 1, the group can use different counting patterns (e.g. the 2-times or 3-times table, etc.)

All of these variations can be combined to make the game even more complicated as the group acquires skill. The complexity level should be raised gradually for a positive experience.

OBSERVATIONS:

The enjoyment of the activity strongly depends on the rhythm and the energy conveyed through the voice, the "impulse" and the clapping, as well as through movement and speed.

The use of numbers (instead of names or colors) can increase the anxiety of some students. The facilitator should be able to accompany them and lower the anxiety generated by the possibility of doing a mistake.

3.2. TIMES TABLES COUNTING

PURPOSE: Training participants to count time tables

DRAMA (KEYWORDS): Rhythm, Physical beat, Ensemble synchronization, Movement control, Inner pulse

COGNITIVE DIMENSIONS: Quantitative Literacy, Body Control and Awareness, Metacognition, Social aspects

MATHEMATICAL LITERACY (KEYWORDS): Multiplication Fluency, Number Patterns, Mental Arithmetic

MATHEMATICAL CONTENTS (KEYWORDS): Times Tables, Multiples, Number Sequences

DURATION: Approximately 10 minutes

DESCRIPTION:

The group stands in a circle. The times table to be used is established (the example below uses the 3-times table). Participants "march" on the spot at a shared pace.

The facilitator starts the game by saying "One" to the marching beat. Following the pace, one by one, each participant says the numbers in sequence (from 1 to the number of participants) until the counting has completed a full circle and got back to number 1 (the facilitator).

Then the group starts again. This time, only the facilitator and the last participant will say the number aloud. All the other participants will only count mentally. The facilitator must check that the last number is correct.

Then the group starts again, but this time there will be more people saying their number aloud on their turn: for example, number 1 (the facilitator), and all multiples of 3.

All the other numbers will not be said aloud. If someone makes a mistake, the group starts over.
If the group is small, the game could continue for multiple rounds up to the required number (e.g.: 30), in order to be counting for a longer time.

The teacher gives the following **DIRECTIONS:**

- Feel **the beat in your feet** and follow it
- Don't increase the **speed**
- **Follow the pace** of the group

VARIATIONS: If all the participants are comfortable with the activity, it is possible to not set a number to reach and the game can continue until a mistake occurs.

OBSERVATIONS: Since this activity involves the ability to follow a rhythm it is important to start without numbers and just play with the group to "march" on the spot with the same pace. When the group is comfortable with the "march" it's time to introduce numbers.

3.3. THE RAFT - NUMBERS

PURPOSE: Training participants to break down numbers into prime factors, to count time tables

DRAMA (KEYWORDS): Spatial awareness, Physical transformation, Statue, Body control, Space distribution

COGNITIVE DIMENSIONS: Quantitative Literacy, Spatial Reasoning, Body Control and Awareness, Metacognition

MATHEMATICAL LITERACY (KEYWORDS): Classification of Numbers, Divisibility Rules, Factors and Divisors

MATHEMATICAL CONTENTS (KEYWORDS): Multiples, Divisibility, Prime Numbers, Divisors, Prime Factors

EQUIPMENT: Music player or a percussion

DURATION: From 15 minutes

DESCRIPTION:

The activity has the same structure as the activity "The raft" (see paragraph 2.5) . What is different is that the participants are assigned a number from 1 to N which will be theirs for the duration of the activity.
The raft game continues this way: the facilitator asks participants to walk in the space and stop or go when requested. At the "stop" signal, the facilitator calls a rule: "*Only numbers [CHARACTERISTIC OF THE NUMBER] transform into [OBJECT TO BE REPRESENTED WITH A STATUE]*" . E.g: «Only multiples of 3 transform into a cat»; «Only numbers that can be divided by 2 and 3 transform into a coffee maker»; "Only prime numbers transform into a tree"; etc.
After the transformation the facilitator checks if the students transformed themselves respecting the given rule or not.

The teacher gives the following **DIRECTIONS:**

- Avoid **walking in a circle**
- **Spread out** evenly in the space
- **Look ahead** and widen your vision
- Keep the **body relaxed**
- **Be aware** of every part of your body
- Keep **high energy** in your body even if you walk slowly

VARIATIONS: This variation is suggested in order to specifically work on prime factors. At the "stop" signal, the facilitator calls the rule: *"Only DIVISORS of number [NUMBER] transform into [OBJECT TO BE REPRESENTED WITH A STATUE]"*

OBSERVATIONS: In order to not increase the anxiety toward mathematics the facilitator should gradually increase the difficulty of the tasks.

3.4. ADDITION

PURPOSE: Understanding the mechanics of addition

DRAMA (KEYWORDS): Physical contact, Ensemble movement, Non-verbal communication, Merging

COGNITIVE DIMENSIONS: Quantitative Literacy, Problem-solving, Spatial Reasoning, Social aspects

MATHEMATICAL LITERACY (KEYWORDS): Understanding Addition as Aggregation, Decomposition of Numbers, One-to-One Correspondence

MATHEMATICAL CONTENTS (KEYWORDS): Addition, Addends, Unit Value

EQUIPMENT: Music player

DURATION: Approximately 30 minutes

DESCRIPTION:

As in "The raft" activity the participants walk within the perimeter of the raft trying to remain evenly distributed around the space. Participants are assigned a number from 1 to N which will be theirs for the duration of the activity.
The raft game continues this way: the facilitator asks participants to walk in the space and stop and go when requested (either with a "stop" voice signal, or on the interruption of the music). When the group has started walking, the facilitator explains that at the "stop" signal, they will have to stop and, as quickly as possible, form groups of 2 or 3 or 4 people in physical contact with each other (the facilitator can specify with which part of the body). When the music starts or the "go" signal is sent, the subgroups move around the space without losing contact. At the next "stop" signal, the facilitator asks the subgroups to merge and create larger groups (e.g. groups of N people), letting participants decide which groups will need to be merged in order to reach the N number required by the facilitator.

E.g: If the group is made of 24 participants, at the first "stop" there might be 8 subgroups of 2, 2, 3, 3, 3, 3, 4 and 4 people.
At the first "go" signal, the subgroups move in the space and at the second "stop", the facilitator asks to form groups of 12 people. At this point the participants can decide to merge four groups of 3, or two groups of 3 together with one group of 2 and one group of 4, and so on.
If the number of participants is not high enough to reach the result, objects of the room can be included in the game instead of people. E.g. 4 sub-groups (of 2, 2, 3, 4) are left out and they cannot reach number 12. To be able to do it, they can take and use a chair. In order to support this kind of solution the facilitator can disseminate objects all around the space.
After making sure that the result of the addition is correct, the participants start walking alone on the raft again, ready for a new round.

The teacher gives the following **DIRECTIONS:**

- Focus on **keeping the body contact** and moving together
- Remember that **1 object counts as 1 person**
- Try to **understand** each other **without talking**
- **Don't intervene** if someone seems to be wrong, I will help them

VARIATIONS:

- When participants have familiarised themselves with the activity, they can be asked to form subgroups without communicating with each other.
- Participants can be asked to form subgroups without being in physical contact with each other if the physical contact is an issue for that particular group

OBSERVATIONS: In this kind of activity it could be useful to take note of all the operations done and recall them on the blackboard at the end of the activity

3.5. SUBTRACTION

PURPOSE: Understanding the mechanics of subtraction

DRAMA (KEYWORDS): Choreography, Mimesis (Imitation), Entrances and Exits, Stage presence, Movement quality

COGNITIVE DIMENSIONS: Quantitative Literacy, Body Control and Awareness, Social aspects

MATHEMATICAL LITERACY (KEYWORDS): Understanding Subtraction as "Taking Away", Calculation of Difference, Introduction to Integers (Negative Numbers)

MATHEMATICAL CONTENTS (KEYWORDS): Subtraction, Minuend, Subtrahend, Difference/Result, Negative Numbers

EQUIPMENT: Music player

DURATION: Approximately 30 minutes

DESCRIPTION:

The group is divided into subgroups. Each subgroup demonstrates an operation.
E.g. Let's take the operation 7-3 as an example.
The facilitator creates a group of 10 participants. One subgroup of 7 is the minuend of the subtraction, subgroup of 3 is the subtrahend.
First, the minuend group goes into the space and creates a static scene. The participants can be touching each other or not.
Then, music starts and one by one the components of the subtrahend enter the space. They dance or walk in their preferred way following the music, and go to touch one participant of the minuend group. The person touched begins to imitate the dance / walk of the person who touched her/him and following her/him, the two exit the space.
At the end 4 people remain in the space: this is the result of the operation

The teacher gives the following **DIRECTIONS:**

- When creating the first static scene **enter the stage 1 by 1**
- Let the **music influence** your **movements**
- **Take your time to exit** the stage, enjoy the music and show to the audience your particular way of walking/dancing

VARIATIONS: This activity could be used to introduce negative numbers by proposing operations with the subtrahend bigger than the minuend

OBSERVATIONS: In this kind of activity it could be useful to take note of all the operations done and recall them on the blackboard at the end of the activity

3.6. DIVISIONS

PURPOSE: Explaining division and remainders

DRAMA (KEYWORDS): Physical theatre, Embodiment, Rehearsal, Performance, Group improvisation

COGNITIVE DIMENSIONS: Quantitative Literacy, Problem-solving, Body Control and Awareness, Social aspects

MATHEMATICAL LITERACY (KEYWORDS): Division as Equal Grouping, Understanding Remainders, Divisibility

MATHEMATICAL CONTENTS (KEYWORDS): Division, Dividend, Divisor, Remainder

EQUIPMENT: Music player

DURATION: Approximately 30 minutes

DESCRIPTION:

This activity has the same structure of the activity "The raft" (see paragraph 2.5): the participants walk within the perimeter of the raft trying to remain evenly distributed around the space.
The raft game continues this way: the facilitator asks participants to walk in the space and stop or go when requested (music or a percussion instrument can be used).
When the music stops the participants have to make contact with each other and form one large group. This can be repeated until the group is fully focused.
Then, after a "stop", the facilitator asks participants to divide in N equal subgroups. Each subgroup of participants must improvise and build an animal by using their bodies and being in touch. They can make sounds too.

The number of participants is the dividend and N is the divisor. If the number of participants is not exactly divisible by N, some participants might be left out as an incomplete subgroup. This is the remainder of the division. Since they are just a part of a subgroup, they will build just a part of that animal.
Now we have N subgroups and another small group. These groups have 5 minutes to rehearse how to bring their animals on stage: how it moves, how it behaves (eating, sleeping, …) and which sounds it makes.
Then, each subgroup performs its animal in front of the others.

The teacher gives the following **DIRECTIONS:**

- When you stage the animal, **make it move and perform actions** such as sleeping, eating, walking, etc…
- Remember to **make the sounds of your animal**, it makes it more real
- When you rehearse decide precisely where **the animal moves on stage** (e.g. in points A it sleeps, it walks from point A to point B, in point B it fights, etc…)

VARIATIONS: The participants can be asked to represent objects or abstract concepts, instead of animals. Depending on the skill level of the group, this variation can be more challenging when it comes to representing abstract concepts.

OBSERVATIONS: A previous engagement in group improvisation activities is necessary for this activity to be enjoyed.

In this kind of activity it could be useful to take note of all the operations done and recall them on the blackboard at the end of the activity

3.7. FRACTIONS

PURPOSE: Training participants to recognise simple fractions

DRAMA (KEYWORDS): Improvisation, Physical transformation, Character consistency, Body shape, Contact.

COGNITIVE DIMENSIONS: Quantitative Literacy, Spatial Reasoning, Body Control and Awareness, Social aspects

MATHEMATICAL LITERACY (KEYWORDS): Part-Whole Relationships, Equivalent Fractions, Unit Fractions

MATHEMATICAL CONTENTS (KEYWORDS): Simple Fractions, Part-Whole Relationship, Equivalent Fractions

DURATION: A minimum of 15 minutes

DESCRIPTION:

This activity has the same structure of the activity "The raft" (see paragraph 2.5): the participants walk within the perimeter of the raft trying to remain evenly distributed around the space.
The raft game continues this way: the facilitator asks participants to walk in the space and stop or go when requested (music or a percussion instrument can be used).
When the group stops, the participants have to make contact with each other and form one large group. This can be repeated until the group is fully focused.
Then, after a "stop" signal, the facilitator asks participants to divide in N equal subgroups. The participants in each subgroup must hold physical contact. When the facilitator says "go", they start walking without losing contact. At the next "stop", the facilitator asks a fraction of the participants to transform in an object/animal/abstract concept.

These transformations are improvised. Participants can be asked to do it without talking. At the following "start" signal, they move without losing their transformations.
E.g. Subgroups of 6 are formed. The participants are asked to transform as follows:
1 / 6 transform into a chair
2 / 3 transform into a chicken (4 out of 6)
2 / 12 transform into a sandwich (1 out of 6)

The teacher gives the following **DIRECTIONS:**

- Focus on **keeping the body contact** and moving together
- Remember that **1 object counts as 1 person**
- Try to **understand** each other **without talking**
- **Don't intervene** if someone seems to be wrong, I will help them

OBSERVATIONS: If the number of participants doesn't allow to divide the group in N equal subgroups it is possible to use objects in order to have an equal number of participants/objects in each subgroups (as it is described in the activity 3.4 "Addition")

3.8. CALCULATING IN YOUR HEAD: THE OLD-WESTERN DUEL

PURPOSE: Experiment to calculate in your head in a playful way

DRAMA (KEYWORDS): Stylization (Genre), Mime, Dramatic death, Stage presence, Atmosphere

COGNITIVE DIMENSIONS: Quantitative Literacy, Body Control and Awareness, Social aspects

MATHEMATICAL LITERACY (KEYWORDS): Mental Calculation, Speed and Accuracy

MATHEMATICAL CONTENTS (KEYWORDS): Mental Calculation, Arithmetic Operations

DURATION: Approximately 30 minutes

DESCRIPTION:

The facilitator introduces the setting: we are in a Western movie. A duel is about to take place. The room is divided in two parts: stage and audience. On stage two participants are actively involved in the duel, whereas the others act as spectators. The two participants start by standing back to back like in a gunfight. The facilitator gives the "start" signal and the duellers take three steps in opposite directions. After the third step, the facilitator says an operation aloud. The duellers calculate it mentally and, as soon as they have the answer, they can turn, say the result and shoot the other dueller (miming the typical gesture of a Western movie character). The first to shoot with the correct answer wins, the other dies in a very tragic and theatrical way. Now a new dueller can enter the scene to challenge the winner.

The teacher gives the following **DIRECTIONS:**

- **I want to see the "Spaghetti western" atmosphere:** your gaze, your walk, your way of dying is very important
- **Don't turn to shoot** if you don't have the answer
- **The teacher can comment how tragic is the death** in a playful way, giving importance to the one who has "lost"

VARIATIONS: In order to decrease the level of competition, both duellers can be replaced after each round.

OBSERVATIONS: It is important to maintain a playful climate throughout the activity, in order to prevent the competition from scaring those who feel weaker at calculating. One way of doing this, is to emphasize the theatrical part of the walk, the posture and the dramatic death of the duellers.

3.9. GREATEST COMMON DIVISOR

PURPOSE: Understanding the mechanics of greatest common divisor

DRAMA (KEYWORDS): Storytelling, Scene creation, Object transformation, Rehearsal, Creative metaphor

COGNITIVE DIMENSIONS: Quantitative Literacy, Problem-solving, Social aspects

MATHEMATICAL LITERACY (KEYWORDS): Set Intersection, Common Factors

MATHEMATICAL CONTENTS (KEYWORDS): Greatest Common Divisor (GCD), Set Intersection, Least Common Multiple (LCM), Prime Factors

DURATION: Approximately 30 minutes

DESCRIPTION:

The group is divided into subgroups of 3 or 4 people. Each subgroup has to theatrically represent a holiday by using the theatrical language they prefer.
The preparation of the theatrical scene consist in these steps:
In each subgroup every participant must express 5 desires for the holiday they are going to represent;
Within the subgroup the participants share their desires.
The subgroup is going to represent a holiday that includes only the desires that all its participants share;
After sharing the desires, each subgroup has 15 minutes to rehearse how to represent the holiday;
Then, each holiday is shown to the others.

The teacher gives the following **DIRECTIONS:**

- When representing the holiday, **try to create a story**, not only to show the activities/places
- You **can use imaginary objects** (see activity 2.13 "Imaginary object") by transforming others (e.g. in the story you need an umbrella but you have a stick, use the stick as an umbrella)
- **Rehearse carefully your scene** in order to remember its main passages. Then, there is always a part of improvisation

VARIATIONS: it is possible to address the concept of least common multiple using the same activity structure. The difference stands in the fact that every participant expresses only 1 or 2 desires and the holiday represented must include all desires expressed.

OBSERVATIONS: The desires expressed are related to the type of holiday they are going to represent or related to the activities they are going to do during it. E.g. at the beach, relaxing, biking, abroad, reading a lot, or biking in the mountains.
Keeping only the common desires (or all the desires) is a metaphor of keeping the common prime factors during the greatest common divisor process (or least common multiple).

