

Physik



Acht Experimente für Schüler und Lehrer

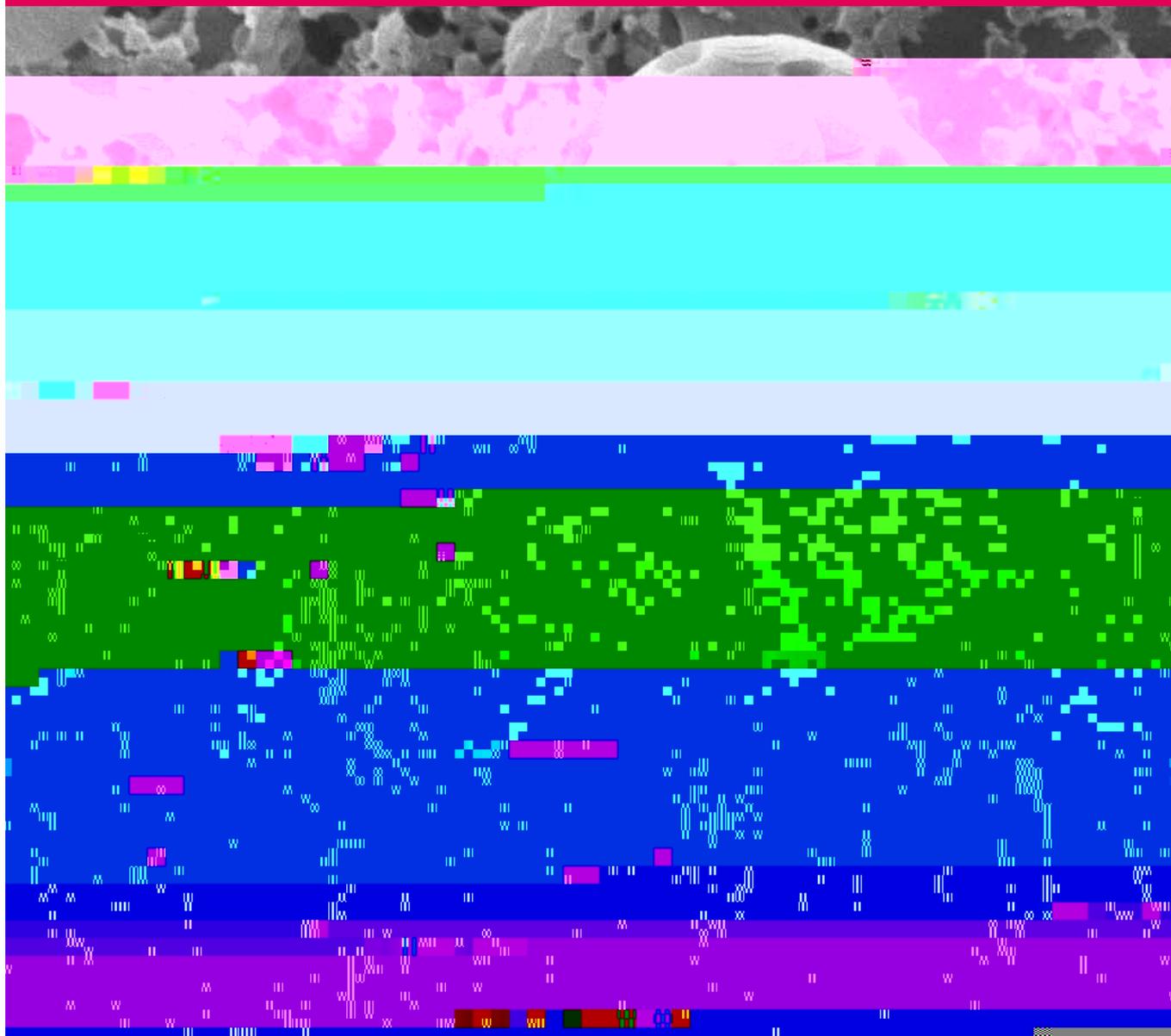


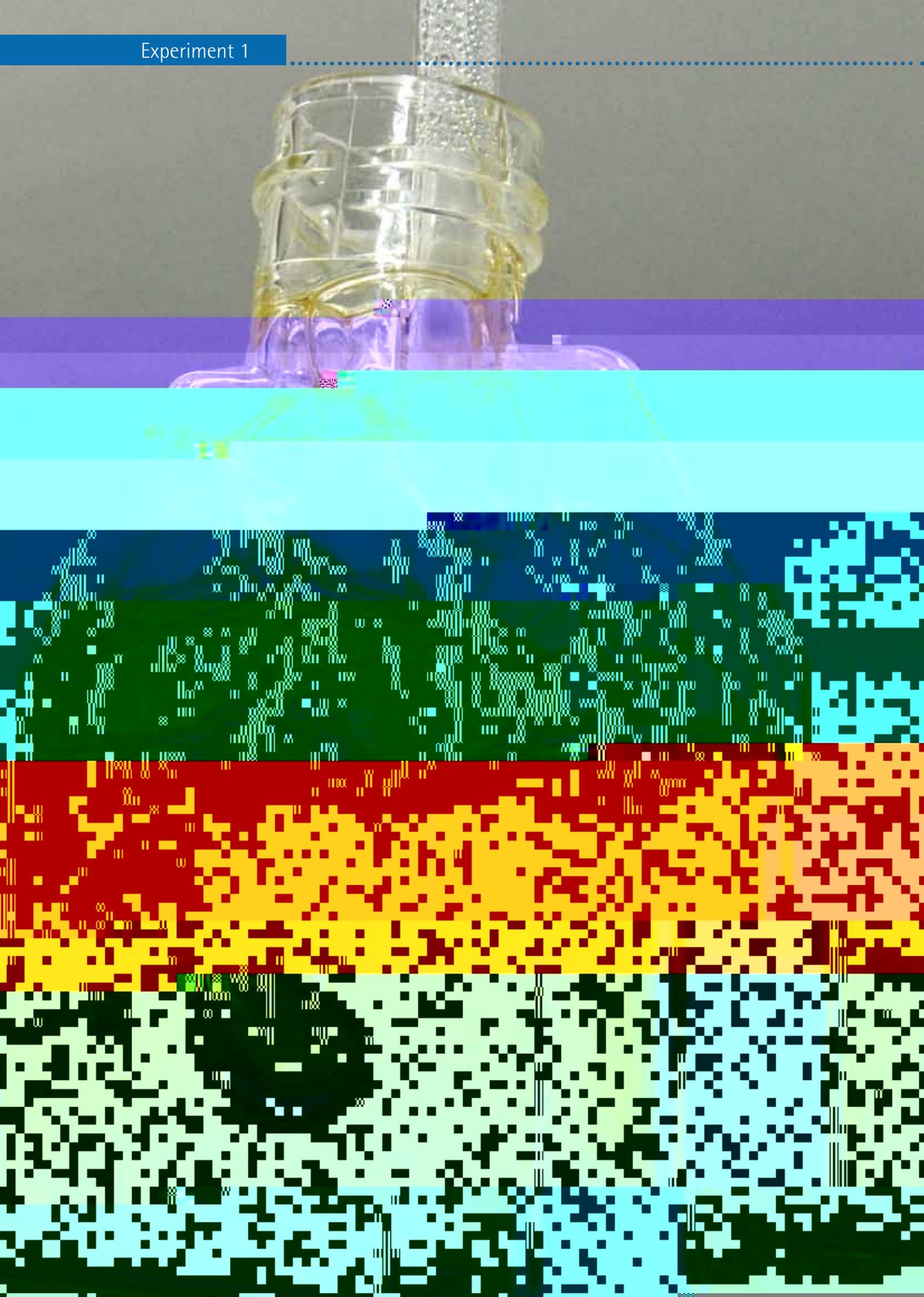
Physik

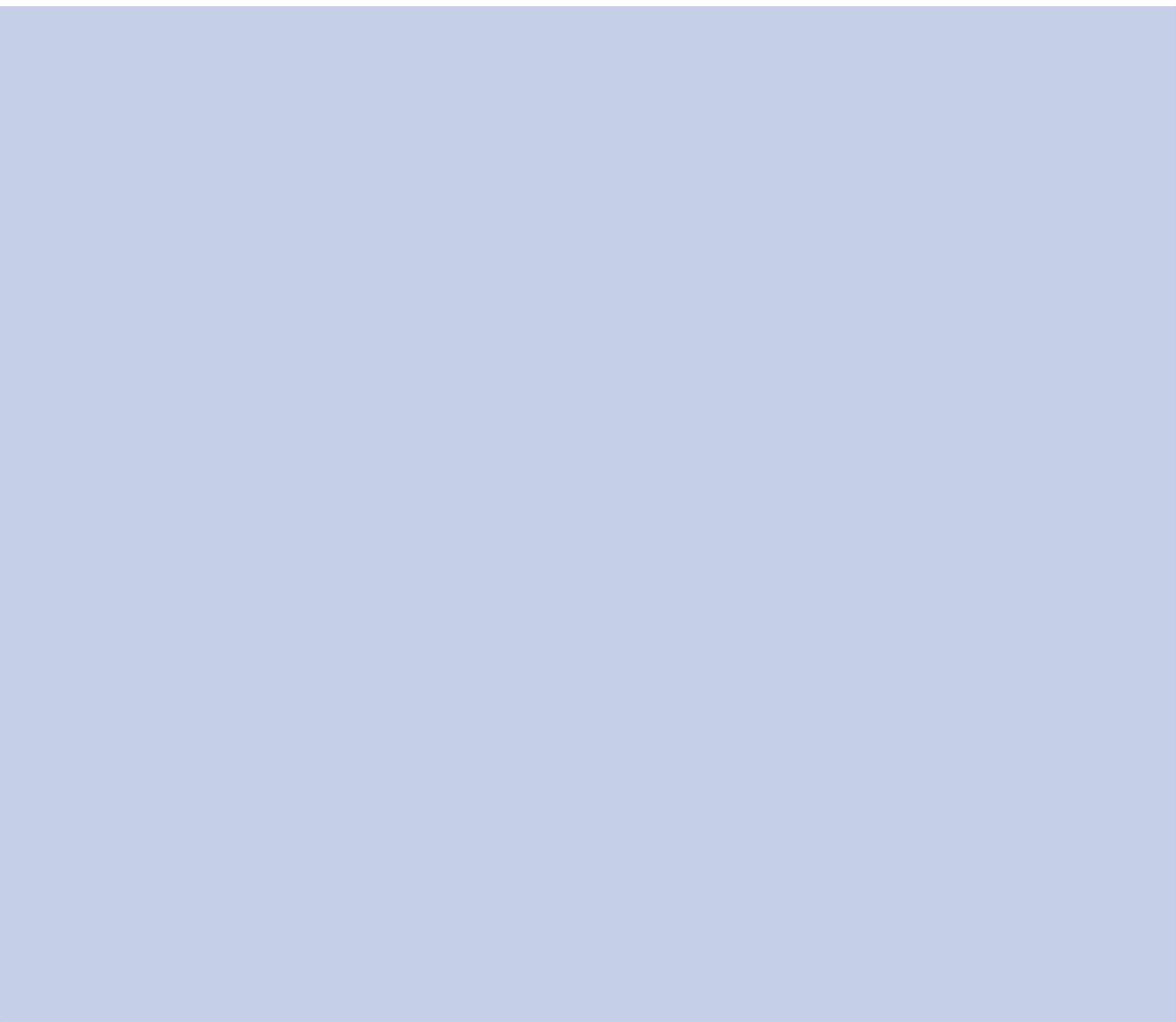


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t p M .
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• t t t M t t • t
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Die Coccolithophoride *Calcidiscus* heute...







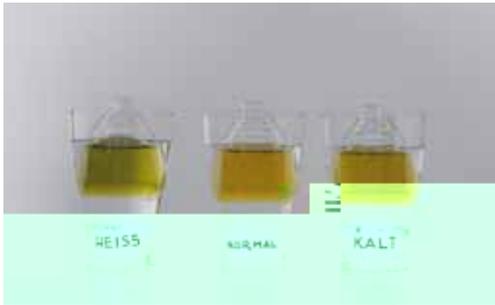
1. \bullet t tW .
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 t M .
 p tt t ,
 W \bullet t t .