3.10. FLAT GEOMETRY: A STICK STORY

PURPOSE: Introducing elements of plane geometry

DRAMA (KEYWORDS): Storytelling, Freeze-frame, Stage composition, Use of props, Visual narrative

COGNITIVE DIMENSIONS: Spatial Reasoning, Body Control and Awareness, Social aspects

MATHEMATICAL LITERACY (KEYWORDS): Recognition of Geometric Figures, Visualizing Geometry in Space

MATHEMATICAL CONTENTS (KEYWORDS): Plane Geometry, Lines, Angles, Basic Elements

EQUIPMENT: A 100 - 150 cm stick for each participant

DURATION: Approximately 1 hour

DESCRIPTION:

The group warms up by playing the 'Imaginary object' activity (see activity 2.13) using a stick. After 10 minutes of this, the group is divided into subgroups of 4-5 participants.
Each subgroup invents and stages a story where participants use the sticks as if they were something else.
The story must include three moments in which the characters freeze and the story stops, and by looking at the position of the sticks on stage, the audience must detect geometrical forms (parallel lines, acute angle, a dot, a segment, etc.).
It is recommended that each story is shown twice. The first time the audience doesn't say aloud which geometrical forms they are able to see. During the second replica the pauses are longer and the facilitator and the audience can discuss the geometrical elements that are visible on stage.

The teacher gives the following **DIRECTIONS:**

- **Rehearse carefully your scene** in order to remember its main passages. Then, there is always a part of improvisation
- When you freeze **choose a comfortable position** because you have to stay still for some time

VARIATIONS: If staging a story is too difficult for the group, they can be asked to stage only 3 different still images representing the core moments of a story. The link between the three moments is made apparent by one (or more) narrator. In the still images the audience should be able to see the geometrical elements.

OBSERVATIONS: It is very important to give enough time to rehearse the scenes. This allows the participants to create good theatrical performance and improves to overall quality of the experience

3.11. PERIMETER AND AREA

PURPOSE: Take confidence with geometrical shapes and their parts

DRAMA (KEYWORDS): Physical characterization, Exaggeration, Movement qualities, Stylized walk, Body levels

COGNITIVE DIMENSIONS: Spatial Reasoning, Body Control and Awareness, Social aspects

MATHEMATICAL LITERACY (KEYWORDS): Properties of 2D Shapes, Perimeter Concepts, Area Concepts

MATHEMATICAL CONTENTS (KEYWORDS): 2D Geometric Shapes, Shape Components, Perimeter, Area

EQUIPMENT: Mask tape or chalk

DURATION: Approximately 45 minutes

DESCRIPTION:

The facilitator traces geometric shapes on the ground by using some masking tape or chalk. The sides of the shapes must be long enough to allow the participants to walk along them (2-3 meters each). The number of sides must be equal or higher than half the number of participants. E.g. For 26 participants we need at least 13 sides (3 triangles and 1 square).

The group is divided into two subgroups: audience and actors. The activity starts with each actor moving along the sides/lengths of the shapes. While the participants are moving, the facilitator asks them to transform into things according to their position on the shape.

E.g: << *Those on a height turn into a train*>>

<< *Those on a base turn into …* >>

<< *Those on a hypotenuse turn into…* >>

Sometimes the facilitator calls out a stop, and the participants must stand still. Then, the facilitator and the audience determine whether the performed walk is appropriate for the line on which the participant is standing.

The teacher gives the following **DIRECTIONS:**

- Try to be very **clear when you change your way** of walking. Exaggerate your movements
- When you decide how to change your way of walking remember that **you can use all the parts of your body** (not only hands and arms)

VARIATIONS:

- While asking different ways of walking it is possible to ask the participants to also make different sounds according to the place they are. The sounds are connected with the walk
- In order to address the topic of perimeters and areas, it is possible to ask the participants to walk along the parts needed to calculate perimeter and area.

E.g. To calculate the area of a triangle, the participant will walk along the base and then along the height.

- In order to incorporate more theatre into the activity, it is possible to give the participants a context in which to perform (an era, a cinematographic or theatrical style, a situation, etc.). In this case, it is important to give the participant some time for rehearsing before showing their walk to the audience.

3.12. SOLID GEOMETRY

PURPOSE: Understanding the spatial concept of three-dimensional shapes

DRAMA (KEYWORDS): Physical representation, Sound design, Context building, Rehearsal, Visual storytelling

COGNITIVE DIMENSIONS: Spatial Reasoning, Body Control and Awareness, Social aspects

MATHEMATICAL LITERACY (KEYWORDS): Properties of 3D Shapes (Solids), Spatial Visualization

MATHEMATICAL CONTENTS (KEYWORDS): 3D Geometric Shapes (Solids), Vertices

EQUIPMENT: A pair of white gloves for each participant (optional), music player

DURATION: Approximately 45 minutes

DESCRIPTION:

The facilitator divides the group into subgroups. The task for each subgroup is to build a solid in the room.
The solid is represented in the space by showing its vertices with the participants' gloved hands closed in fists.
After deciding which solid they want to represent and how to build it, each group has to prepare the theatrical part. They choose a soundtrack, a way to move accordingly, and a context (an era, a cinematographic or theatrical genre, a situation, etc.). Then, they rehearse it before showing it to the others.
During the performance, the actors enter the stage one at a time with a special walk or dance that suits the soundtrack and the context chosen. At the end of the performance the audience has to guess which solid is represented.

The teacher gives the following **DIRECTIONS:**

- **Rehearse carefully your scene** in order to remember its main passages. Then, there is always a part of improvisation
- When you freeze **choose a comfortable position** because you have to stay still for some time

VARIATIONS: If the group has good theatrical abilities, the construction of the solid can be done through the development of a story ending with a still image representing the solid. It needs to be a visual story, hence they can incorporate music and few spoken words, but no dialogues.

OBSERVATIONS: It is very important to give enough time to rehearse the scenes. This allows the participants to create good theatrical performance and improves to overall quality of the experience

3.13. REPRESENTING MONOMIALS AND POLYNOMIALS

PURPOSE: Understanding representations of monomials and polynomials

DRAMA (KEYWORDS): Performance style (Fashion Show), Audience interaction, Atmosphere, Body symbolism, Costume/Prop usage

COGNITIVE DIMENSIONS: Quantitative Literacy, Body Control and Awareness, Metacognition, Social aspects

MATHEMATICAL LITERACY (KEYWORDS): Structure of Monomials, Symbolic Representation, Polynomial Construction

MATHEMATICAL CONTENTS (KEYWORDS): Monomials, Polynomials, Variables, Coefficients, Exponents, Signs

EQUIPMENT: A4 paper sheets, large-tipped felt pens, two tunics of different colours, music.

DURATION: Approximately 45 minutes

DESCRIPTION:

The facilitator asks the participants to transform into monomials and perform a parade or a fashion show.
The rules on how to transform into a monomial are shared at the beginning of the activity and are the following:
One person can be a letter or a number;
The letters (x and y, a and b) are represented by the colours of the tunics. Its coefficient is written on a A4 sheet of paper and held up by the letter/participant with her/his hands;

The exponent (from 2 to 5) is represented by the left hand raised;

The sign (+ or -) is represented by the position of the participant. If he/she is facing the audience he/she is a positive number, if he/she faces the opposite direction, he/she is a negative number.
Each participant chooses which monomial he/she want to be and if to work alone (one letter, e.g. 3x^2) or with a groupmate (two letters, e.g. 3x^2y^4) and prepares him/herself for the parade/fashion show.
When the participants are ready the facilitator prepares the setting, chooses the music and the position of the stage. Then, half the group makes the parade/fashion show and the other half is the audience. After that, the two groups swap roles.
In this activity, the role of the facilitator as a presenter of the parade/fashion show is very important to create the right atmosphere of amusement, both for the performers and for the audience.

The teacher gives the following **DIRECTIONS:**

- Make your **movements strong and clear**
- **Exaggerate** your movements
- Take **inspiration from the chosen soundtrack** of the fashion show

VARIATIONS: With the same structure, it is possible to represent simple polynomials

OBSERVATIONS: The rules on how to transform into a monomial are an example that can be changed according to the situation, the materials there are at school, the needs of the group. What is really important is to build and share these rules with the class so that all the participants are aware and independent during the creation phase.

3.14. OPERATIONS BETWEEN MONOMIALS

PURPOSE: Understanding the representation of monomials and polynomials, make simple calculations with polynomials

DRAMA (KEYWORDS): Staging, Genre exploration, Choreography of action, Narrative logic

COGNITIVE DIMENSIONS: Quantitative Literacy, Problem-solving, Body Control and Awareness, Social aspects

MATHEMATICAL LITERACY (KEYWORDS): Algebraic Operations, Procedural Logic

MATHEMATICAL CONTENTS (KEYWORDS): Algebraic Operations, Products, Polynomial Identities

EQUIPMENT: A4 paper sheets, large-tipped felt pens, two tunics of different colours, music player

DURATION: Approximately 45 minutes

DESCRIPTION:

Monomials are represented with the same rules of the activity 'Representing monomials and polynomials' (see activity 3.13).
The facilitator divides the group into subgroups of 3 to 5 people.

An operation is assigned by the facilitator or each group decides which operation they want to represent. After that, the participants determine what mathematical steps are needed to represent the operation chosen.
Then, each subgroup decides how to stage the operation, by defining a context (e.g. an era, a cinematographic or theatrical genre, a situation, etc.) and a soundtrack.

According to the style chosen, they also choose the intermediate steps that will bring to the solution and rehearse them (how would monomial characters move in a Western movie? And if we were samurais?).

At the end, every subgroup shows their operations to the others.

The teacher gives the following **DIRECTIONS:**

- Make your **movements strong and clear**
- Even if you focus on the calculation remember to **keep clear the theatrical context** (e.g. an era, a cinematographic or theatrical genre, a situation, etc.)
- When performing the calculation, please ensure you **proceed one step at a time**. This allows the audience to understand what is going on

VARIATIONS: With the same structure, it is possible to represent products between monomials or polynomial identities

OBSERVATIONS: The rules on how to transform into a monomial are an example that can be changed according to the situation, the materials there are at school, the needs of the group. What is really important is to build and share these rules with the class so that all the participants are aware and independent during the creation phase.

3.15. EQUATIONS

PURPOSE: Understanding how to solve first order equations

DRAMA (KEYWORDS): Character interpretation, Staging clarity, Symbolic movement

COGNITIVE DIMENSIONS: Quantitative Literacy, Problem-solving, Body Control and Awareness, Metacognition, Social aspects

MATHEMATICAL LITERACY (KEYWORDS): Equality, Solving First-Order Equations, Balancing Equations

MATHEMATICAL CONTENTS (KEYWORDS): First Order Equations, Equality, Balancing Equations, Expressions

EQUIPMENT: A4 paper sheets, large-tipped felt pens, two tunics of different colours, music

DESCRIPTION:

The facilitator divides the group in subgroups with a variable number of participants according to the first order equation they want to represent. It is recommended to include an equation with at least two monomials and two numbers (E.g. 2X+7 = -3X +2).

In each subgroup participants decide which equation they want to solve and how to represent monomials and polynomials with the rules described in the activity 'Representing monomials and polynomials ' . A new symbol is introduced: the equals. It can be represented by a participant bending his/her elbows horizontally and positioning his/her hands one above the other, palms down, at chest level (or by writing it on a sheet of paper the symbol " = ").

Now, the group writes how to solve the equation on a sheet of paper. Then, the group works on the theatrical process by choosing a soundtrack, decide how the

actors move and a set a context (an era, a cinematographic or theatrical style, a situation, etc.).
The process of solving the "human equation" is then rehearsed, before showing it to the other subgroups.
Some points of attention are necessary for a good result:
All the operations must be done separately and with no overlaps, so that the audience can understand what is happening;
The equals character is a sort of facilitator who checks that everything is working correctly and directs the other;
The solving of the equation should be shown twice: the first one as a theatre show (with no interruptions), the second one with interruptions, so that the audience can check that every operation is mathematically correct;
By giving importance to the setting, the soundtrack, and the way the actors move, we are giving the activity a good theatrical quality and therefore, it becomes more enjoyable for the audience;
It is not important that the staging of the equation is mathematically perfect. If errors are made, they can be the starting point of a discussion within the audience.
It is very important that the actors feel comfortable and enjoy the theatrical part of the activity. In this way they can fully commit to the interpretation of their characters.

The teacher gives the following **DIRECTIONS:**

- Make your **movements strong and clear**
- Even if you focus on the calculation **remember to keep clear the theatrical context** (e.g. an era, a cinematographic or theatrical genre, a situation, etc.)
- When performing the calculation, please ensure you **proceed one step at a time**. This allows the audience to understand what is going on

VARIATIONS: It is also possible to use the same format to work on expressions. There will only be numbers and no letters and there will be no equals sign, but the theatrical framework can be the same.

OBSERVATIONS: In order to reach a good theatrical result it is important that each group can rehearse with the teacher and get avdice

3.16. EXPRESSING DEFINITIONS AND THEOREMS

PURPOSE: Understand the importance of the mathematical language. Improving the ability to express a definition, theorem, etc.

DRAMA (KEYWORDS): Physical theatre (Double/Mannequin), Voice-body split, Role-play, Grammelot, Public speaking

COGNITIVE DIMENSIONS: Quantitative Literacy, Body Control and Awareness, Metacognition, Social aspects

MATHEMATICAL LITERACY (KEYWORDS): Mathematical Communication, Formal Language

MATHEMATICAL CONTENTS (KEYWORDS): Definitions, Theorems

EQUIPMENT: A 2m x 2m black cloth

DURATION: At least 1 hour, depending on the number of pairs

DESCRIPTION:

The context is an international conference to be broadcast worldwide because a new mathematical discovery is going to be presented.
The group is divided into pairs and each pair will present their mathematical discovery. This can be a theorem, a definition, or a mathematical concept taken from the school curricula.
In order to present the discovery, participants A and B have different roles within the pair. A is sitting on a chair with his/her hands hidden behind his/her back and he/she can speak. B is kneeling behind A, hiding his/her head and passing his/her arms under A's arms. From the audience's point of view, B's arms look like A's arms (in order for it to be more effective, it is possible to cover A's chest with a big

cloth). What B can do is move his/her arms consonant with what A is saying.
Each pair is given time for rehearsing their presentation and understanding how to coordinate A's talk with B's movements.
Then, each pair presents their discovery to the rest of the group. This is introduced by the facilitator in the role of the presenter. The presenter's role is very important, as they have to introduce each presentation with a lot of emphasis on the fact that this is an international conference, it is broadcast worldwide and is going to change the history of mathematics.

The teacher gives the following **DIRECTIONS:**

- Please **rehearse carefully the synchronization** between words and movements
- If **you don't remember the full definition** you want to talk about **you can read it** while doing the performance

VARIATIONS:

- In order to help A and B, the presenter can intervene during the presentation by dialoguing with them, asking questions, underlining what a remarkable discovery they made, and so on.
- If you are working with groups of three, a possible variation is to have the third person translating what A is saying. In this case, A is speaking an invented language (gramelot) that sounds like a real and known language (e.g. English, German, Chinese, etc.)

OBSERVATIONS: The role of the facilitator as presenter is very important in this case. Making the situation theatrical will foster the audience and performers' enjoyment

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Toolkit: activities and exercises

Part 2 | Process Drama

4. PROCESS DRAMA

4.1 THE OUTLAWS - PRIMARY SCHOOL

The Outlaws
A process drama for drama and mathematics for 11 to 14 years old
TIM (teater i matematikk), 2024
By Silje Birgitte Folkedal and Mette Bøe Lyngstad@mon
in collaboration with Mona Røsseland and Eva Elise Tvedt

KEYWORDS: Process drama, matematical problem solving

PURPOSE:
- To explore the ethics of justice; how far can we go with good means?
- To explore mathematics through aesthetic learning processes.
- Improve mathematical problem-solving skills

MATHEMATICS SKILLS (KEYWORDS): Mathematical communication, reasoning, problem solving, multiple strategies

COGNITIVE DIMENSIONS: Critical thinking, creative thinking, problem-solving, metacognitive awareness

EQUIPMENT:

COSTUMES: Robin's costume: hat, cape, feather
Sheriff: black coat and cap
Monk: a hooded cape

PROPS: Forest soundscape, paper for maps, precious stones, leather pouches, masking tape, banners, flashlights, cushion, speaker, a belt for each student in different colors, paper for coordinate system, an envelope for the Monk, with tasks inside

OTHER EQUIPMENT: :Projector, flipchart, speaker, markers, A4, flipchart with squares or other large sheet for coordinate system, items to create sound, dices, copy sheet 1-5 (annex)

MUSIC TRACK: Marc Streitenfeld: Robin Hood

DURATION: Three parts. Minimum 90 min each

HOW:

The process drama is structured into three parts and can be led by one teacher, but preferably two. It is important that the teachers have competence in both mathematics and drama.
Teachers will assume various roles throughout the process drama and must handle being narrators, in addition to stepping in and out of roles such as:

- Teacher in the role of Robin
- Teacher in the role of the Sheriff
- Teacher in the roles of the Monk

Through this process drama, we aim to highlight the aesthetic process and allow students to experience collective, creative, aesthetic learning processes. This requires time. Therefore, it is advised not to rush through the process drama, but to allow time to engage in and out of roles, and to fully immerse in it. Throughout the process, reflection both in and out of roles should be emphasized. Teachers must listen carefully to the students' ideas and incorporate them into the process.

THE DRAMA SEQUENCES:

PART 1 | EXPOSITION

DURATION: 90-120 minutes

Building the context, establishing the time and place for the drama, storytelling, bodily enactment
Teacher 1 acts as the narrator, inviting the students into the classroom with dimmed lights and music, possibly forest sounds in the background. They sit down and close their eyes. The teacher begins to tell a story from Ragnar Hovland's "A Day in Sherwood Forest" (1994):

"I stand here, deep in the forest, waiting – waiting for him to come. But I know he is not easy to spot as he is dressed in green and blends with the forest. So maybe he is already here, sitting and watching me and laughing a little because I can't see him. Maybe all his men are sitting around me laughing like mad. Maybe I should say: 'I know you're there, just come out!'

But it would be a bit silly if they weren't there after all. Anyway, it is a beautiful day in the forest, with little wind and birdsong. Maybe I will soon see a deer because I know the forest is full of them. Or maybe I'll see a hare.

Deer are dangerous, but not hares. Or maybe the wild and angry hares – and then I hear it: rustling behind a bush, this is no hare.
'I know you're there,' I say carefully. 'Come out!' A green hat with a feather appears behind the bush. 'I knew there was someone there,' I say. 'You didn't know,' says the man. 'Yes, I did,' I say. As we go deeper into the forest, all other sounds become distant, and only the sounds of the forest remain. The old oak stands where it should, just as I had imagined. 'Here we are, boys - welcome our guests.' And suddenly there is life in the bushes, and a whole bunch of green-clad men appear with bows over their shoulders."

As we go deeper into the forest, all other sounds become distant, and only the sounds of the forest remain. The old oak stands where it should, just as I had imagined. "Here we are, boys - welcome our guests." And suddenly there is life in the bushes, and a whole bunch of green-clad men appear with bows over their shoulders.

ESTABLISHING THE FOREST THROUGH TABLEU:

Teacher 1 continues:

When you open your eyes, we want you to imagine walking into this forest and populating it. (We show the image of the forest on a large screen)

What do you see here? Everyone can make suggestions.

We want you, in pairs or groups of 3-4, to create a tableau (a still image) that shows how you are positioned in the forest right now. You can choose who you are at this moment.

If necessary, the teacher can also demonstrate what a tableau is by creating a position and showing it. The students present their tableaux to each other.

BUILDING THE CHARACTERS

The teachers initiate the conversation:

What do you think an outlaw is? Discuss this together in pairs. Share with the group. We would now like to invite you into the drama. Can we imagine that we are the people who actually live in this forest, the outlaws? I must mention; you know – in our story, there is this young man who says he fights for the poor, and therefore he helps them. Gives them things they need. He is a very nice person! His name is Robin, and you are about to meet him in our forest. He is actually the leader of the Outlaws, and the people who live there are very grateful to have him as their leader.

RITUAL

Teacher 2, in the role of Robin, interrupts:

"Dear outlaws, welcome to us in the forest! I must know that I can trust you... we never know who might be lurking around in the forest... therefore, I need you to swear an oath... We will now perform the traditional initiation ritual into the outlaws' community here in the forest."

Interruption

Teacher 1 explains that everyone must stand in line, and two by two come forward and kneel to receive the outlaws' mark. It is important to create a calm and solemn atmosphere.

Robin: "To you, my people." Do you swear, free men of the forest, that you will do anything to protect the old and sick, women and men, rich or poor?

Robin: Then kneel at my feet and take this oath by touching my feather and saying: I SWEAR!

The outlaws come forward in turn.

BUILDING THE SPACE/ESTABLISHING THE FICTION

Teacher brings out the gray paper roll and begins to mark the forest). Teacher:

> Now we will imagine that this is the forest. Let's gather in a circle. We know there is a clearing in the forest somewhere in the middle, where do you think it is?

The teacher marks the elements in the forest as they decide on the map;

> Now there must be a clearing where they can meet... Where is it? And we know for certain that there is a well here somewhere, where? And there are many trees of course, but there are some particularly tall trees clustered together in one place, can you tell me where?

The teacher creates the map together with the students.
The map can be hung on the wall after it is finished.

MATHEMATICS 1: ESTABLISHING THE COORDINATE SYSTEM

Equipment: Copy sheet #1 (coordinate system)

Teacher: In the forest, there was always a danger of being discovered, and they constantly had to ensure that no one found out they were there. There was a need for a map of the forest. The outlaws had to make sure they could send each other messages that could lead them to specific places in their settlement without revealing it to others. The outlaws used a coordinate system to keep messages about locations secret from others. Now I am standing at the point (0,0), also called the Origin. Do you remember what that means?

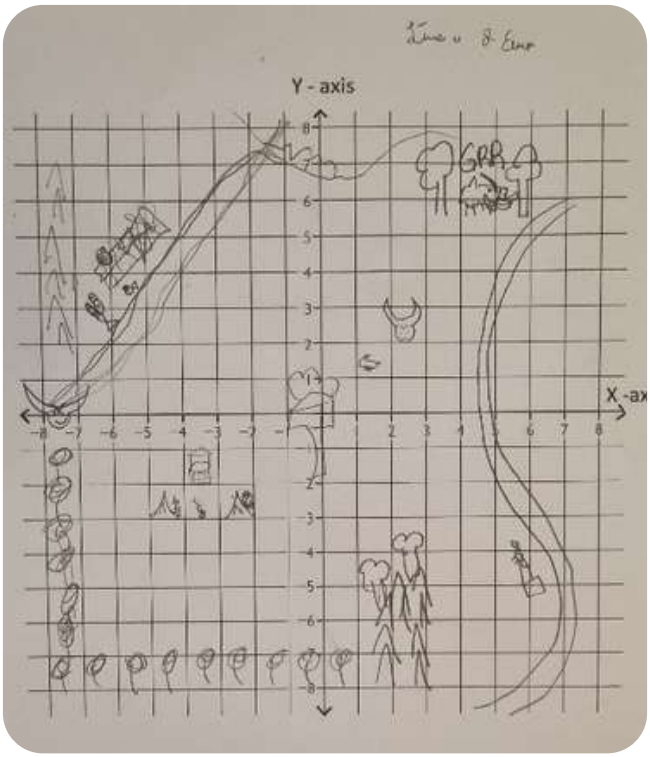
The teacher draws the origin and axes on a coordinate paper on the wall.

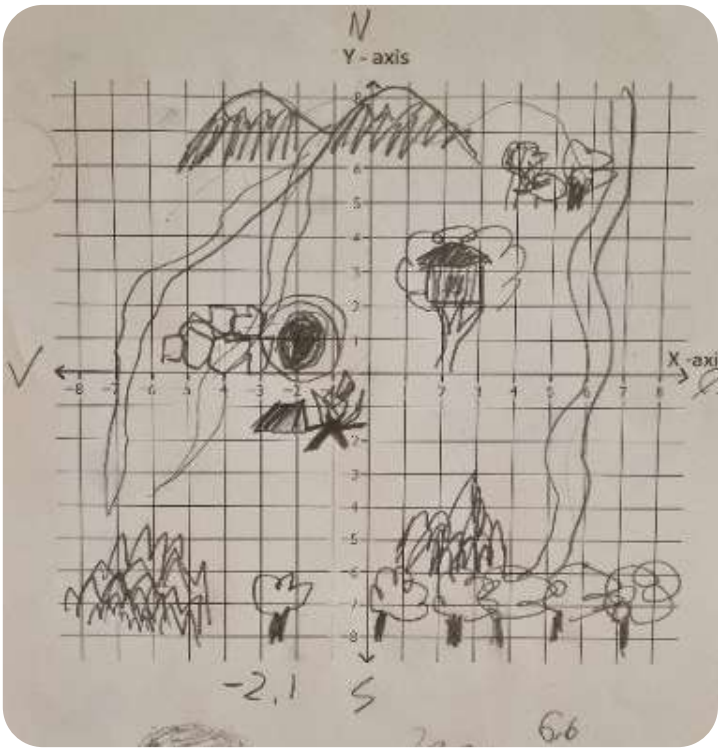
At which point in the coordinate system do you think the well is located?

Class discussion about where the well is located. The teacher places the well at a point on the coordinate paper on the wall.
Teacher is holding up a coordinate system (copy sheet 1):

Now we have placed the Origin and the well. Can you, in groups of 2-3, create a map of the forest on a coordinate system?

Class discussion about where the well is located. The teacher places the well at a point on the coordinate paper on the wall.
Teacher is holding up a coordinate system (copy sheet 1):





After a while, the students gather for a joint summary and discussion. The class creates a shared coordinate system where the students' various coordinate systems are synchronized into one. This shared coordinate system is a sheet hung on the wall, with the main elements from the map drawn in. (Alternatively, you can draw the coordinate system on the map of the forest. Write down the coordinates of the different elements on the map.)

WHAT DO THE OUTLAWS DO?

We meet in the circle on the floor again.
Teacher explains:

> In this forest where the outlaws live, there is a small community where everyone has their tasks. (Brings out the belts and lays them down one by one as she explains) - We have gatherers (the red), the guards (the green), the archers (the brown), and the cooks (the white). And we will get to know all these roles better next time we meet... We know that this little community has some different tasks that need to be done every day;
> I would like to suggest a little game for you, okay? We have some archers; can you show me what it looks like when they work?

Everyone mimes the work of the archers, and then the other tasks...
Alternatively, the yes-game can be used:
"Shall we shoot the bow? YES!" (and so on, involving the children physically in miming the work), gathering firewood, cooking, guarding the forest, taking care of the horses. There can be different roles, but if there are four groups, we would recommend choosing the first four in the list. Do it like the YES game.

ROLES

Teacher gives each student a belt after the introduction. The belts are made of fabric in different colors and divide the group into four (or more) groups, .depending on the color. Each color belongs to one of the roles:

- Archers – hunters (orange)
- Gatherers (berries, mushrooms) (brown)
- Guards (green)
- Cooks (white)

Teacher:

> Where do you think the different groups work in our forest? Now you will gather in your color groups. When you hear this signal, you will know it is time to gather around the campfire in the clearing. (Sound: for example a drum)

The groups perform their assigned tasks and establish their area in the forest. Here they can engage in the role-play as long as it seems to be working. The teacher-in-role as Robin can walk around and provide input to the game.

REFLECTIONS

1. Why do they live in the forest? Who are these people?
2. Who are the outlaws of today? (Perhaps this will serve as a topic for discussion after the drama)
3. What thoughts do you have after the program today?
4. How did you like it?
5. What could we have done differently?

PART 2 | LIFE IN THE FOREST

Start the day by having the students continue to establish the forest and their roles. Give them time to play into the drama.




DRAMATIC ESCALATION:

Teacher takes on the role of a Wandering Woman (tattered shawl, stick). Robin "finds" her at the edge of the forest, possibly with the help of a couple of guards, and brings her to the campfire. She has a low status and is quiet and disoriented. Robin acts as if he found her "snooping" around their forest, and they don't know who she is or where she comes from. Depending on how inquisitive or cautious the children are, Robin adjusts his actions. He asks the different groups if they know anything, have seen anything, or are curious about anything.

Eventually, the Woman speaks up:

I am a wanderer who has been on a Pilgrimage for many months. I have never seen the sea and thought I would experience it before I get too old. A few days ago, I came to a village with great poverty. It was terrible to see how these people struggled to provide food for their families. There was no help from the Mayor of the town.
They begged me for help, but I own nothing and have nothing to sell. But I told them – that I promised to come back if I could find something on my way.

Yes, that is why I searched for your forest, because I had heard rumors about the Forest of the Outlaws, where all who lived and worked there were good-hearted, under the leadership of someone named Robin – maybe they could help?

By the way, I have some drawings of the families that a traveling artist made... I have them here (crumpled in her pocket). She shows pictures of four families (copy sheet 2).

Here, Robin and the Woman work together in the dialogue with the group's resistance or empathy, and eventually, it emerges that Robin has hidden away a bag of diamonds meant for an emergency. He asks the outlaws: Should we use these now? After a few rounds of discussion, we hope they will decide to help. (If not, we can break the play and talk about what happened and why they didn't want to help...).

MATHEMATICS 2: DISTRIBUTION OF DIAMONDS

Equipment: Copy sheet #2 (Pictures of poor families), "Diamonds" in three different sizes

Teacher in role as helper to Robin:

> Robin is out on a mission, and when he returns, we will distribute what he has brought to the poor families in the village. You will help Robin decide the distribution among four different families. You will determine what fraction of everything each of the four families will receive.

Each group (guards, archers, cooks, and gatherers) (large groups can be divided into two) receives copies of pictures of the four different families (Copy sheet 2)

Robin arrives. He brings a bag of diamonds, which he then gives to each group. It can be a handful for each group. It doesn't have to be the same number for each group. They will now distribute the diamonds among the four families according to the fraction they have decided. The diamonds come in three different sizes. The ratio between them is 4:2:1.

Summary:

> How did you distribute and why did you distribute like this?

MATHEMATICS 3: GAME NIGHT

Equipment: Copy sheet #3 (game), dices

Narrator:

> In the evening, they gather around the campfire to hear how things are going. Some input from each group.

Teacher as Robin:

> Outlaws, the workday is over, it's time to play games! Come and gather around the fireplace. Tonight, I will teach you a new game I learned in the village.

Teacher says:

> This is the game they played: In this game, you will try to get 4 in a row (shows how you can get four in a row on the coordinate system, four consecutive x-coordinates, or y-coordinates, or adjacent on a diagonal line). And to do this, you roll two dice, and see what numbers you get. If you get a 2 and a 3, you can place them at (2,3) or (3,2) or (-2,-3) or (-3,-2). Ok? If there is already a mark there, you have to wait until next time, then it's the next person's turn. One player will mark their coordinates with a star, and the other with a heart, or another symbol, so you know which is which. You win if you get four in a row. Let's see who wins! Pair up so everyone has someone to play with.

If one teacher: the teacher goes out to change the music and dress as a sheriff.

Dramatic music is put on, Robin hides somewhere in the room (if two teachers).

MEETING WITH THE SHERIFF:

(Music background: Jed Kurzel: The Letter from Macbeth)

Teacher 1 as the Sheriff (high status):

> We are here today to search for Robin Hood! And this time, we WILL catch him! Men! Take your best weapons and search! There is no longer any place to hide in the forest, we will find you, and whoever finds him will blow the whistle! I will give a thousand pounds to the one who captures him. Dead or alive!

The Sheriff walks among them, using the flashlight in their faces as he says:

> "Only those who were spoken to could move and speak, all the others had to freeze like a picture!"

The Sheriff interacts with the different groups and asks about Robin. As he walks around, he informs them that Robin is a thief, stealing from people under the excuse of helping the poor! Robin is hiding somewhere in the room and is eventually found.

Interruption:

The Music Stops

Teacher as narrator:

> There is complete chaos in the forest, everyone fightin to try to hide Robin, some were scared, others were angry, some hid among the trees or tried to flee. But in the end, there was no other way, Robin was captured, and the forest fell completely silent.

There is complete chaos in the forest, everyone fightin to try to hide Robin, some were scared, others were angry, some hid among the trees or tried to flee. But in the end, there was no other way, Robin was captured, and the forest fell completely silent.

That same night, there was a tense and different atmosphere in the camp. Robin was captured, and they were uncertain about what the future would bring. All the outlaws decided to write down some thoughts in a journal they had hidden in their tent.

Distribute paper and pencils to everyone. Each person writes individually. They can come up with a name other than their own that they think fits. When they are finished, they place the paper in a basket in the middle of the room and sit down again. During the writing sequence, it might be nice to have some calm and atmospheric music in the background (Gabriel Olafs: Filma solo).

When everyone is finished, we can either ask some to read their own notes aloud, or we can choose some from the basket and read them out loud.

DISCUSSION:

How do you think things went for Robin? And for the outlaws in the forest?
We must wait until tomorrow before we get any answers...

PART 3 | ROBIN IN PRISON

DURATION: 90-120 minutes

We gather in a circle. Discussion:

> Do you remember what happened yesterday? What do you think happened to Robin and the strangers?

THE FOUR WALLS OF THE PRISON:

Teacher 1:

> Let's leave the forest for a moment and move to the prison where Robin is being held. What do we think it looks like?

We go into the other classroom, which is completely empty. We use tape to mark the space.

Teacher

> What does it look like in the prison cell where Robin is? Are there any furnishings in there?

The teacher tapes the space while the children make suggestions.
The teacher explains the method "The Walls Speak."
Version A: The students line up along the walls. If the walls could speak and tell something about what they see in the room, what would they say? (Some examples from us, one of us goes in and plays Robin in the room, taking in the information that comes from the play. One by one, they can say out loud what they see).
Version B: Improvisation: If there is only one teacher, a student can, for example, act out what the walls have seen.

If this doesn't work, we can use the same square with "Robin's Thoughts."

THOUGHT TUNNEL (ROBIN'S THOUGHTS):

The teacher divides the group in two and places them in two lines facing each other. He explains that he will walk between the two lines in the role of Robin. This "tunnel" can extend from one room to the other.

TUNNEL WITH ADVICE:

Teacher 1:

> What advice would you give him from the outside, as he walks past you, on what he should do?

The teacher walks slowly through the tunnel, making sure to pause if someone speaks quietly. The other teacher can repeat loudly if not everyone hears.