 M t t .
 t W .

2. t t t t . t
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 \bullet t tt , \bullet $p - W$ t
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3. t \bullet t tW
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A

1. W \bullet , W p t t , t \bullet \bullet -
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W \ddagger E \ddagger

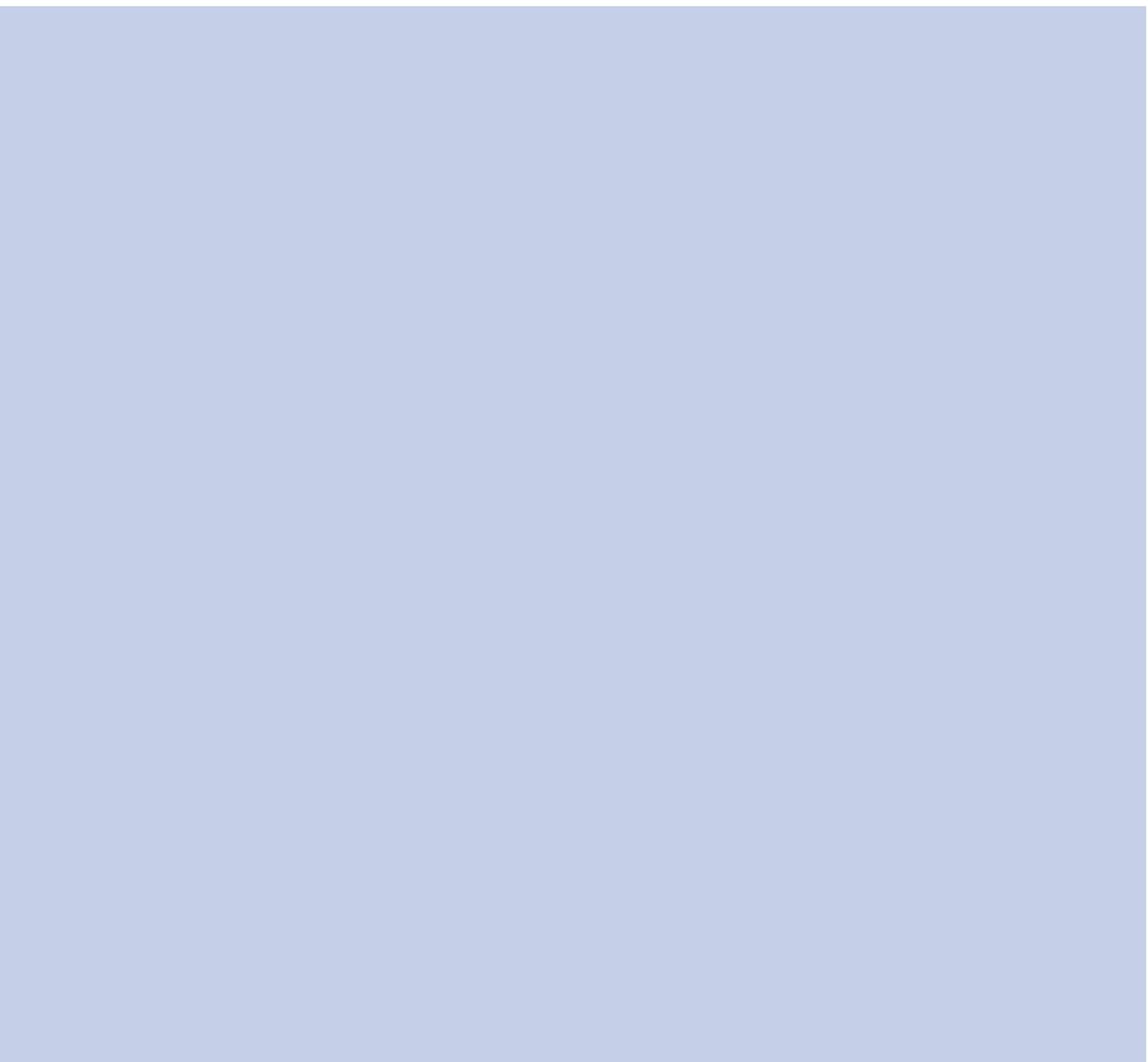
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2. \bullet t t \bullet \bullet W \bullet t t t t ,
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V G O A₁

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16(2D35L5-2B73)TJ 022032 172r0244 32 172r05J3030202r023730 b56 W172034A

A

1. $\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = \frac{d}{dt} \left(\frac{1}{2} m v^2 \right) + \frac{d}{dt} (p V)$

$\frac{d}{dt} \left(\frac{1}{2} m v^2 \right) = m v \frac{dv}{dt} = m v a$

$\frac{d}{dt} (p V) = p \frac{dV}{dt} + V \frac{dp}{dt}$

$\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = m v a + p \frac{dV}{dt} + V \frac{dp}{dt}$
2. $\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = \frac{d}{dt} \left(\frac{1}{2} m v^2 \right) + \frac{d}{dt} (p V)$

$\frac{d}{dt} \left(\frac{1}{2} m v^2 \right) = m v \frac{dv}{dt} = m v a$

$\frac{d}{dt} (p V) = p \frac{dV}{dt} + V \frac{dp}{dt}$

$\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = m v a + p \frac{dV}{dt} + V \frac{dp}{dt}$
3. $\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = \frac{d}{dt} \left(\frac{1}{2} m v^2 \right) + \frac{d}{dt} (p V)$

$\frac{d}{dt} \left(\frac{1}{2} m v^2 \right) = m v \frac{dv}{dt} = m v a$

$\frac{d}{dt} (p V) = p \frac{dV}{dt} + V \frac{dp}{dt}$

$\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = m v a + p \frac{dV}{dt} + V \frac{dp}{dt}$
4. $\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = \frac{d}{dt} \left(\frac{1}{2} m v^2 \right) + \frac{d}{dt} (p V)$

$\frac{d}{dt} \left(\frac{1}{2} m v^2 \right) = m v \frac{dv}{dt} = m v a$

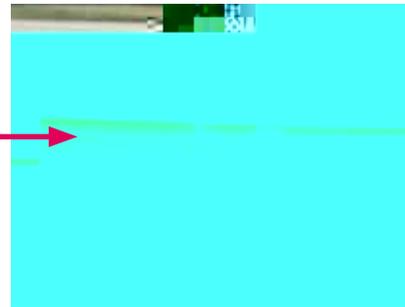
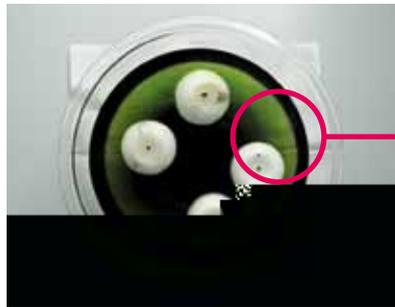
$\frac{d}{dt} (p V) = p \frac{dV}{dt} + V \frac{dp}{dt}$

$\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = m v a + p \frac{dV}{dt} + V \frac{dp}{dt}$

V



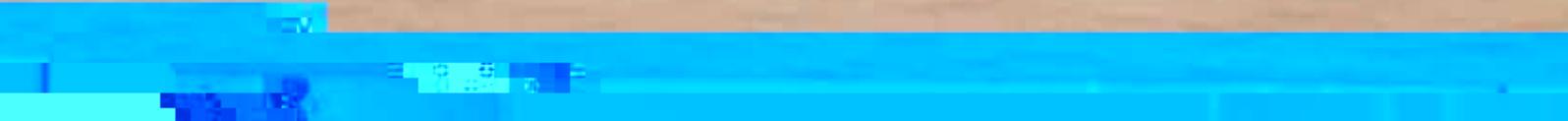
N



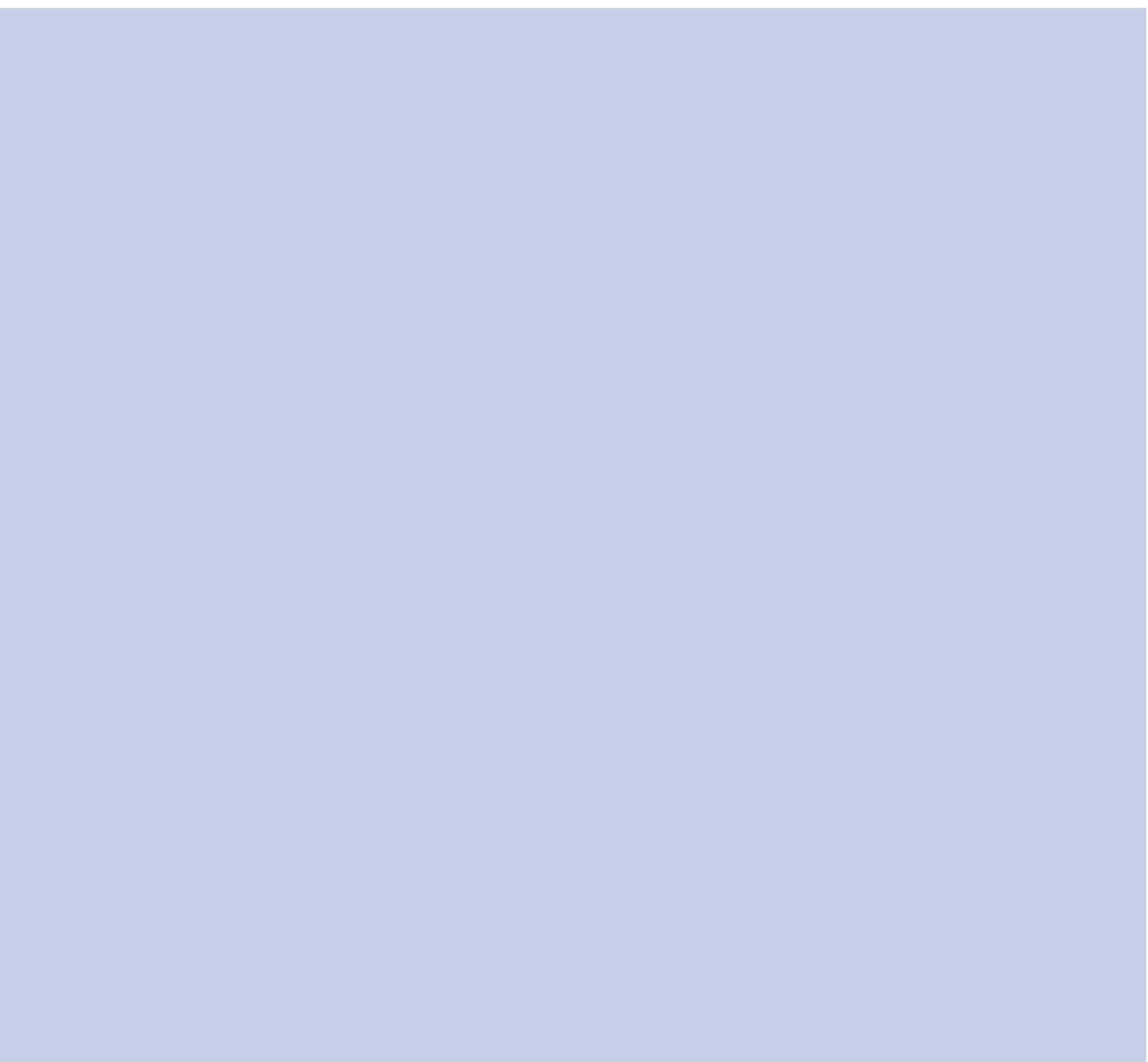
$\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = \frac{d}{dt} \left(\frac{1}{2} m v^2 \right) + \frac{d}{dt} (p V)$
 $\frac{d}{dt} \left(\frac{1}{2} m v^2 \right) = m v \frac{dv}{dt} = m v a$
 $\frac{d}{dt} (p V) = p \frac{dV}{dt} + V \frac{dp}{dt}$
 $\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = m v a + p \frac{dV}{dt} + V \frac{dp}{dt}$