Interruption

A MEETING AROUND THE CAMPFIRE

Teacher 1 in the role of Monk David:

> We gather sitting in a circle around the campfire again. I am Robin's good friend, Monk David. I come in peace and bring news about Robin. He says that a guard is willing to help him escape, but he wants to be paid a certain sum of money for it.

The monk raises questions about accepting bribes. He can be quite skeptical and cautious, using low status. He facilitates a discussion:

> What can we do to save Robin? Is it okay to bribe someone for a good cause? Is it acceptable? Can we do that? What do you say, my friends? Talk to the person sitting next to you.

Monk:

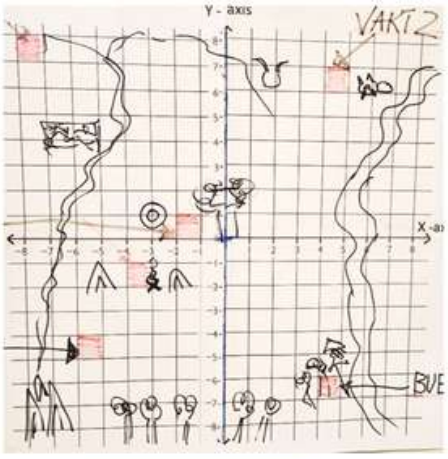
> Robin told me about a hidden chest where he has stashed some money somewhere in the forest. But I need your help to find it, as you know the forest best. Will you help me? He didn't tell me exactly where it is, he just gave me this note, but I don't understand what it means (reads the note from Robin that he has in his bag: Mathematical task 4). What do you think it means?

MATHEMATICS 4: FIND THE CHEST

Equipment: Copy sheet #4 (treasure map- finding the chest)

The teacher steps out of the role and gives the students the the the task:

> Now you will use the map we made on Monday to find out where the chest is hidden.



Tegn inn løypen i koordinatsystemet over.
Hvilke steder og koordinater på kartet går løypen innom?
Hvor har Robin gjemt kisten?

The students work in group of 3.
After a while, the narrator interrupts:

> With the help of the outlaws, the Monk found the chest in the Castle.

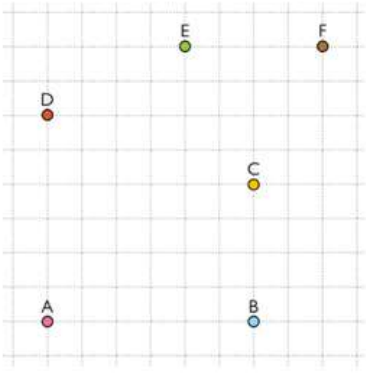
The Monk comes with the chest:

> Oh no, it's locked. That won't help us much. Wait a minute, I was wondering if I have something more from Robin... (takes out the letter: Mathemtical task 5) Maybe I should see if this can help us?

MATHEMATICS 5: CODE SOLUTION TO OPEN THE CHEST

Equipment: Copy sheet #5 (Code solving)

Teacher explains based on the letter and hands out one task to each group (copy sheet 5).
The students receive a code-solving task in their groups, the goal is to find the correct code to unlock the chest. Teacher helps them if needed. The teacher playing the Monk takes care of the chest.
Afterwards, we gather in the circle and listen to the different groups. When the correct code is tested, one of the teachers opens the chest.



Narrator:

> The code was found, and the chest was opened. There were enough gems to pay off Robin at the guard in the prison. So the Monk set off."

CELEBRATION

Teacher as narrator:

David took what they had found to the prison. Now Robin would be free. Now there would finally be a celebration in the forest. Robin's reputation was surprisingly good higher up in society; King Richard the Lionheart and Robin understood each other. The Outlaws planned a feast in the forest, and King Richard himself would come to inspect the forest to consider if the Outlaws could become part of lawful society again, after hearing so many good things about how they lived there. Everyone wanted to show the forest at its best, and they prepared day and night with their various tasks

- The gatherers create a dance
- The archers decorate the forest
- The guards make a guard schedule to show the king how proper their security is, and a formation through which the king will walk. They must inspect all uniforms and weapons.
- The chefs make a gigantic soup based on wild boar (with a recipe list) and prepare a speech to the king from the Outlaws.

The groups work independently and get some help if needed. Before they go into their groups, we agree on the signal that when the King comes, they will hear this sound (drum); it means everyone must gather and line up for the King's entourage."



After a while:

The King is coming! He wanders through the forest and the groups are neatly lined up. All the groups present their work in talks with the King. Music: Planting the fields (Marc Streitenfeld, from the film Robin Hood)

REFLECTION

We meet together in a circle. We step out of the drama and reflect together on what happened within the process drama, both in the story and while we developed the fiction together.

Do you think they will be reintegrated into society?
What does it take to be part of a society?
Isn't it okay to steal from the rich then?

Finally: A round about these days: In groups of four, write down five sentences about these days, afterwards; one presents to the rest of the class what they have discussed.

4.2. THE OUTLAWS - SECONDARY SCHOOL

The Outlaws
A process drama for drama and mathematics for 11 to 14 years old
TIM (teater i matematikk), 2024
By Silje Birgitte Folkedal and Mette Bøe Lyngstad@mon
in collaboration with Mona Røsseland and Eva Elise Tvedt

KEYWORDS: Creative processes, collaboration, fiction, exploration, drama, matematical problem solving

AGE: 11-14

PURPOSE:
- Exploring creative learning processes collectively
- Exploring the ethics of justice; How far can we go with good means?
- To explore mathematics through aesthetic learning processes.
- To explore students' engagement in fictional situations.
- Improve mathematical problem-solving skills

MATHEMATICS SKILLS (KEYWORDS): Mathematical communication, reasoning, problem solving, multiple strategies

COGNITIVE DIMENSIONS: Critical thinking, creative thinking, problem-solving, metacognitive awareness

EQUIPMENT:

COSTUMES: Narrator: a vest
Visevald: a jacket and beret
Police: uniform coats
Father David: a dark coat suit jacket

PROPS: paper roll and markers for maps, stones, leather case, masking tape, banners, flashlights, pillow, speaker, small stickers with DF on them, box with buttons

OTHER EQUIPMENT: Projector, flipchart, speaker, markers, A4, items to create sound, copy sheet 6-9 (annex)

MUSIC TRACK: For the opening: Morning twilight: Forest and village sounds Spotify; Ritual Music of the Kayapo-Xikrin, Brazil
During the police action: Ed Kurzel: Macbeth: The Letter
In prison: Music material: Marc Streitenfeld: Destiny
For the dance: Marc Streitenfeld: Planting the Fields (from the soundtrack Robin Hood 2010)

DURATION: Two parts. Minimum 60 min each

HOW:

The process drama is built up in three parts and can be led by one teacher, provided that the teacher has competence in both mathematics and drama.
The teacher must step into different roles throughout the process drama to challenge the students and bring the story forward. The teacher can put on different garments to highlight the different roles, so that it is easier to understand what role the teacher is in. The characters can also have different statuses that can be marked through the use of voice, posture and presence in the room.

- Role: Teacher in the role of Fevronia , a narrator
- Role: Teacher in the role of Visevald
- Role: Teacher in the role of Police
- Role: Teacher in the role of street priest

It is important to have an aesthetic focus in the work. This means that you think through what you want the students to learn and how you facilitate this in the aesthetic learning processes. What forms of expression do you highlight, and how are the students allowed to express their impressions? Don't rush through the process drama, but spend time going in and out of roles in the process drama. Immerse yourself in the situations and reflect both in and out of role on the topics that lie there and or that come up along the way. Remember to clearly show the students when you are in role and out of role. Create safe situations in the classroom so that students dare to express themselves. Listen carefully to their ideas and take them further into the process.

PART 1 | EXPOSITION

DURATION: 60 - 90 minutes

ESTABLISHMENT OF THE AREA:

Audio Context: Morning twilight: Forest and village sounds Spotify;
Ritual Music of the Kayapo-Xikrin, Brazil

The teacher invites the students into the classroom, which has dimmed lights and music (city sounds in the distance), where the desks have been cleared away. The students gather in a circle, sit down and close their eyes.
The teachers in the role of Fevronia begin to tell a story:

Imagine that you are on the outskirts of the city of Kitesh, in a country not too far away. The year is 2058. It's night. Smoke seeps out of some old factories nearby. You are sitting at a bank. There is a well-trodden path along the riverbank. You can hear sirens and Dogs barking in the distance. The night fog begins to seep into the nearby forest. River and some dead trees separate the place you are sitting from the city.

A wall frames the city. Someone scattered old caravans frame the plain you are sitting on. You look over shoulder to check that you are alone. Slight crackling of a fire.
You live here, on the outskirts of this city. You are undocumented people who for various reasons reasons have been banished to live here on the outside of the Wall. You can't go inside walls without a special passport, you can't take regular jobs, you're displaced. Maybe you did something illegal, maybe you were just in the wrong place at the wrong time. Maybe were you born in the wrong country, or in the wrong family? The outlaws.

The teacher continues:

Create some inner pictures of what it looks like here? What do you envision? What does it smell like here? What sounds are here? When you open your eyes, we want you to tell about this place to someone else, before we gather in plenary and make a joint drawing of the area (collective drawing), and after that go into the camp area and build it up.

COLLECTIVE DRAWING/ESTABLISHING THE FICTION:

Teacher:

Let's gather in a circle. Now we will make a landscape drawing of the camp together

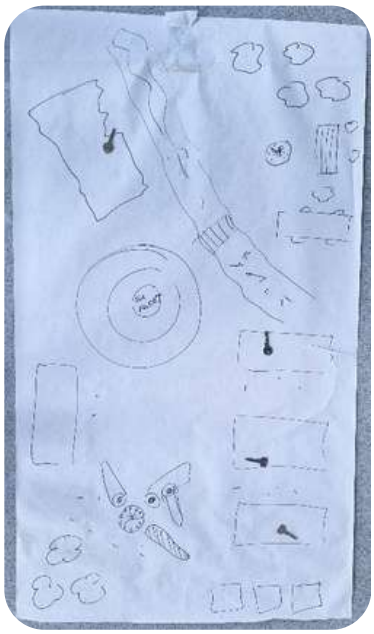
(Teacher pulls out the gray roll of paper and starts marking on the map by drawing the forest. The others then take part in the design either by drawing themselves or saying what the teacher should draw).

We know that there is an opening in the forest in the middle of the campsite, where would you say it is?

The teacher marks the items as they make suggestions.

Tank here somewhere? And there are some trees of course, but there are some special tall trees. There must be a place where the people in the camp meet....Where is it? And we know for sure that they have access to a water r clustered together in one place, can you tell me where? Where are the caravans that they live in? We know that they gather in the evening around a barrel fire... Where?

The teacher creates the map together with the students.



CREATING A TABLEAU:

The students in pairs or groups of 3-4 will make a tableau (still image) from the camp, which shows how they are positioned in the camp right now. Who are they, and where are they in the camp?
Viewing the tableaux:

The students are challenged both to work in detail with their own expression and with the group's tableau

BUILDING THE CHARACTERS:

The teachers start a plenary discussion:

What do you think it means to be an outlaw/exiled? Discuss it together in pairs. Share thoughts in plenary? Who are today's outlaws?
We would like to invite you to be the people who you think live here, as outlaws/exiled. Now let's imagine that we are in this camp. What we do know is that you are all fairly new arrivals, and have been "placed" 4 and 4 in the different wagons in the camp (adjust the number of groups according to the number of students). Who are these people?

The pupils are each assigned a button: Sit first by yourselves and link the button to stories about your character.

1. What object/garment was this button on? How did you react when you discovered that it had come loose from the object/garment? What does this button mean to you?
2. Who are you (age, identity, life situation)?
3. How far have you traveled, and how have you traveled?

The pupils first work individually with the questions, before they gather in groups and share. After a while, the facilitator says:

I must mention; In our story, there is a young man who helps the outlaws, he fights for the poor and lawless, and lives in the camp with them. He has contacts, and provides them with things they need. His name is Visevald, and you will meet him in our camp. He is their leader.

Note: Here the facilitator puts out an idea that Visevald may be somewhat dubious, it can create tension, uncertainty but also credibility to the fiction.

RITUAL:

Teacher-in-the role of Visevald arrives, he behaves somewhat paranoid, waves to the crowd and is busy keeping an eye out for intruders. He asks a couple of the students to check the outskirts of the camp/path, that they are alone.

Dear friends, welcome to us in the camp! In order for us to be able to trust each other in here, it is important that everyone takes an oath that all of us who are going to live here must take part in.

He explains and shows how they are to line up, and one by one come forward to receive the sign of the outlaws, saying: For the people! (Here, teacher 2 can assist with the organization)
Visevald says:

For the people!

One by one answers: For the people!
Visevald's assistant gives each student a sign (tattoo with various geometric signs after taking the oath. The badges divide the group into four (or more) groups, depending on their appearance.

Visevald :

When everyone has received their sign and gone back into the ranks.

You have taken this oath as free men of the camp, an oath that gives us the right to take from the rich to feed the hungry and protect the old, the sick, all women and men, all who are vulnerable! You solemnly swear to fight to the death the oppressors of the helpless. Fight with your heart! For the people!

Outlaws: For the people!

Fiction is ended

MATHEMATICS 1: ESTABLISHING THE COORDINATE SYSTEM

Equipment: Copy sheet #6 (coordinate system)

Teacher:

> In the camp, there was always a risk of being discovered, and they had to constantly make sure that no one found out that they were there. There was a need for an exact map of the area. The outlaws had to make sure that they could give each other messages that could lead them to certain places in their settlement, without revealing it to other people. Do you have a suggestion on how to do that? How can we create a system that we can use to tell someone where something is, without talking about the things we see? Students discuss proposals in pairs.

If the coordinate system is not mentioned by the students, the teacher can introduce it:

> The outlaws used a coordinate system to keep messages about places secret from others. Can you, in groups of three or four (or in the groups that their medallion suggests), make a map with a coordinate system of the forest?

The students are given brown paper on which they can create their coordinate system. Ask the pupils to draw key elements from the map they have made together, such as entrances to the forest, wells, large trees and houses, etc.

Later, everyone meets as a group and discusses their proposals, and agrees on where to place the origin, x, and y axes. The class creates a common coordinate system where the students' different coordinate systems are synchronized into one. This common coordinate system is drawn on the map of the forest on the floor. Write down the coordinates of the different elements on the map.

ESTABLISH THE ROOM

> Now let's imagine that this map is our room here, where is the barrel fire? Where is the gateway to the city? Where is the wall? Where are our carts?

MATHEMATICS 2: FIND THE COORDINATES OF THE SECRET TUNNELS

Equipment: Copy sheet #7 (Find secret tunnels)

Teacher:

> In the forest, the outlaws have made four tunnels/underpasses? Here they can hide if necessary and they can store food and equipment. We know the location of the opening of one of the tunnels. Visevald has given us some hints so that we can find the entrance to the other three.

The groups are now given a task where they must find the coordinates of the entrances to the three secret tunnels that are still unknown.

See separate document describing the task, marked as "Copy sheet 2_Find the secret tunnels"

Rounding off day 1:

.

> We have set the secret underpasses, we know that the outlaws had various jobs; Some scouted, kept watch at the various posts into the camp, some made sure to collect food, sneaked out in garbage cans and at restaurants at night, some even cultivated on a small green spot behind the camp, some cooked the food, some made things that they could sell on the black market. But all these people, and what happens to them and Visevald, you will not know until we meet again...

PART 2 | ESTABLISHING THE DRAMA AND THE CAMP

DURATION: 60 - 90 minutes

WHAT DO OUTLAWS DO?

Teacher:

Each family lives in its own caravan. Who are these people?
What do the caravans look like? Draw the caravans on the outside and inside. Can you furnish your caravan together?

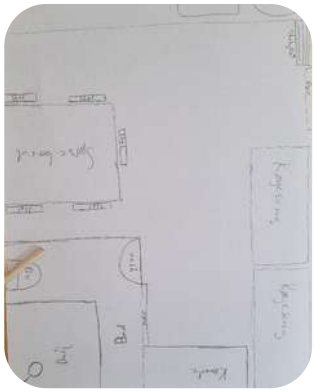
We know that this small community has different tasks to be done every day. Among other things, we have some scouts who spy on what is happening "out there", to watch out for intruders. Other tasks we have to allocate ourselves to:

Scouts – who spy on what is happening "out there" in the city, watch out for intruders.

Chefs – create a "restaurant" where everyone can come and eat

Collectors – Dumptserdivers; collect food from waste from the city can give. Maybe they have some animals? Maybe someone is growing something edible?

The creators – make things that they can sell on the black market by the wall.



Teacher:

> Where do you think a normal day is for these people in our camp? Those of you who have the same mathematical sign on hand gather as groups and we decide who is who. Possibly redraw these, or that they have got a sticker

Students are asked to establish their play spaces and set up the space with available equipment found in the room. Here it is a good idea to bring some equipment they can use, for example, cardboard boxes, large blocks or pillows, pieces of cloth, ropes, stools, sticks or the like? The younger children brought twigs and broom from outside after a while – don't know how important it was for 9th grade?

Improvisation in groups

The students are challenged to interact with the changing groups in the camp. If needed; Visevald comes around and talks to them, gives them some tasks, helps them to be in the roles. Here V can also bribe some people, or ask someone to take care of some treasures he has, but they must promise not to say anything to others.