W \uparrow E \uparrow

$\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = \frac{d}{dt} \left(\frac{1}{2} m v^2 \right) + \frac{d}{dt} (p V)$
 $\frac{d}{dt} \left(\frac{1}{2} m v^2 \right) = m v \frac{dv}{dt} = m v a$
 $\frac{d}{dt} (p V) = p \frac{dV}{dt} + V \frac{dp}{dt}$
 $\frac{d}{dt} \left(\frac{1}{2} m v^2 + p V \right) = m v a + p \frac{dV}{dt} + V \frac{dp}{dt}$



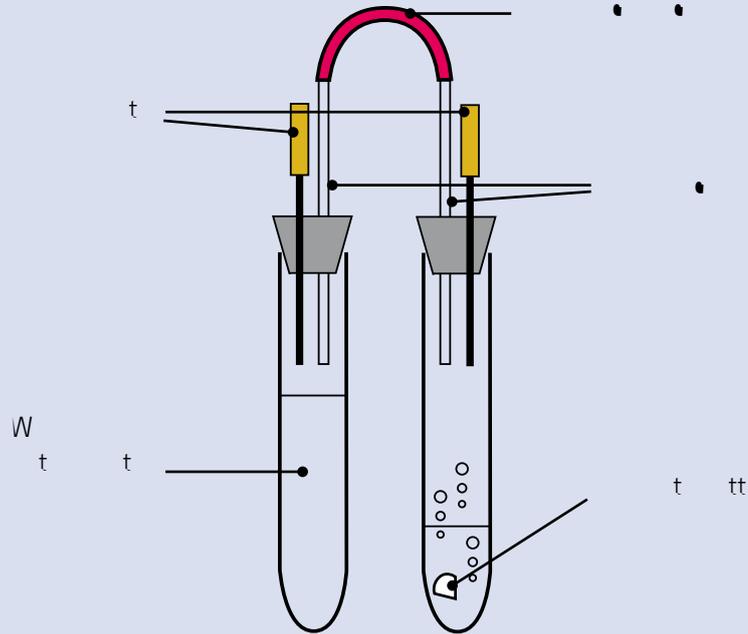
V M -
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 t (2)



1. $t \bullet$ -
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 \bullet t \bullet \bullet

2.

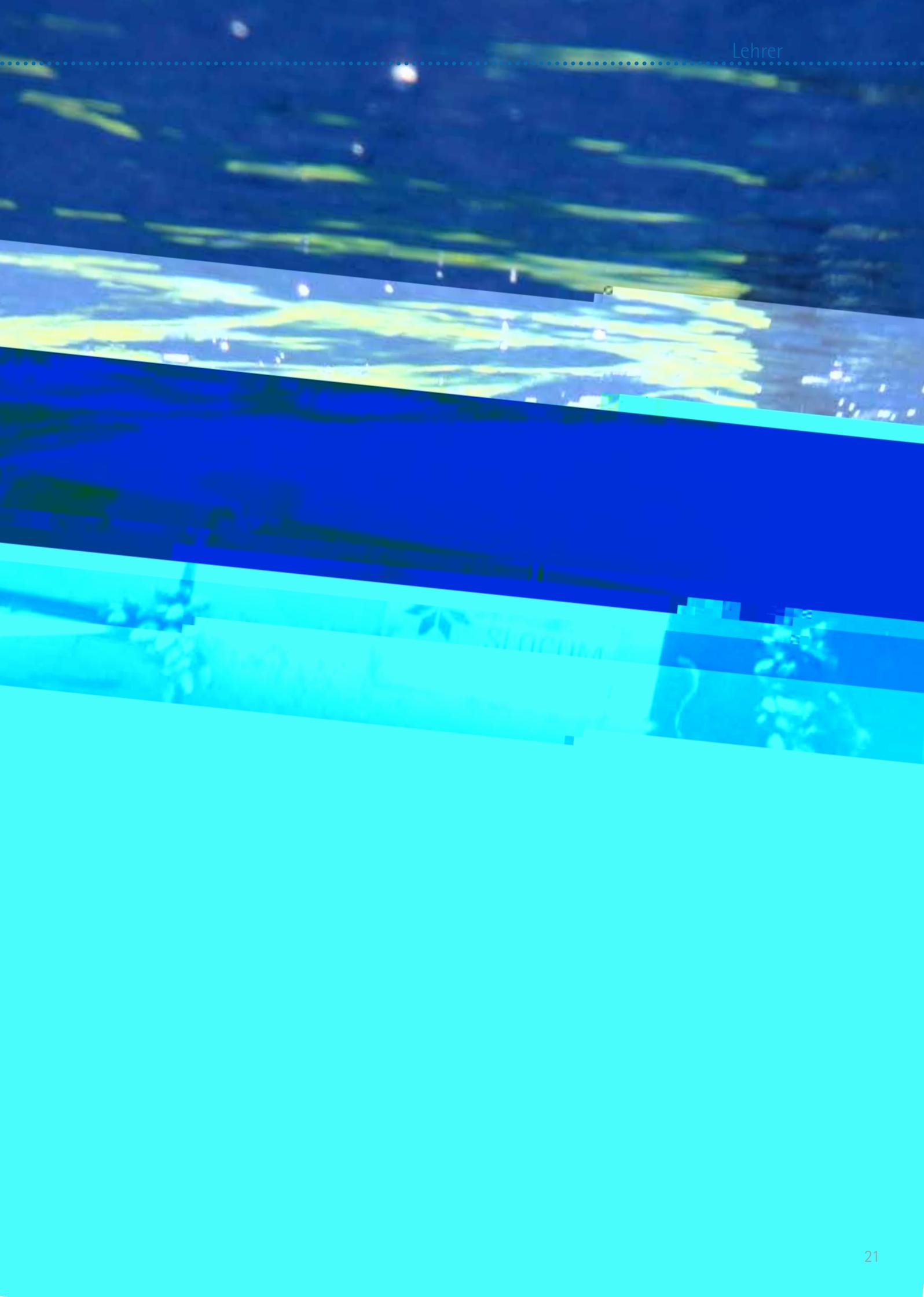
V



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E

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- 2.
- 3.





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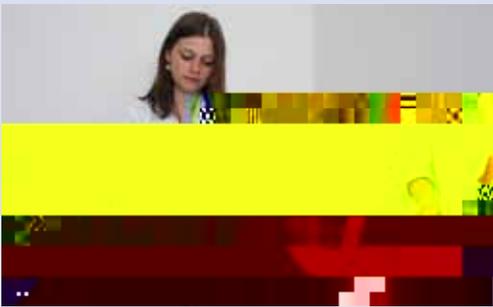
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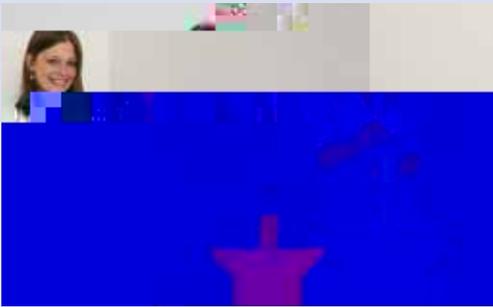
V



1: t t t



2: t t



3: t t M
p t.



4: t M
t W t t

1. W t t t t
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2. M t W
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3. t M . p t
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t .

5. t W t

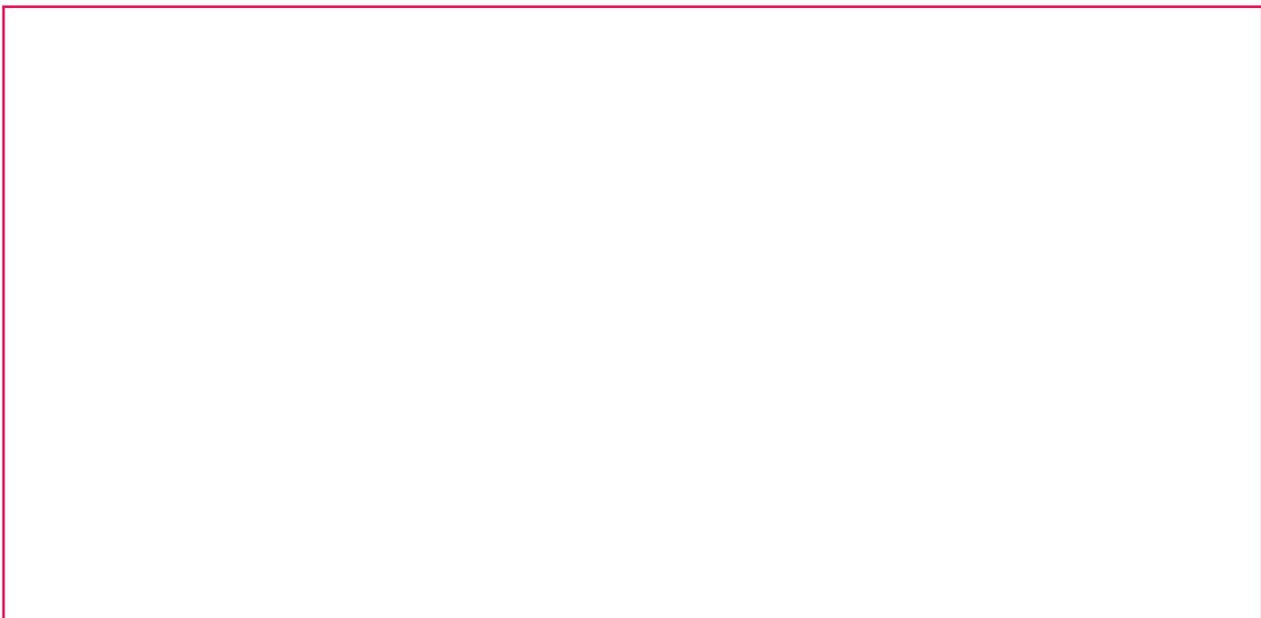
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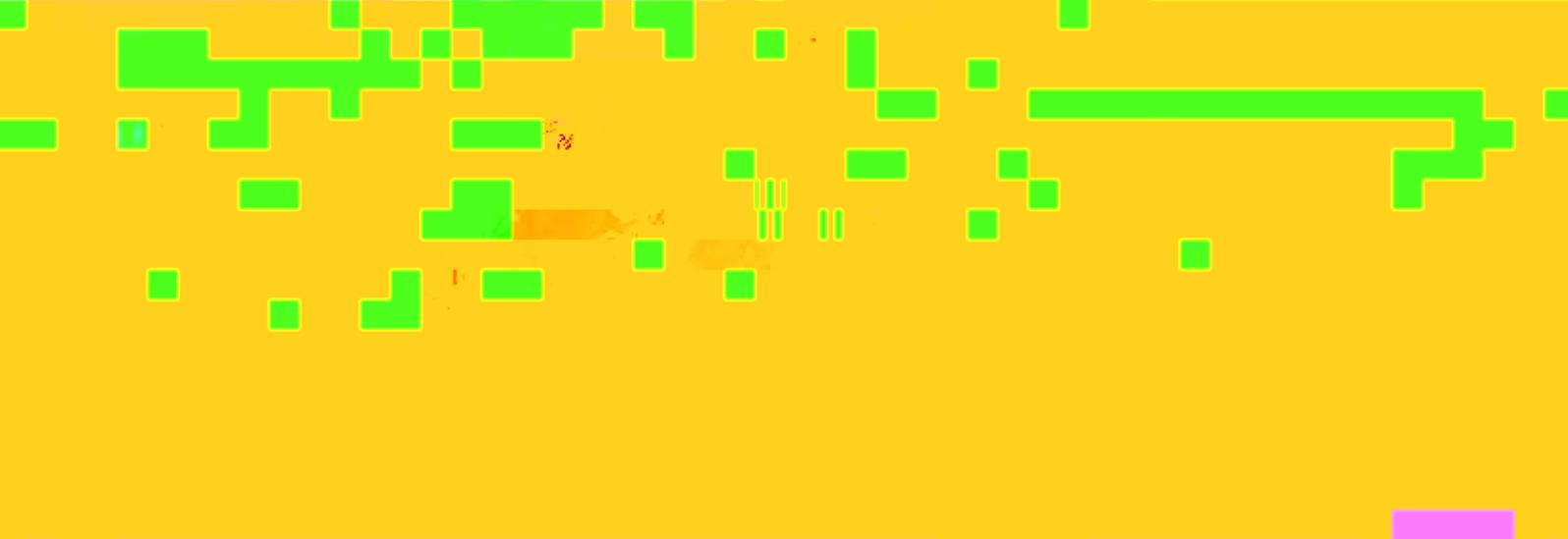
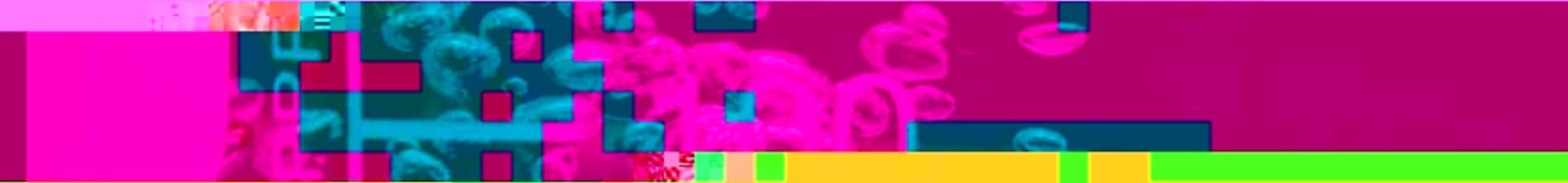
E

A

1. W • t tt t , 2 . t t ,
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2.





D F W CO₂-G L M

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I

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V

1. \bullet t tM
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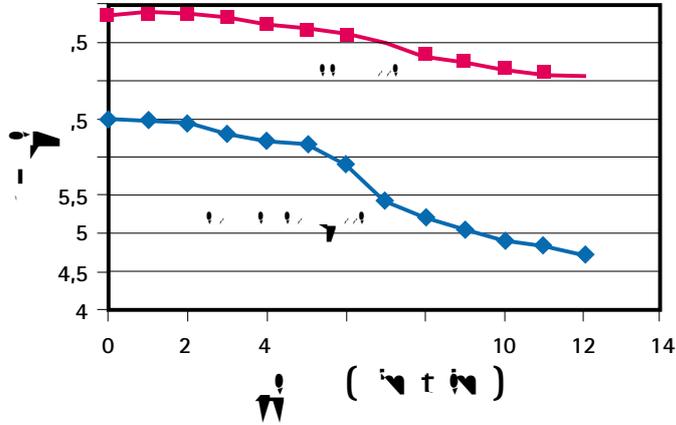
2. t $p - t$ \bullet
 t $p - M t$ $.$
 t t $.$