DRAMATIC INTENSIFICATION:

Teacher 1 takes on the role of an older wife.Visevald "finds" her on the outskirts of the area, perhaps gets help from a couple of the guards and brings her into the campfire. She has a low status and is quiet and dazed. Visevald plays on the fact that he found her "snooping" around their area, and that we do not know who she is and who she comes from. Visevald takes a round with the different groups if they know anything, have seen something, what are they wondering about?

Teacher-in-role, like an elderly lady, who introduces a problem that needs to be solved:

> I wander around, help where I can and get some food as a thank you. Yesterday I passed some families who live all the way out in the wilderness and they had nothing to live on. It was horrible to see how these people struggled to be able to feed their familier. There was no help to be had from anyone. They asked me thinly for help, but I own nothing, and has nothing to sell. But I told them—that I promised to come back if I could find something on my way. Yes, that's why I searched for area, I had heard rumours about you, where everyone who lived and worked in here were good at heart, under the leadership of someone called Visevald – maybe you have aomething you can share with them? By the way, I have some photos of the families ... I have these.

She crumpled in the pocket and take out picture of the poor families (Copy sheet # 8)

Here, Visevald and old lady work in dialogue with the group's resistance or empathy. They can try to get those who have received gemstones to give them away for distribution to the poor families.

Visevald may also have hidden away a bag of diamonds that was supposed to be for an emergency. Ask the outlaws; Should we use these now? After a few rounds of discussion, we bet they will help. (If not, we can possibly break the game and talk about what happened and why they don't want to help....)

MATHEMATICS 3: DISTRIBUTION OF DIAMONDS

Equipment: Copy sheet #8 (Picture poor families), "Diamonds" in three different sizes

Teacher in the role of helper to Visevald.

Does anyone have any values that we can give to these families? Visevald also has some treasures hidden that we can distribute. You will help Visevald decide on the distribution of four different families. You must decide how large a fraction of everything should each of the four different families receive.

Each group (Scouts, Chefs, Creators, and Collectors) (large groups split in two) is given copies of photos of four different families.

Teacher in role: Visevald is coming. He brings a bag of diamonds that he then distributes to each group. There can be a handful for each group. Doesn't have to be the same number for each. They will now distribute the diamonds among the four families according to the fraction they have decided. The diamonds come in three different sizes. The ratio between them is 6 : 3 : 1

Summary:

If there is only one teacher in the drama, the teacher goes out to dress as a policeman. Puts on music with a scary undertone.
If two teachers are involved in the drama, Visevald can hide now.

Musikk her: Jed Kurzel: Macbeth: The Letter

MEETING WITH THE AUTHORITIES

Teacher-in-role as a police officer:

> Raid! We are here today to search for Visevald! And this time we WILL catch him! Men! Grab your best weapons and search! There is no longer any place to hide in the forest, we will find you, and whoever finds him will blow the whistle! I will give you a free pass into the city of whoever catches him. Dead or alive!

Note: here the teacher may have allied himself in advance with a couple of students who may have some gaming experience or be able to take on roles as extra guards for the police.

The policeman walks among them and uses the flashlight on their faces as he says,

"Only those who were spoken to could move and talk, all the others had to freeze like an image!"

The police interact with the various groups and ask about Visevald. As he walks around, he informs them that Visevald is a thief, stealing from people with the excuse of helping the poor!
The police find Visevald's belongings (uniform jacket and beret)
Teacher steps out of the role of police officer by taking off his hat and continues as a teacher:

Visevald was found and placed under arrest. There was complete chaos in the forest, everyone was fighting for to try to hide Visevald, can you show me what it looked like just before the Police got hold of him, in the middle of the game!?

A tableau with all the people in the forest is displayed, here you can get thoughts from the characters, by asking them to say the character's thoughts while you put your hand on their shoulder.



VICE-CHANCELLOR IN PRISON

Music material: Marc Streitenfeld: Destiny

Establishment of rooms:

Teacher:

> Let's leave the camp for a moment and move to the prison where Visevald is imprisoned. How do we think it looks? [We use tape to mark the space.] Is there any furniture in there?

The teacher taps up the room as the students come up with ideas. Alternatively, one student at a time can enter and lose some of the inventory.

4 WALLS

The students line up along the 4 walls; If Wallens can talk and tell something about what they see in the room, what would they say? (Some examples from us, one of us goes in and plays Visevald in the room, taking in the information that comes from the game. One by one, they can say out loud what they see.)

Improvisation:

A student can act out what the students say the walls have seen while the students are telling.

Thought of tunnel:

The teacher asks the pupils to stand on two lines facing each other, with approx. one metre between them.

Teacher:

> Now you will be Visevald's thoughts when he goes inside the prison by himself? Have your say loudly as I walk by you.

Tunnel and suggestion:

Another version where the students also stand on two lines. This can be carried out after the other:

Teacher:

> What advice would you give Visevald from the outside for what he should do? Say it out loud as he passes you.

A meeting around the barrel fire

The teacher in the role of the Street Priest:

> I am Visevald's good friend, Father David. I come in peace and bring news about Visevald. He says that a guard can help us in an attempt to save Visevald from prison, but he wants to be paid a certain amount of money for it.

The priest raises questions about accepting bribes. He can be quite skeptical and cautious, using low status. He facilitates discussion:

> What can we do to save Visevald? Is it okay to bribe someone for a good cause? What do you say, my friends?

Priest:

> The guard can give us access to the computer. If we manage to get into the PC, we can put in a fake release paper for Visevald . The guard does not know the code for the computer, but has a piece of paper that can give the code words.

MATHEMATICS 4: SOLVING THE CODE

Equipment: Copy sheet #6 or #9 (coordinate system and Code solving)

The students are given a code-solving task in their groups, the goal is to find the right code to unlock the computer. The teacher outside the role helps them if necessary. See separate document with the assignment, marked "Copy sheet # 9_ Solve the code"

RETURN / ROUNDING UP

Musikk: Marc Streitenfeld: Planting the Fields (Fra Soundtrack Robin Hood 2010)

When the students manage to open the computer, Visevald returns and they celebrate by making a party with the outlaws. All the working groups in the camp are given the task of making something for the party; meal, decorating/cleaning, finding prizes for raffles etc. make a little dance.

Reflection can be at the end of each part, or/and at the end of the whole process drama:

The game is interrupted, and the students gather in a circle for reflection. Suggested questions to ask:

1. How do you think it went on with the Outlaws?
2. What have you been involved in through these sessions about The Outlaws?
3. Is it similar to any stories you know, either from books, movies or real life?
4. Where do we find examples like this in our society today?
5. Why have we made this drama with you?
6. What has it been like to work this way?

The teacher concludes:

The myth of the invisible city of Kitesh is that inside all of us there is an invisible city. One invisible to all people, including ourselves. Here in this invisible city, all our longings, ideals and dreams. Fevronia has the ability to see an invisible city in every people. On her long journey to perfection, she must fight against evil, arrogance and stupidity. And with herself.

TiM^2
Theatre In Mathematics

Co-funded by the European Union

TIM^2 – Teaching mathematics Using Drama

Toolkit: activities and exercises

Part 5 | ROLE CATEGORIES

5. USE OF ROLE CATEGORIES IN MATHEMATICS

KEYWORDS: Mathematical communication, problem solving, critical thinking

AGE: 9 – 16

PURPOSE:

- Improve mathematical problem-solving skills
- Alter the dynamics of classroom discussions, steering the students towards more investigative and argumentative collaborations, through the use of role categories.
- Fostering a culture of deep mathematical understanding and critical thinking.

DRAMA (KEYWORDS): Exploring different perspectives, embodying role

MATHEMATICS LITERACY (KEYWORDS): Mathematical communication, reasoning, problem solving, multiple strategies, critical thinking, creative thinking, metacognitive awareness

MATHEMATICS CONTENTS (KEYWORDS): Different content , will vary depending on which tasks you choose to work with

EQUIPMENT:

- Mind maps or charts for group discussions
- Role cards (outlining the specific characteristics and responsibilities of each role) (copy sheet #10)
- Problem-solving tasks or mathematical challenges designed for group work (see copy sheet #11)

DURATION: Minimum 2 lessons

HOW:

Start by introducing the role categories to the students (see Part 1)
In the following lessons (see Part 2) organize the students into groups of four.
Assign each student a specific role:

- **The democratic leader**, who listens to various viewpoints before making a decision
- **The sceptic**, who challenges, seeks explanation and argumentation
- **The curious**, who persistently asks questions for deeper understanding
- **The promoter or initiator**, who initiates and explores new ideas and possibilities.

Let students work on a problem-solving task while actively performing their assigned roles.

PART 1 INTRODUCTION TO ROLES

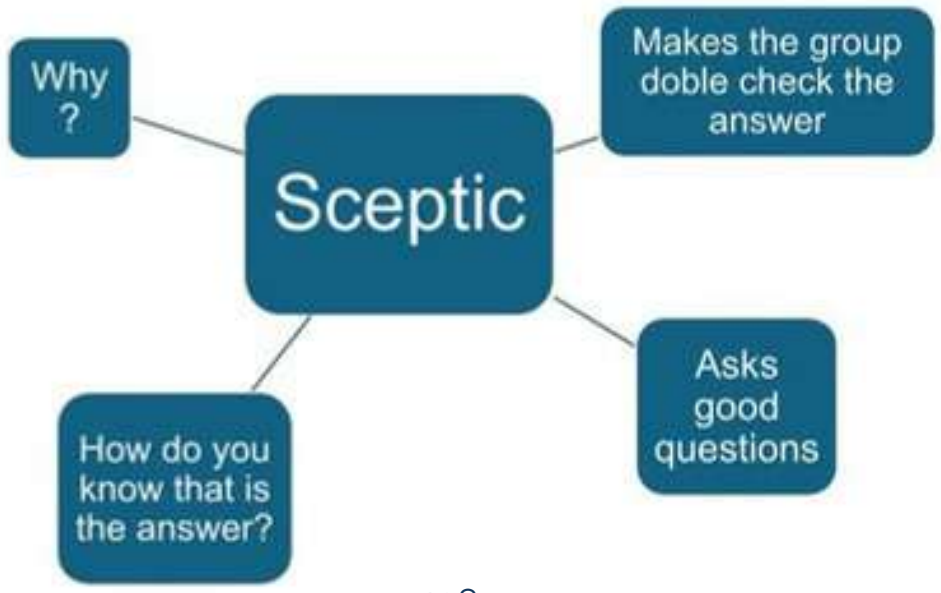
GOAL: To make the students acquainted with the role categories.

HOW: The students work on defining the attributes of each role.

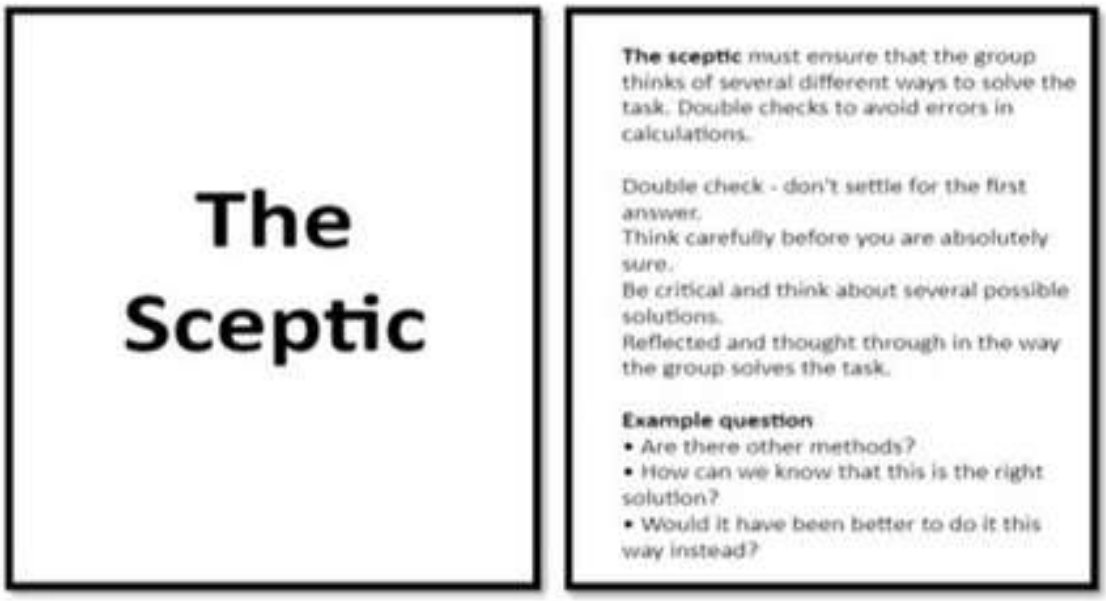
Start by introducing the roles, and that they are important parts of a mathematical discussion. The students are supposed to think about what it means to be for instance "sceptic" in a mathematical discussion, in a constructive way.

MIND MAP

In groups of three to four, students collaboratively create a mind map outlining the distinct characteristics of the four roles, such as illustrated here.



They can write attributes or questions that the role might ask in a mathematical discussion.
Subsequently, the class engages in a collective discussion to sum up the mind maps. Using student contributions, teachers can develop role cards (copy sheet #10) with key words for characteristics and questions. See "The Sceptic" example here.



PRACTICING

Following this, students have the opportunity to apply these roles in a practical context.
This can be done in several ways:

- doing a drama exercise in groups
- working on a logical task
- working on a mathematical problem-solving task

In all cases the students should work in small groups with assigned roles.
The primary objective here is for students to familiarize themselves with the role categories and grasp their potential impact in a mathematical discourse, rather than prioritizing task completion.

A collective debriefing concludes the activity. Here, students share examples of questions and statements that emerged during the exercise. The discussion also covers challenges encountered, such as differentiating between roles like the skeptic and the curious, or the initiator and the democratic leader. It's crucial for the teacher to clarify the purpose of using role categories. Students should understand

that these traits are instrumental in fostering rich mathematical discussions and collaborative problem-solving. This approach is designed to enhance students' reasoning and argumentation skills in mathematics.

PART 2 GROUP WORK WITH ROLE CARDS:

See example tasks on copy sheet # 11

Begin the session by reviewing the content covered in Part 1, emphasizing the four distinct role categories. One way to do this is to divide the class into pairs and list the roles on the board. In turn, let the students choose a role and explain it to the other student without using the name of the role, and let the other student guess the role (such as in the game Alias).
Students then work in groups of four on mathematical problem-solving tasks. Each student is given a role with an accompanying role card. In cases where a group comprises only three students, the role card labelled "promoter/initiator" is omitted. After 20 minutes of collaborative work, students are encouraged to exchange their role cards. This exchange allows them to experience and understand different characteristics and perspectives. A single swap is sufficient for this exercise.
At the conclusion of this part, hold a reflective session with the class. This is an opportunity for students to share their experiences with the role categories in solving the task. Encourage them to consider various aspects of their experience:

- How did the use of role categories differ from their usual approach to solving tasks?
- Were there more or different types of questions asked, leading to a better understanding of the task?
- Did they discover more or alternative methods to solve the problem?
- Are there any changes they would like to implement the next time they use these roles in mathematics?
- Are there characteristics of the discussions or questions they asked that would be beneficial to implement in mathematical discussions without roles?

This discussion is essential for students to recognize the value and impact of role categories in enhancing their problem-solving skills in mathematics.

ANNEX 1
Role Categories Cards

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The democratic leader

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The democratic leader makes sure the group stays on track. He brings the threads together and makes sure that everyone is heard. Contributes to a common solution.

Thinks about the whole group and allows everyone to participate. Takes responsibility and summarizes the proposals the group comes up with. Take care if there is a disagreement. Makes a decision based on input from the entire group.

Example question:
- Does everyone agree?
- What do you think?
- Now we have to concentrate and do what we have to do.
- Have you understood the task?
- Did you get answers to what you were wondering?

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The promoter

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The promoter must take the initiative to start work on the task and help others to get started.

Takes initiative and explores more ideas and possibilities.
Is engaged.
If progress stops, the promoter must help the group to move forward by proposing other solution methods.

Example question:
- What if we do it this way instead?
- Should we try to do it this way?
- What if we start by...

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The
Sceptic

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Sceptic

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The sceptic must ensure that the group thinks of several different ways to solve the task. Double checks to avoid errors in calculations.

Double check - don't settle for the first answer. Think carefully before you are absolutely sure.
Be critical and think about several possible solutions. Reflected and thought through in the way the group solves the task.

Example question

- Are there other methods?
- How can we know that this is the right solution?
- Would it have been better to do it this way instead?

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The curious

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The curious must ensure that the whole group understands what is going on, and that no one moves forward too quickly.

Asks questions because the group needs answers.
Shows interest in learning and understanding.
Want to find out how people think.

Example question
- Why does this happen?
- How did you come up with it?
- What does it mean?

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ANNEX 11
Role Categories Tasks Example

TASK 1

A TRIP TO THE MARKET

Some outlaws are at the market to buy fruit. A stall sells apples and plums. The apples cost 5 NOK each and the plums cost 2 NOK each.