3. t \bullet t t
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 t t $.$ t \bullet t $,$
 \bullet p p t
 $t.$ $p - M t$ \bullet $,$
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4. M t M t M t
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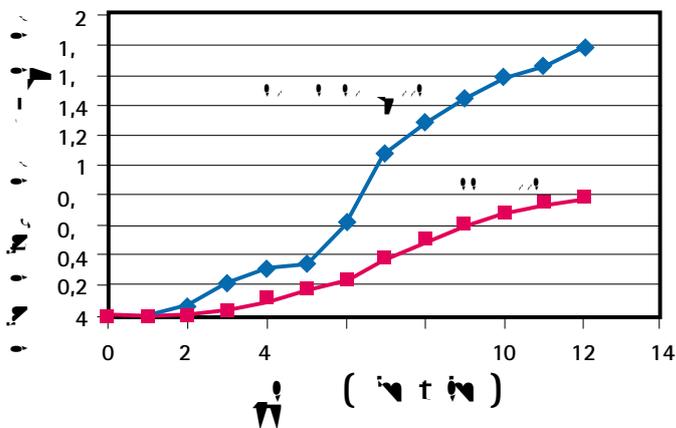
A

1.



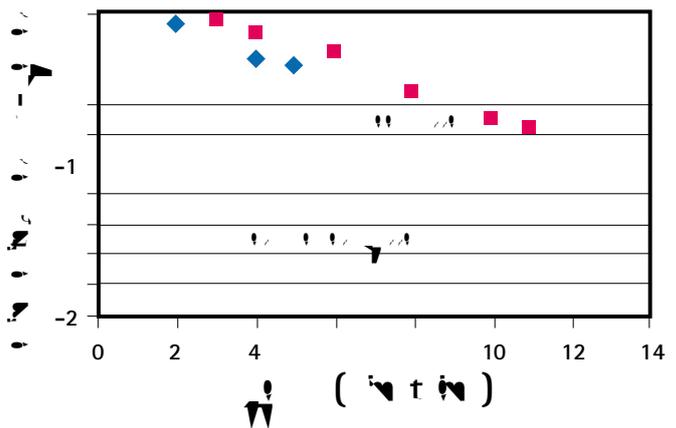
p -W t

p t p -W t t t W M t , 4 ,
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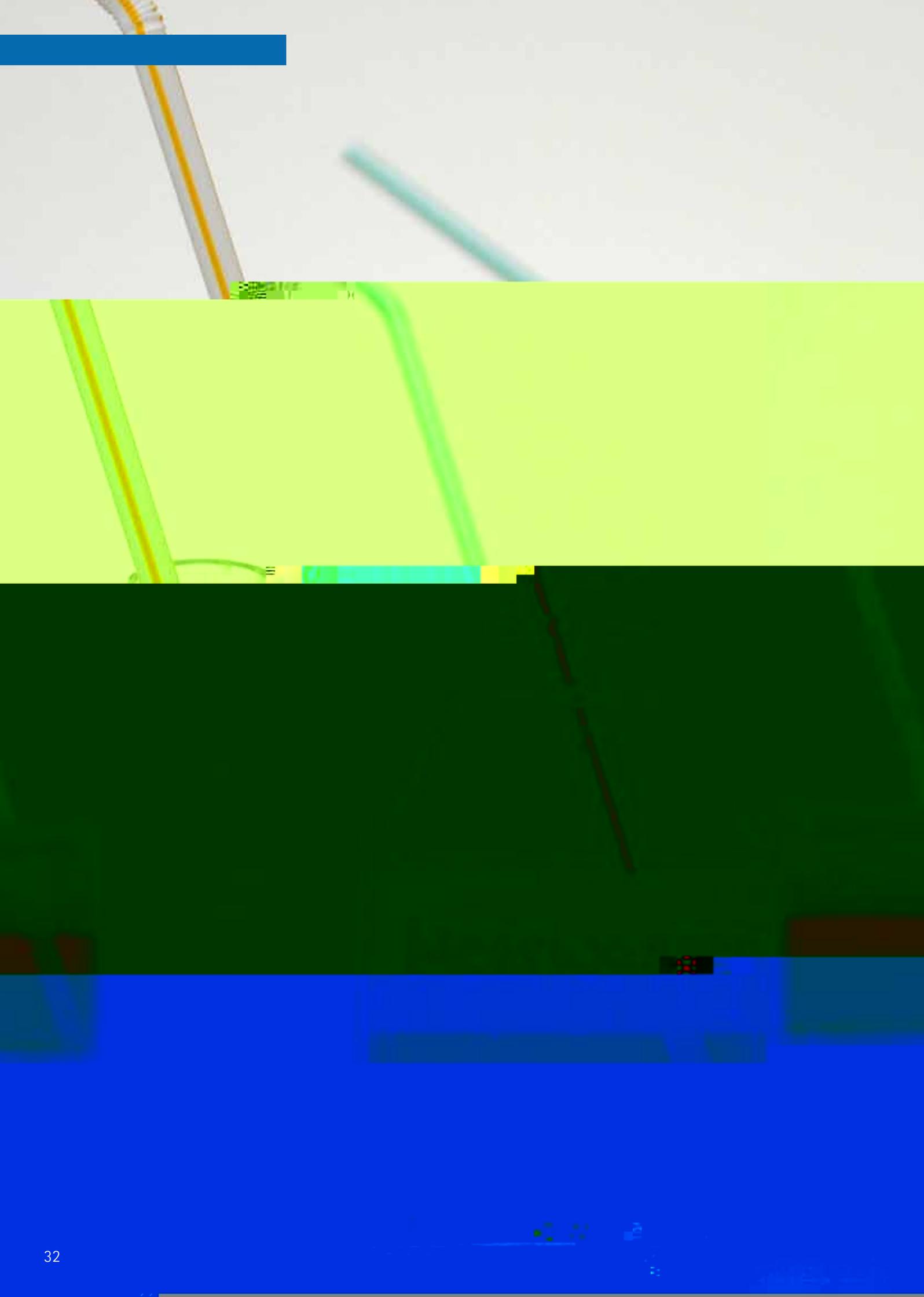


t p -W t

t, p -W t , t, W t t-1 tp . t



t p -W t



H-R H M (HCO₃⁻) : D R K (CO₃²⁻)

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 t- (3²⁻). p -W t M t , • M t -
 t t . t p -W t t • • , • ,
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 • • t W t t t (2 3). t t t t t t .
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V

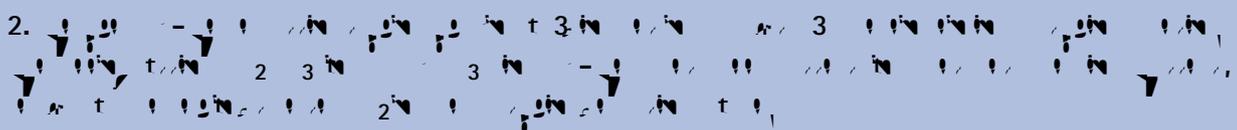
1. t t t W t t M N t -

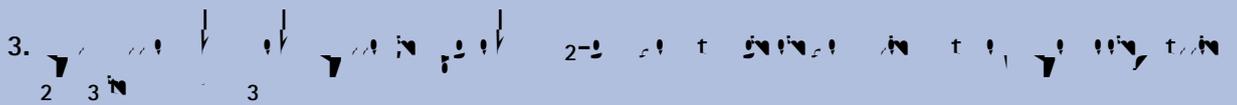
2. t W

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1. N_2 3 t tt M t 3^{2-} $($ tt
 $t t,$ W t
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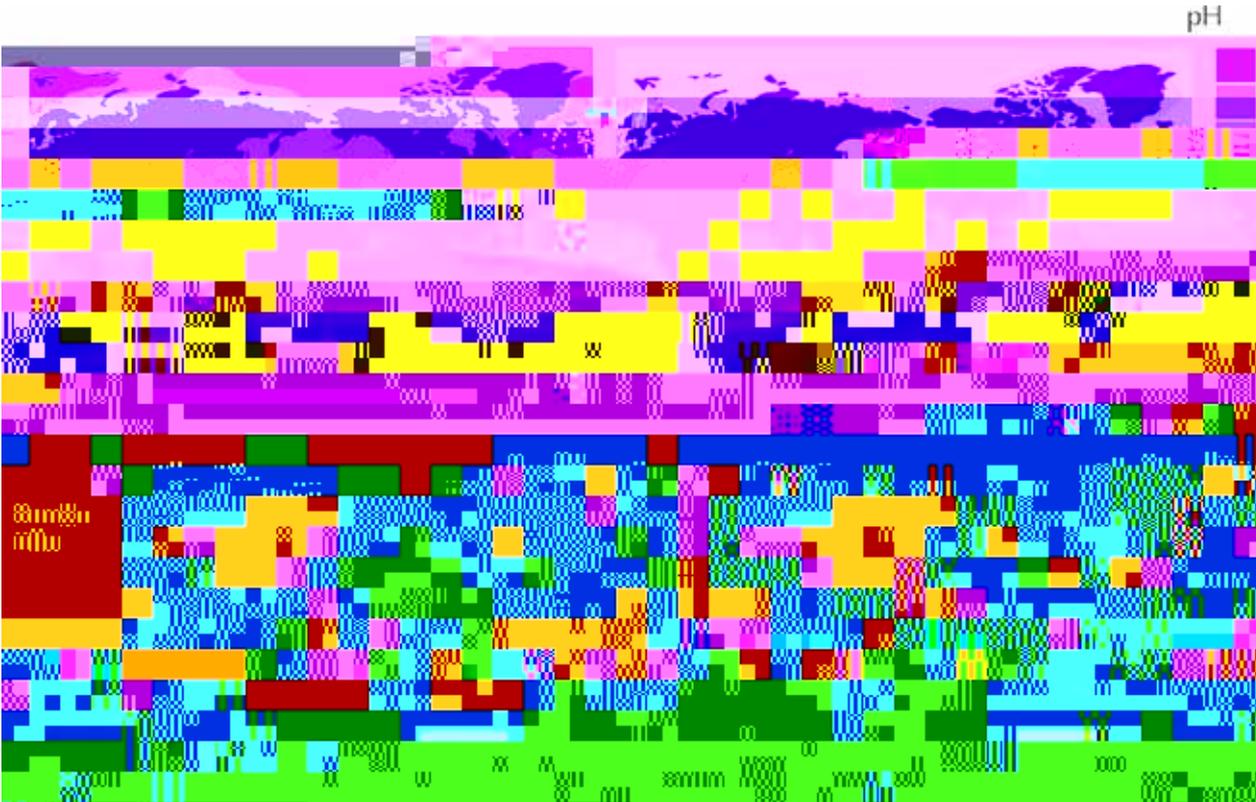
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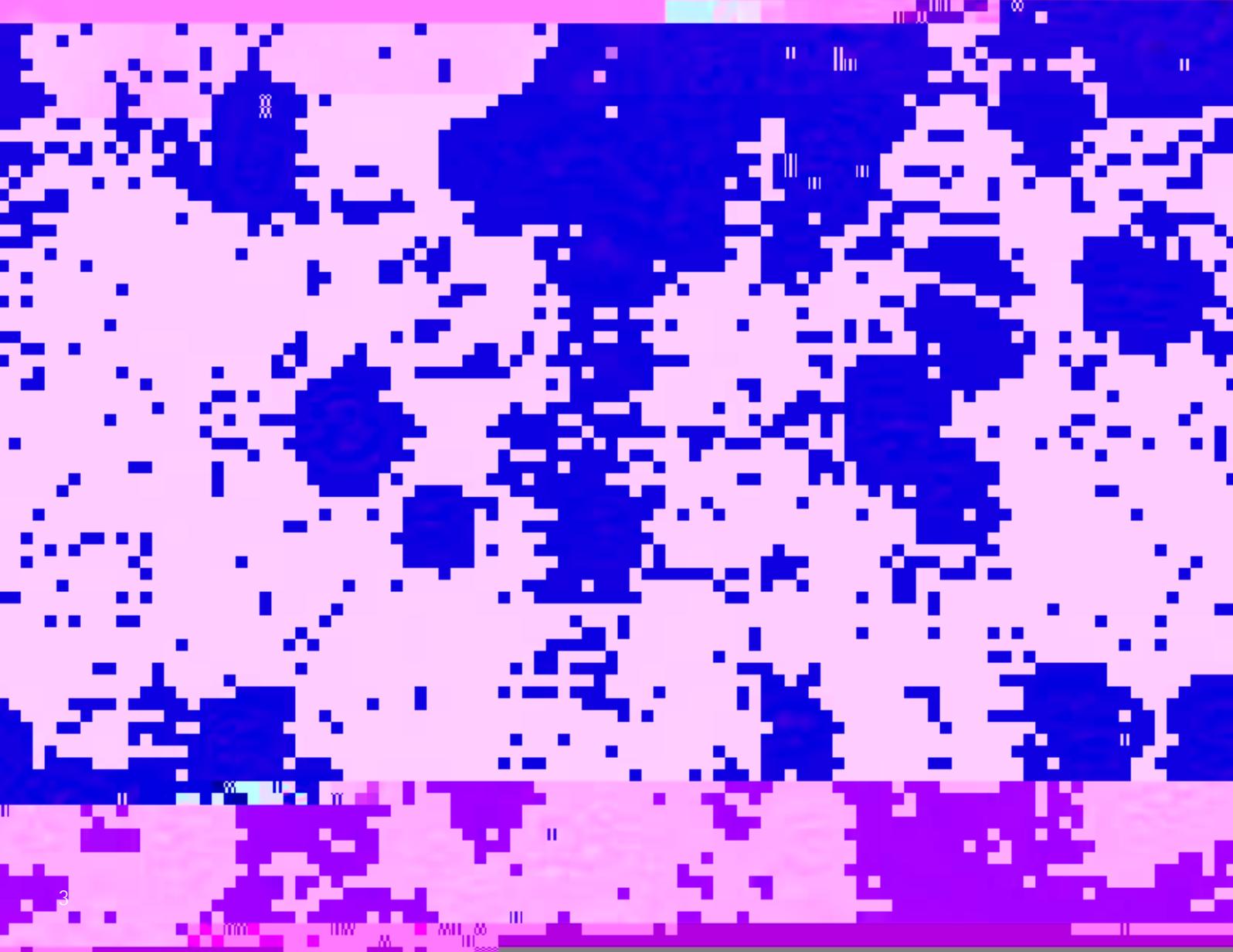
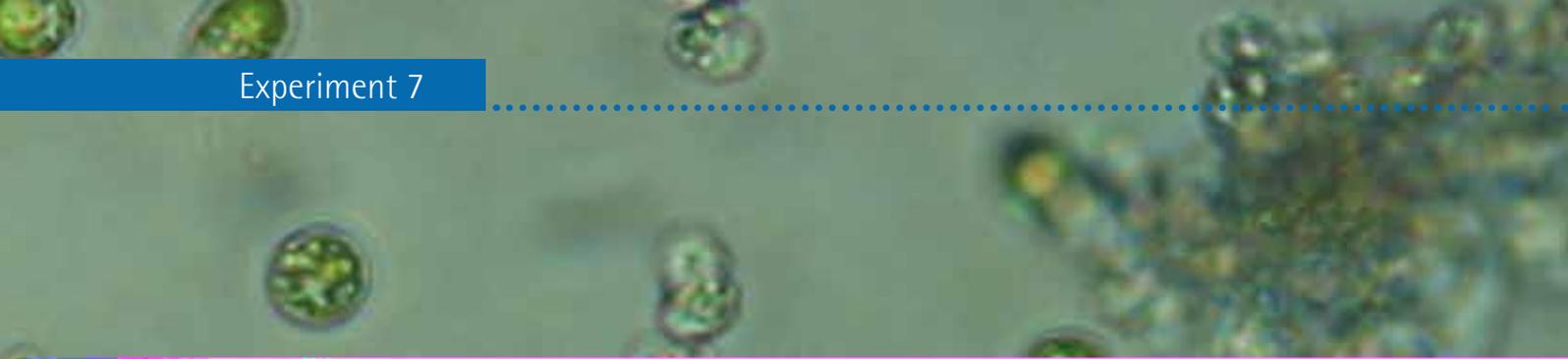
W † **E** †