Everyone buys the same amount, and together they pay 36 NOK

1. What did they order, and how many outlaws were there?

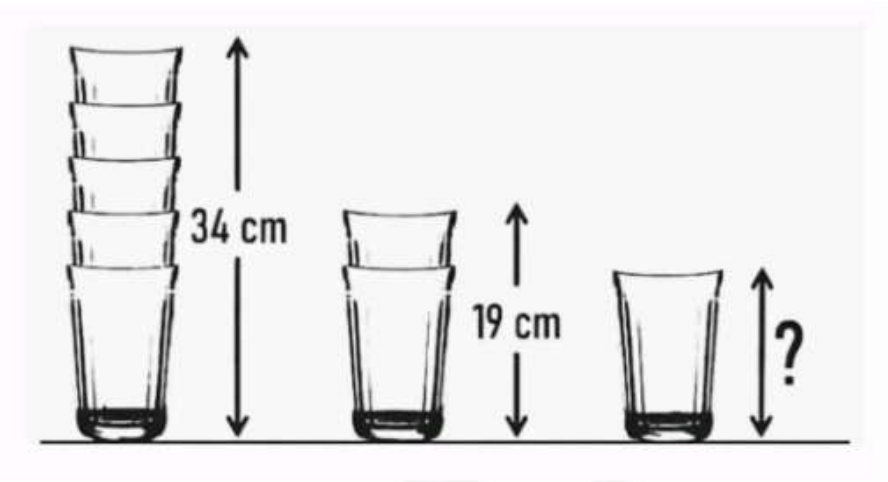
1. There are several possible solutions. Find as many solutions as you can.

1. How many outlaws could there have been and what could they have bought if they paid a total of 54 NOK?

TASK 2

Find the area of the rectangular part of the forest marked A and the rectangular part marked B.

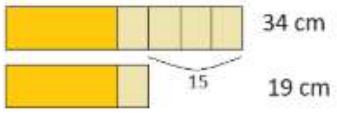
TASK 3
How tall is a glass?



Extension of the task (more open)
How tall will a stack of six glasses be if one glass is 20 cm?

Solution proposal for the glass problem

1. With drawing



2. With algebra

A

19 +3x=34

34 -19 = 3x

15 = 3x -> x = 5

19 – 5 = 14

B

x + 4y = 34cm

x + y = 19cm

x = 14cm

C

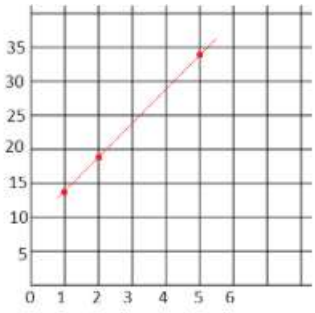
4x + y = 34

x + y = 19

4 (19-y) + y = 34

y = (76-34)/3= 14

3. Graphically



TASK 4
The guard at the bridge

You meet a guard standing and keeping watch at a bridge in the forest. The guard says: "If you want to go back and forth across the bridge, I will double the money in your pocket. Afterwards you must give me 8 Euros".
You think it sounds like an easy way to make money. You walk back and forth across the bridge once, and the money you have in your pocket is doubled before you pay the guard 8 Euros.
You'll want to try it one more time. Once again, the money you have in your pocket is doubled, and again you pay the guard 8 Euros.
You take a third turn, and after that turn you have no more money left.

1. How much money did you have to begin with?

1. How much money do you need at the start in order not to lose money on the deal?

1. What is the smallest amount you would have to have in the start in order not to lose money if the agreement was "three times the sum you have and then 15 Euros for the guard"

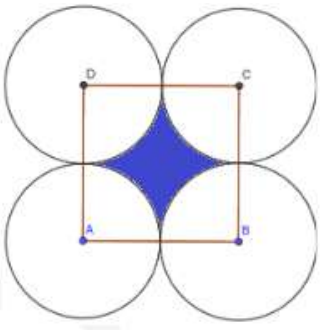
Comments to the teacher

Answer to task 1. You started with 6 Euros.
Different strategies:
Guess and check. Make a table
Start at the back and unravel the problem.
Solve with equation:
3rd trip over the bridge: 2x -8 = 0
2nd trip over the bridge: 2x- 8 = 4
1st time: 2x-8 = 6

Answer to task 2.
You must start with one more than the guard should have (9 Euros). If you start with the same amount as the guard should have, you will neither lose nor win.

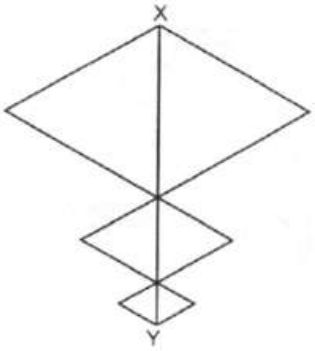
Answer to task 3.
You must start with more than half of what the guard should have. If you start with half the amount (7.5 Euros) that the guard should have (15 Euros) you will neither lose nor win.

Suggested tasks for 9th grade with role categories

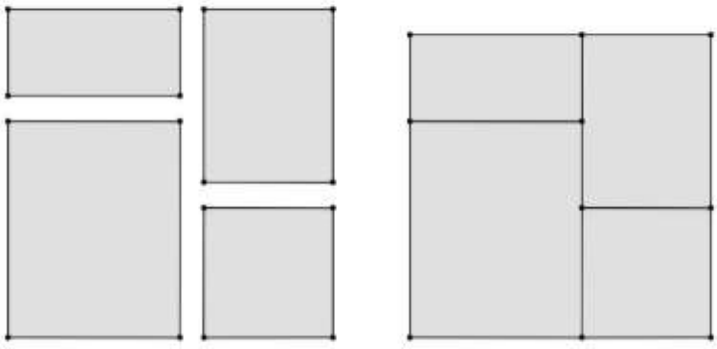


Task 1
Find the area of the coloured region
• Quadrilateral ABCD is a square with side lengths of 1.
• A, B, C and D are the centres of each circle.

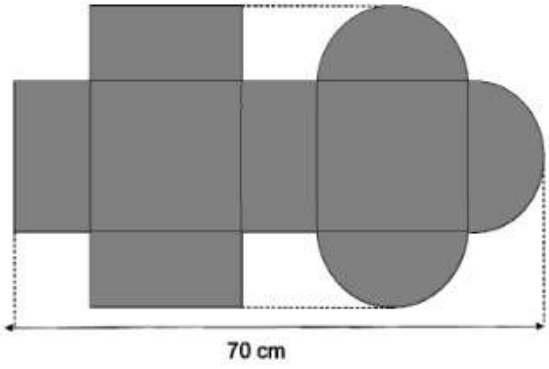
Task 2 Copper wire
• John had 1.5 m of copper wire. He cut part of the thread to make the figure pictured.
• In the figure there are 6 equilateral triangles, and the length XY is 19 cm.
• How much of the copper wire was left over?



Task 3
Three rectangles and one square are put together to form a new square. The sum of the circumferences of the four figures on the left is a total of 96 cm.
What is the area of the composite figure on the right?



Task 4 Find the surface area of this unfolded box
The figure below consists of 2 identical squares, 4 identical rectangles and 3 identical semicircles.
• What is the area of the figure?



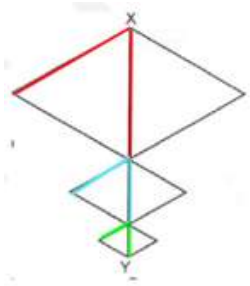
Suggested solutions

Task 1

Since the quadrilateral ABCD is a square, each circular sector into the square constitutes ¼ of a complete circle. As there are four circular sectors, the combined area of these equals the area of a complete circle.
Furthermore, we have that r= ½.
The area of the entire square becomes 1 * 1= 1
The area of a circle is: $A=\pi r^2$ -> 3.14 · $(1/2)^2$ = 3.14 · ¼ (=0.785)
The area of blue areas 1 – π/4 (=0.215)

Task 2

The figure consists of 6 equilateral triangles, that is, each of the three lengths from X to Y is repeated 4 times (twice to each side to form an equilateral triangle) plus the length in the middle.
Thus we know that the length XY (=19 cm) must be multiplied by 5:
• He therefore uses 19 · 5= 95 cm of the copper wire.
• There will be (150 – 95=) 55 cm left over.



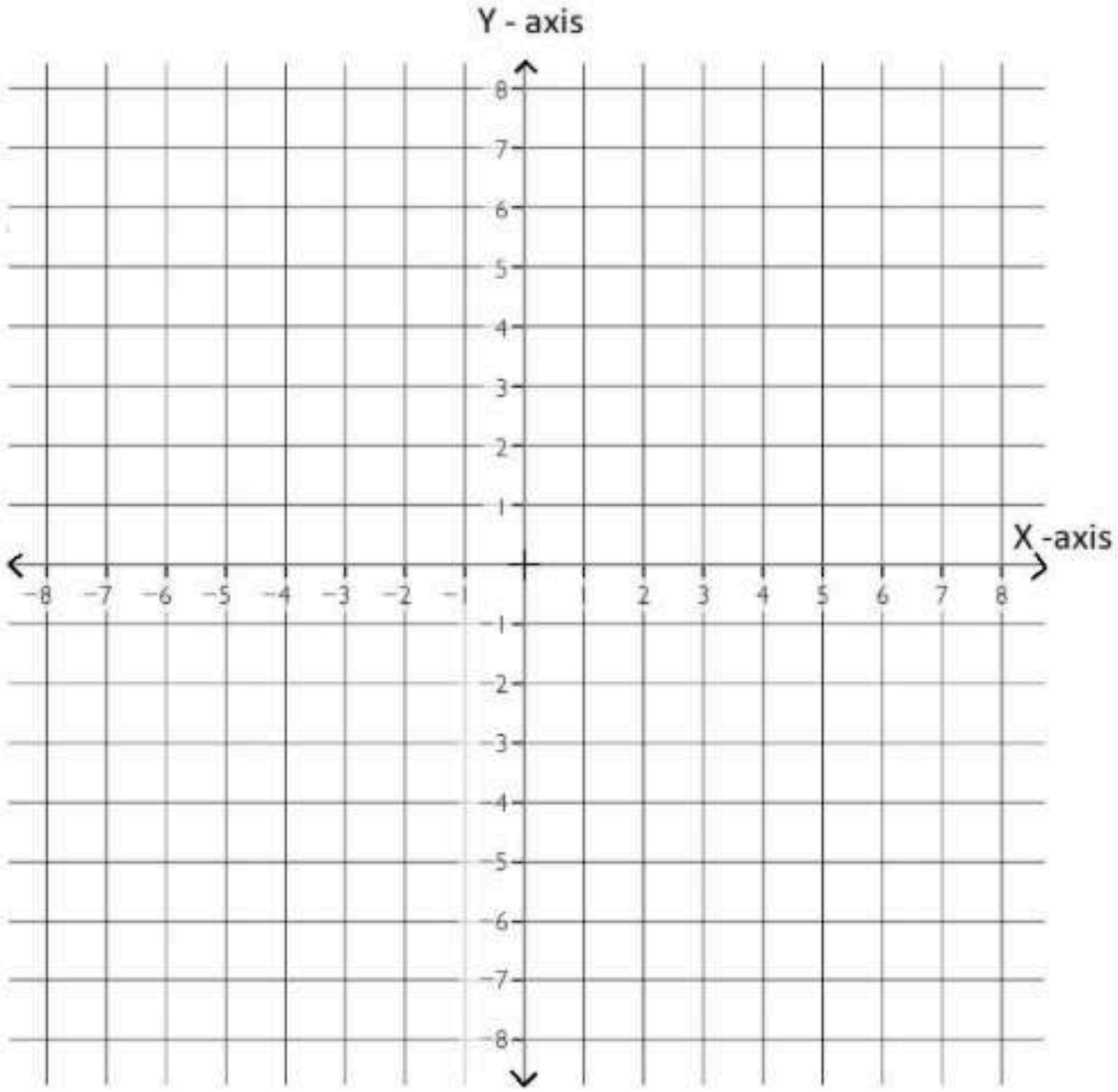
Task 3

The perimeter of the compound square is half the sum of the perimeters of the four figures, i.e. 48 cm. The reason is that when the four figures are put together, only two out of four sides will make up the outside of the compound square. The other two sides in each figure end up on the inside of the compound square.
When the perimeter of the compound square is 48 cm, each side will be 12 cm. The area of the square is then 12 · 12 = 144 cm^2

Task 4 Find the surface area of this unfolded box

The width of the rectangles will be half the length of the sides of the square, because it is equal to the radius of the semicircles (see the dashed line from the rectangle to the semicircle).
This means that the entire length of the figure can be divided into seven equal lengths (corresponding to the width of the rectangles, the radius of the circles, the squares are divided into two such lengths).
Each length is 70 : 7 = 10 cm.
The area of each of the rectangles then becomes: 10 · 20
The area of each of the squares is: 20 · 20
The area of each of the semicircles becomes: $(3.14 \cdot 10^2) : 2$
2071 cm^2 = 20.71 dm^2

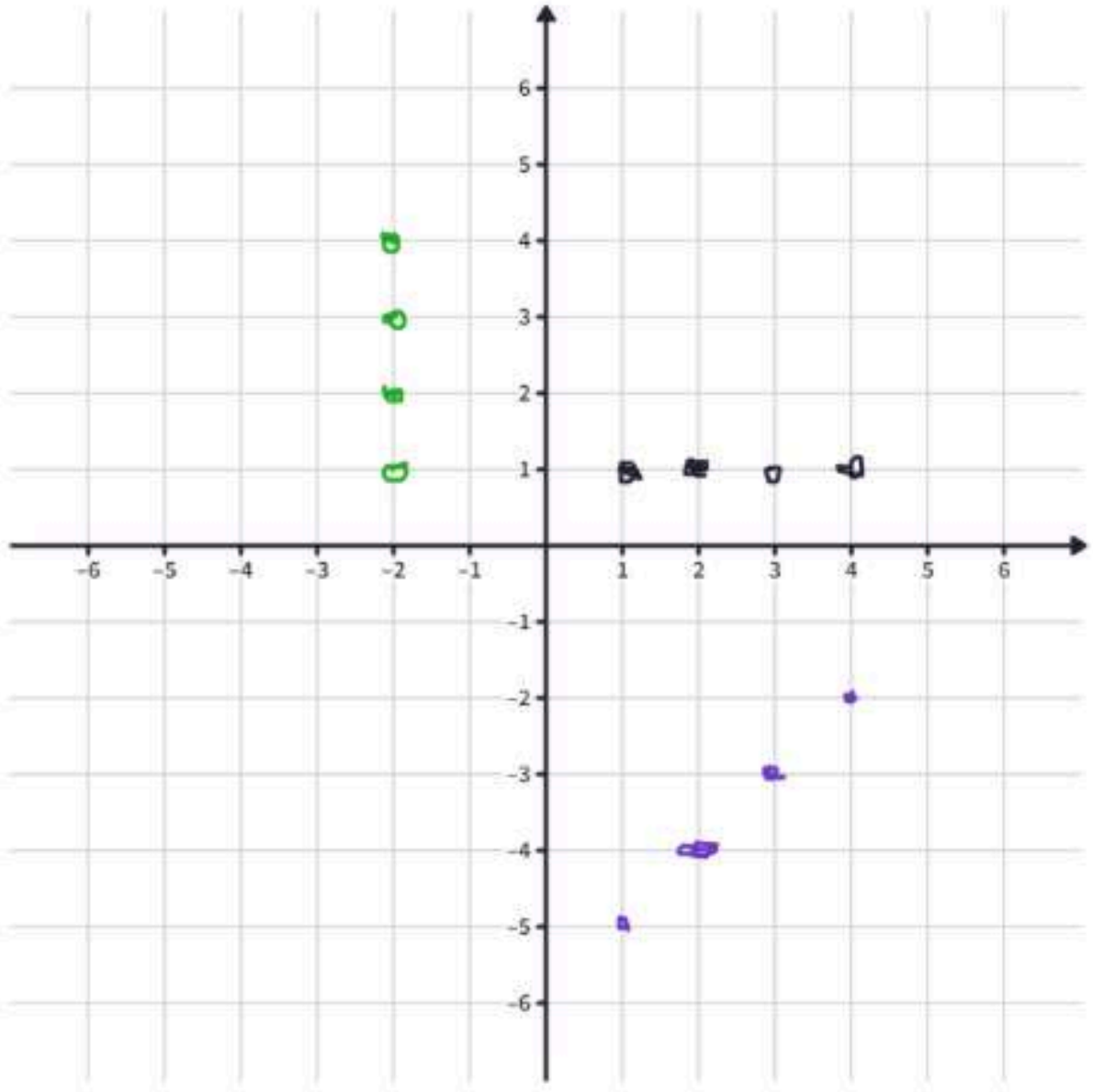
COPY SHEET # 1 COORDINATE SYSTEM



COPY SHEET # 2 POOR FAMILIES

COPY SHEET # 3 GAME: FOUR IN A ROW

The students take turns of rolling two dice and placing their mark on a suitable coordinate. If they roll a 2 and a 3, they can place it in (2,3) or (-2,-3) or (3,2) or (-3,-2). The goal is to get four in a row. The picture shows the three different ways this can happen (horizontally, vertically or diagonally).
If someone has already marked a coordinate, this cannot be taken again. It is then the next player's turn.
Each group need: a playing board (paper with the coordinate system, see next page for this), two dice, and pencils in different colours, or an individual symbol that they can use to distinguish each player's coordinate.



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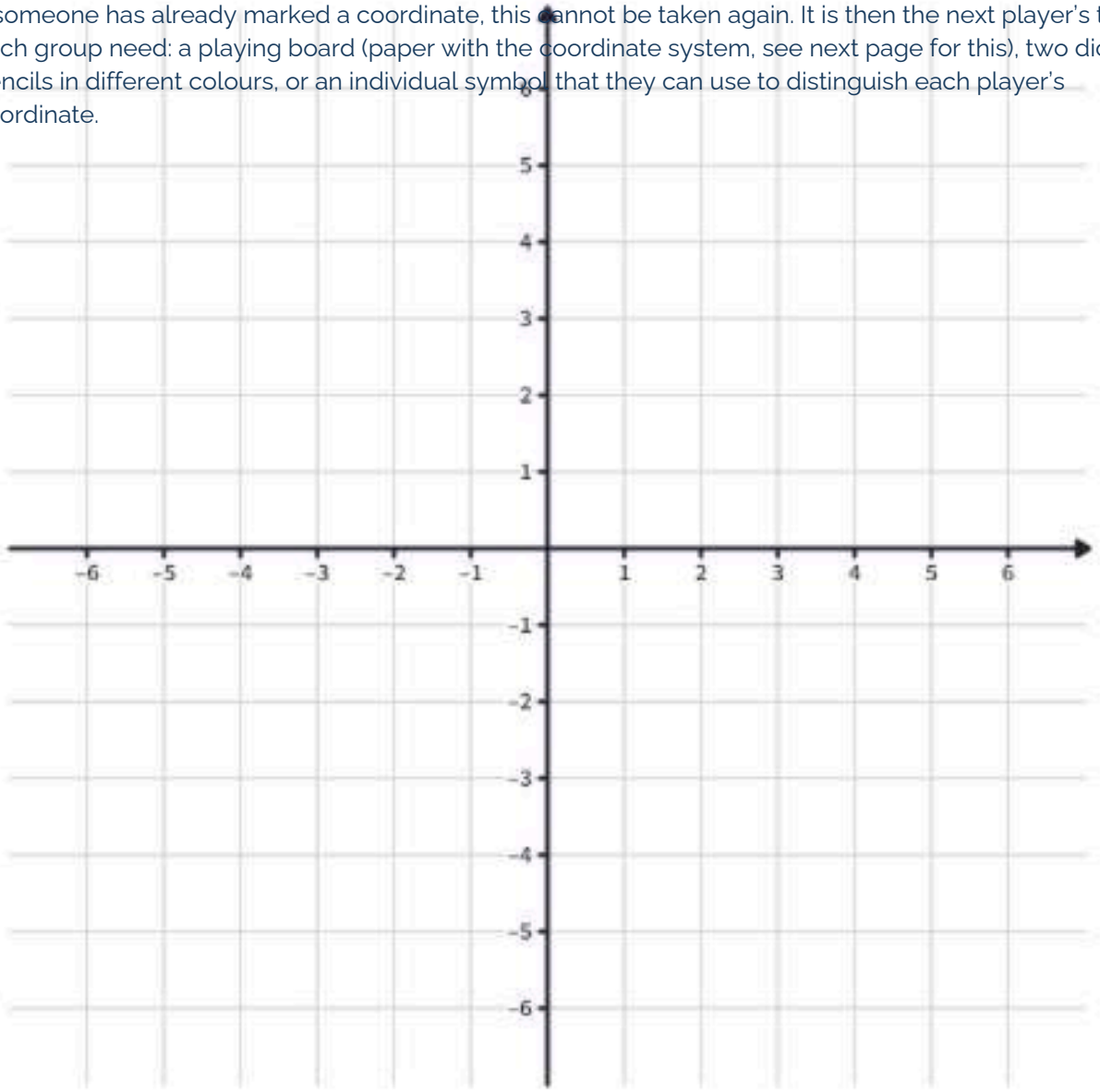
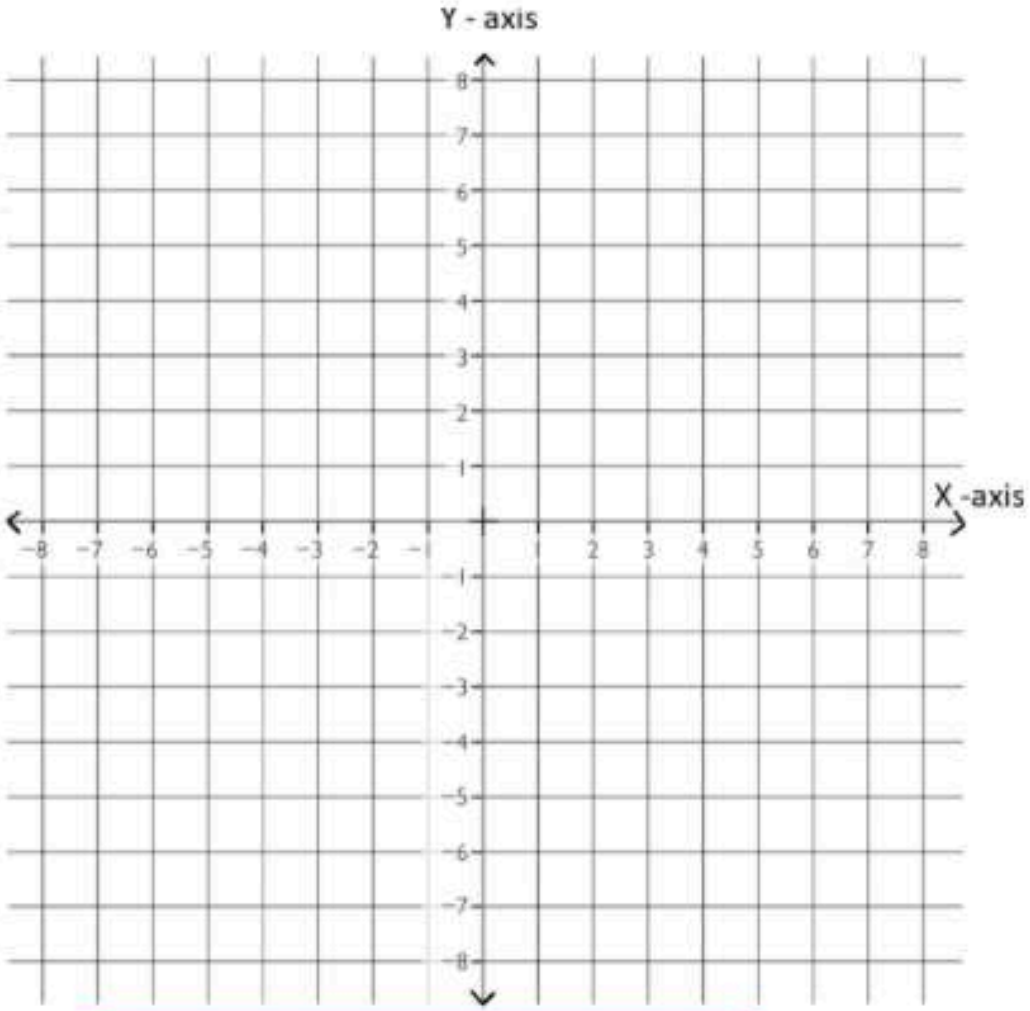


COPY SHEETS # 4 FINDING THE CHEST



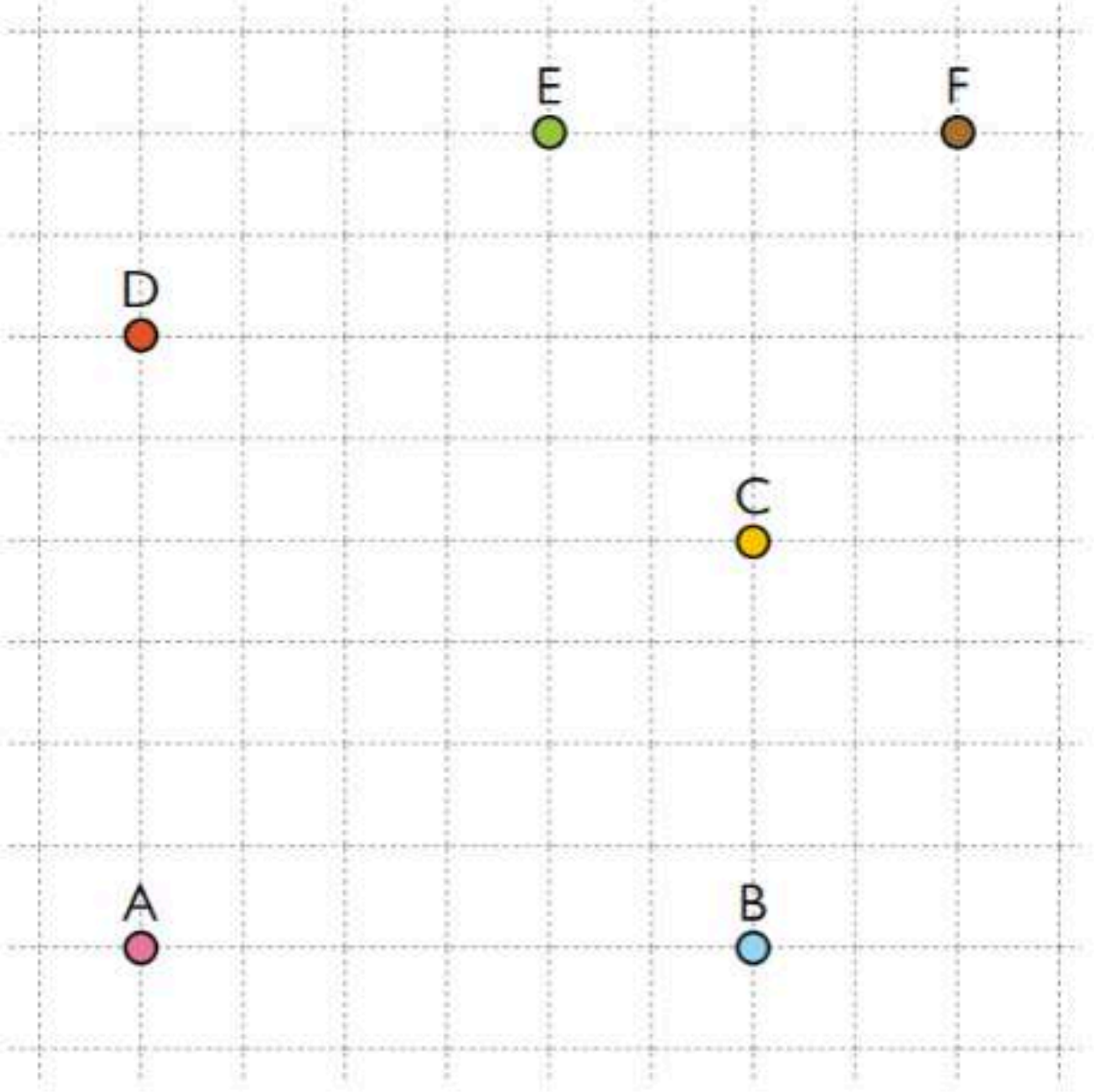
Start in (-3.1 and go

- 1 South and 3 East
- 7 South and 7 West
- 5 North and 2 East
- 6 North and 1 West

Draw the route in the coordinate system above.
Where has Robin hidden the chest?

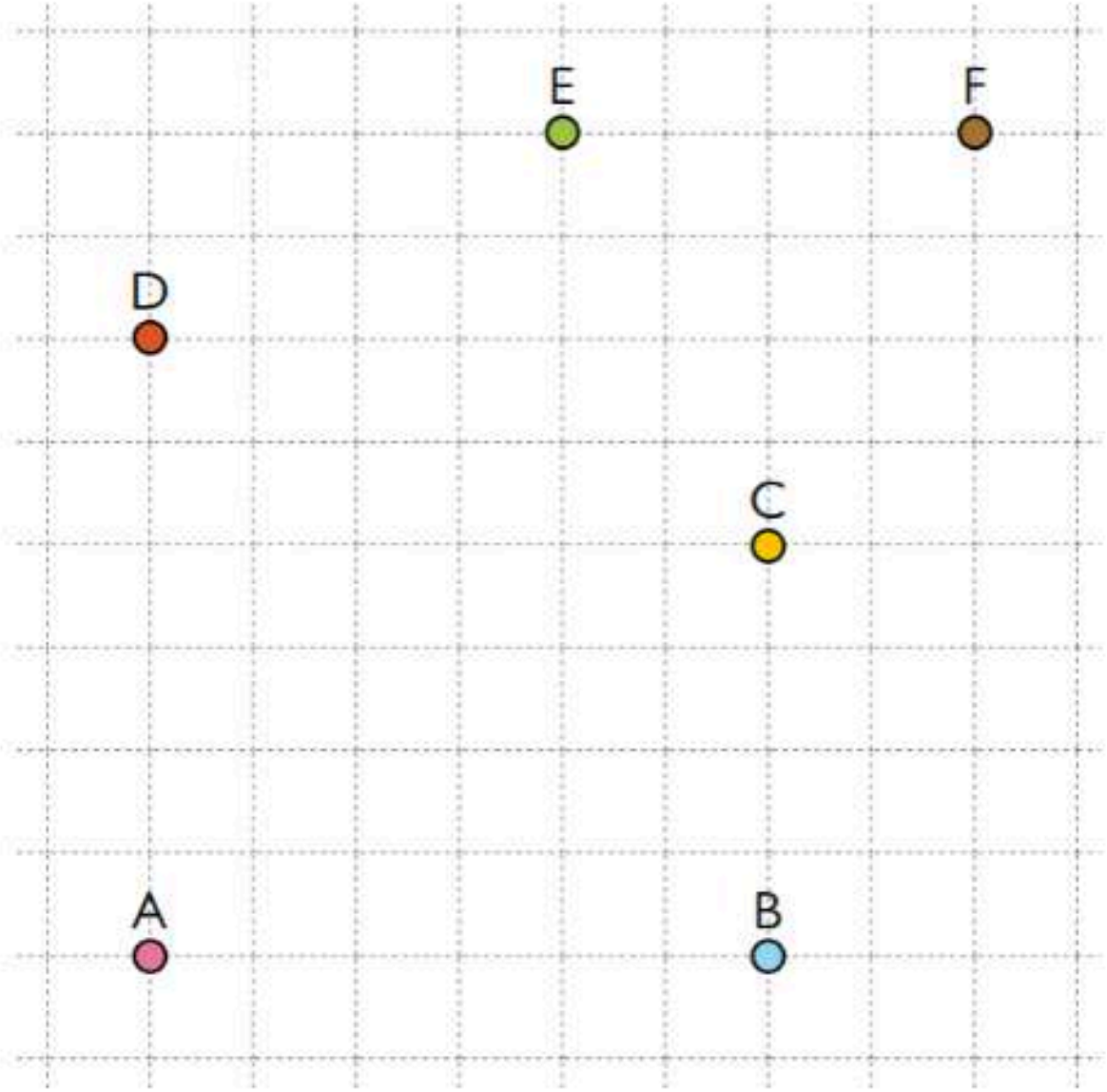
COPY SHEET # 5 CODE TO OPEN THE CHEST

The students are going to find where in the coordinate system the x- and y-axis are, based on the given properties of each point. From this, they are going to find the coordinates of C and F, which gives them the code.
The students need: Paper with coordinate system and information (next page).



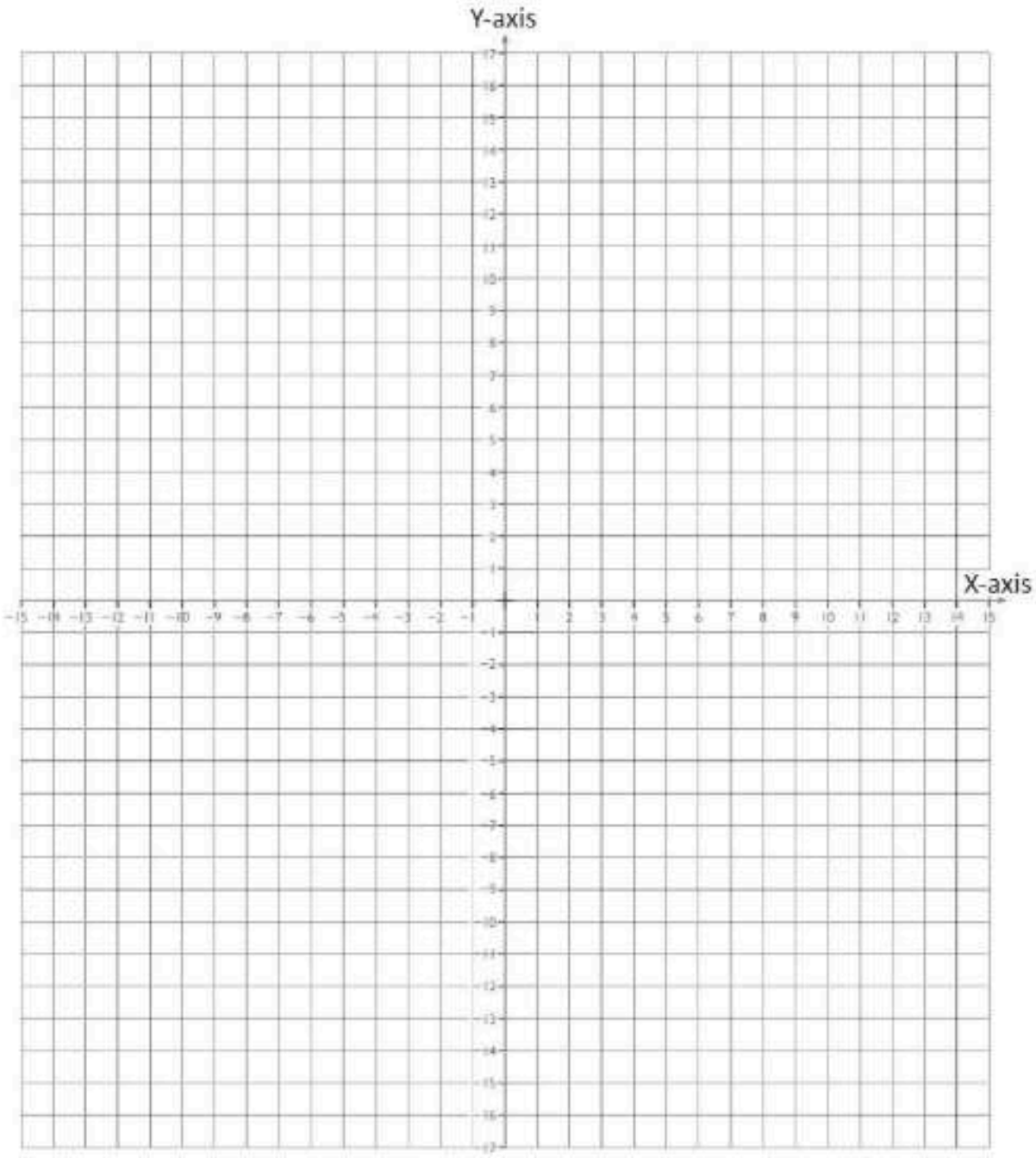
Find the coordinates to each point.
A has a second coordinate of -3.
B has one positive and one negative coordinate.
E has one positive and one negative coordinate.
The code is:
C = (__,__) F = (__,__)

Solution:



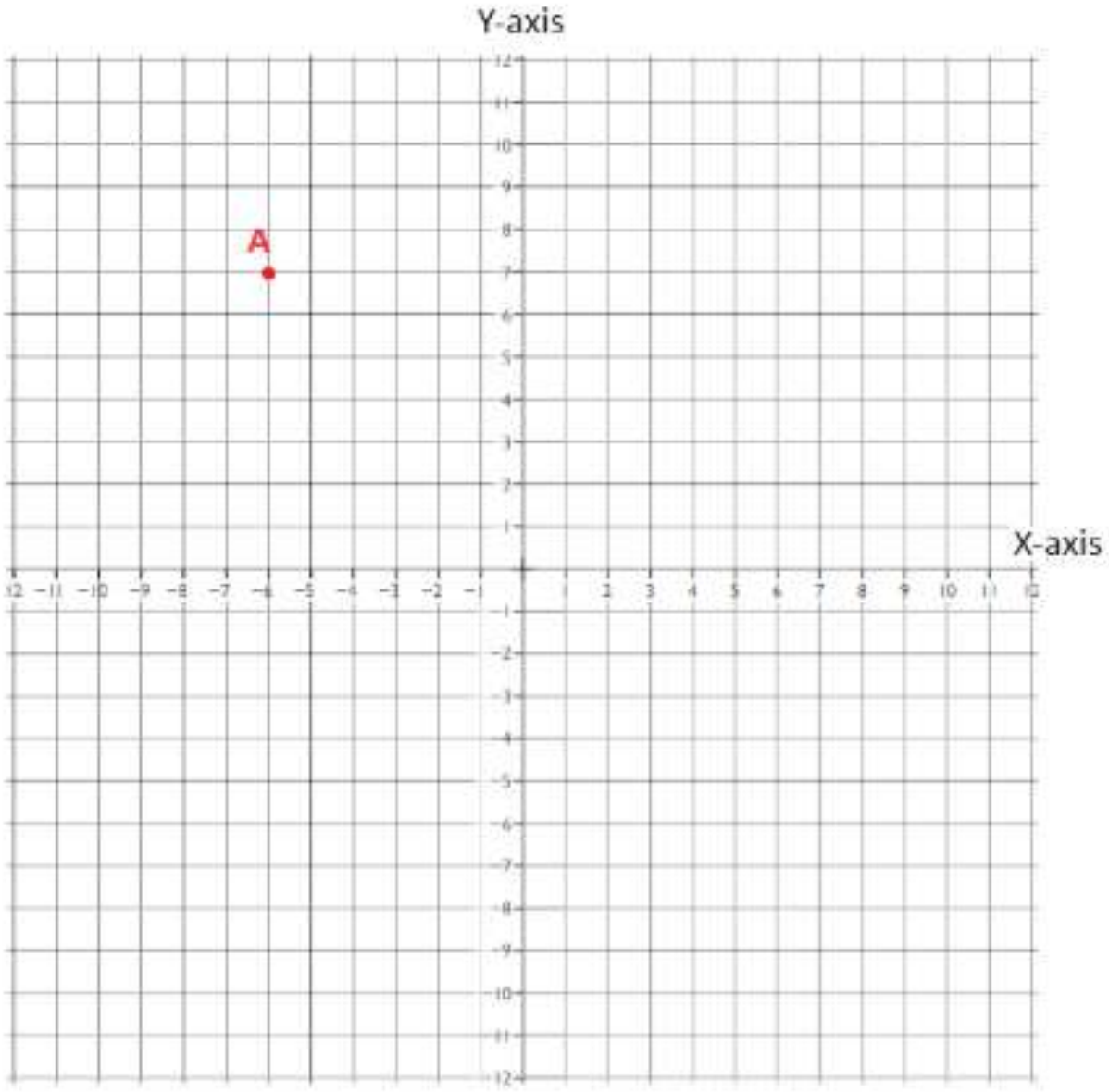
C = (1,1) F = (3,5)
Code: 1135

COPY SHEET # 6 COORDINATE SYSTEM

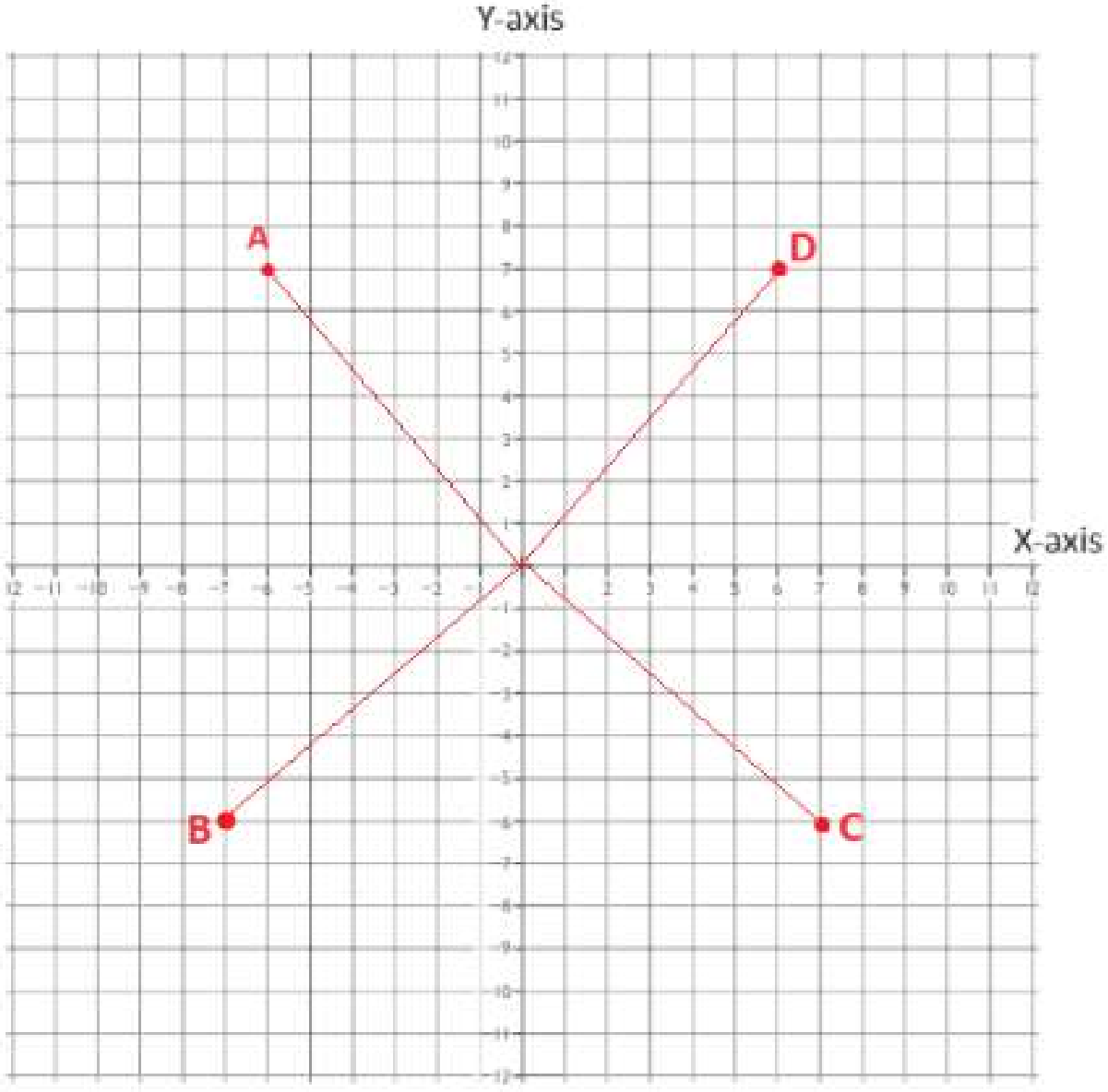


COPY SHEET # 7 FIND THE COORDINATES OF THE SECRET TUNNELS.

Find the coordinates of the entrances of the three secret tunnels that are still unknown and place them in the coordinate system.
a. The entrance of tunnel A is at point A [- 6, 7]. You can find the opening of tunnel B by rotating point A 90 degrees about the Origin (counter-clockwise).
b. You can find the entrance of tunnel C by mirroring point B about the Y - axis.
c. The entrance of tunnel D can be found by rotating point C 90 degrees about the origin (counter-clockwise).



Answer:



COPY SHEET # 8

COPY SHEET # 9 CRACK THE PASS WORDS

Each group (3–4 people) is given 12 cards with information and a coordinate system, on which they must enter the solution. It is possible that they need two copies of the coordinate system, so that they have one to draw on. We recommend that you copy each set in different colors and laminate the cards. The different colors can help you sort the cards afterwards if the students mix them up. Store each set in a zip bag or envelope.
Each group member gets three to four cards as they will be responsible for. Each card has a clue that is important for solving the final task. Each student now owns their own piece of the solution. They must work together to put these pieces together to find the solution.
Each card is therefore like a piece in a puzzle, and it is wise to find the pieces you can start with. Everyone reads their cards. The students then have to decide which of the tracks might be good to start with. They must jointly put the pieces together to form the finished "picture". Sorting important information from unimportant to bring order to the apparent chaos is an important part of the collaborative task.
In addition to the task providing further learning in the coordinate system, it provides training in communication and conceptual learning, and will provide practice in systematic and logical thinking.
The cards are marked with numbers, but the numbers have no other meaning than that they can help the teacher to give hints (see below) and to keep order. If a card is missing from the bag/envelope, the teacher can easily find out which card is missing.

Hint:
1 If the pupils take an unreasonably long time to get started, it may be a good idea to advise them to start with information about the pentagon ABCDE.
2 Ask them to find the card where the points are given with pairs of numbers and mark them in the coordinate system.
3 It is customary to mark the corners of polygons in alphabetical order anti-clockwise.
Be restrained with help. Let the students spend time and discuss until the solution.

(1) The point I is in (8, 13). The square KLMN is mirrored about the first axis and forms the square OPQR.	(3) In the pentagon ABCDE, the point B lies at (−6, 2). The rectangle WXYZ is three squares wide and eight squares long.
(2) Point F is 12 squares east of point B. In the square KLMN is the point K in (7, −8)	(4) In the pentagon ABCDE, the point D lies in (−8, 13). In the square OPQR, the point O lies in (7, 4).

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(7)

The pentagon ABCDE is mirrored around the Y axis and forms the pentagon FGHIJ.

The square STUV is the same size as the square KLMN.

(8)

In the pentagon ABCDE, point A is eight squares west of point B.

The point Z lies in (−12, −4).

(5)

In the pentagon ABCDE, the point C lies at (−4, 7).

Point P is eight squares north of point M.

(6)

Place points and shapes in a coordinate system where the X-axis runs from 14 to −14.

The Y -axis goes from 16 to −16.

Point Y is three squares east of point Z.

(9) When all the points are located in the coordinate system, you can solve this code: (3, −16), (14, 9), (8, 13), (−1, −16), (−12, −12), (−14, 2), (−1, −16), (11, 8), (3, −12), (8, 13), (3, −16), (−14, 9), (−14, 9)(−14, 2), (−1, −16), (−9, −4)	(11) In square KLMN, point K is four squares west of point L. Square SRUV is eight squares south and eight squares west of square KLMN.
(10) In the pentagon ABCDE, point E is seven squares north of point A. Point U is eight squares south and eight squares west of point M.	(12) In the square KLMN, the point M lies in (11, −4). The point S lies in (−1, −16). Point X is directly south of point Y.

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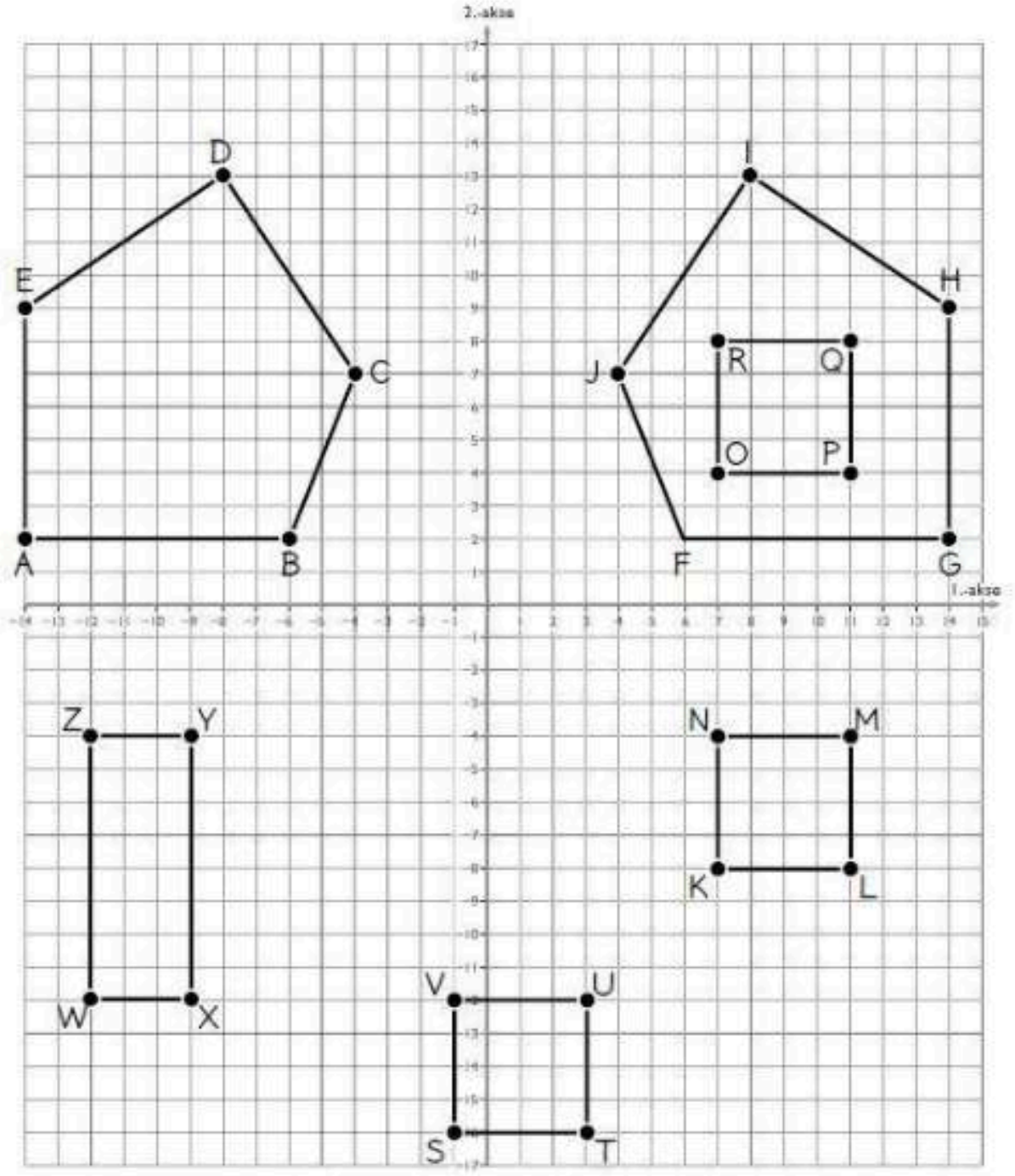
THE ANSWER:



THIS WAS QUITE EASY