1. N_2 3 tt $p - W t$ $t t t W$ t $p - W t$
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 M 2 $t M$ 3^{2-} $t t t$

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 $t W p t N_3 p t$ $t N_2 3$
 $t W p t N_2 3 p t$ $t N_3$
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3.1 (3) 3 1 5,1 5, 2050 20 5.
 t p (200)





K **-D** **M** **-K** † (*Dunaliella* sp.)

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 , t ' . p t t t, • t 2 W • t M
Dunaliella p. M t. , p t t , • • t

V

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2. $t \quad t \quad \bullet \quad t \quad \bullet \quad .$
 $W \quad N \quad t \quad 1 \quad M \quad t \quad N \quad t \quad N \quad t \quad \bullet \quad p \quad t \quad t$
 $M \quad t \quad 00 \quad M \quad t \quad t \quad \bullet \quad .$

3. $t \quad t \quad M \quad t \quad t \quad t \quad . \quad M \quad t$
 $\bullet \quad t \quad t \quad . \quad t \quad t \quad , \quad t \quad \bullet \quad \bullet \quad ,$
 $\bullet \quad t \quad t \quad . \quad W \quad \bullet \quad W \quad t \quad \bullet \quad t \quad , \quad t \quad , \quad ,$
 $\bullet \quad t \quad , \quad t \quad .$

4. $p \quad t - \quad t \quad t \quad t \quad t \quad 1 \quad 0 - M \quad t -$
 $M \quad t \quad t \quad t \quad . \quad t \quad t \quad \bullet \quad .$

p .

1 (1): $2 - \quad t \quad \bullet$
 2 (2): $2 - \quad t \quad t \quad - \quad W \quad t \quad t \quad p$
 $\bullet \quad , \quad \bullet \quad t \quad t \quad , \quad 2 -$
 $t \quad t \quad t$
 3 (3): $t - \quad t \quad W \quad t \quad \bullet \quad , \quad \bullet \quad t \quad \bullet \quad t$
 $\bullet \quad t \quad t$

5. $t \quad \bullet \quad t \quad t \quad \bullet \quad t \quad . \quad t \quad 1 \quad 3 \quad t \quad t \quad t,$
 $\bullet \quad t \quad t \quad t \quad . \quad 2 \quad t \quad 30 \quad 0 \quad t \quad t$
 $t \quad .$

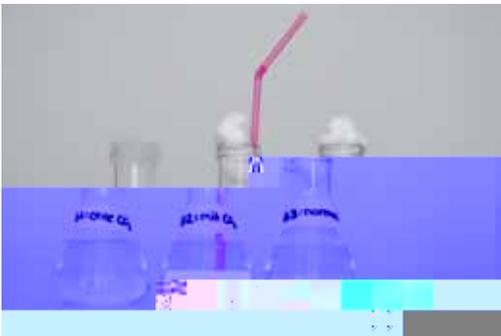
E



A

1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20.

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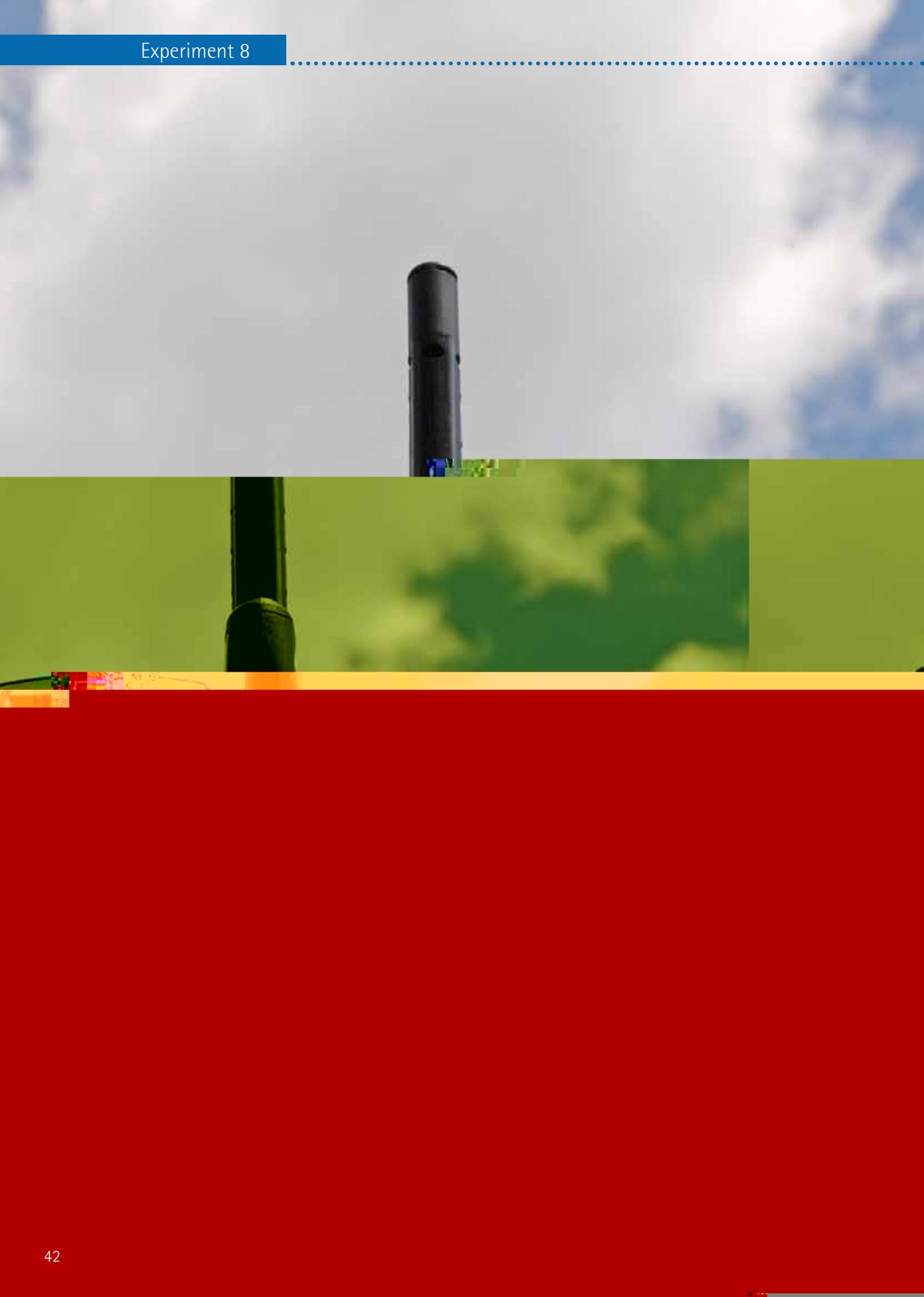
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Lehrer

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5. W

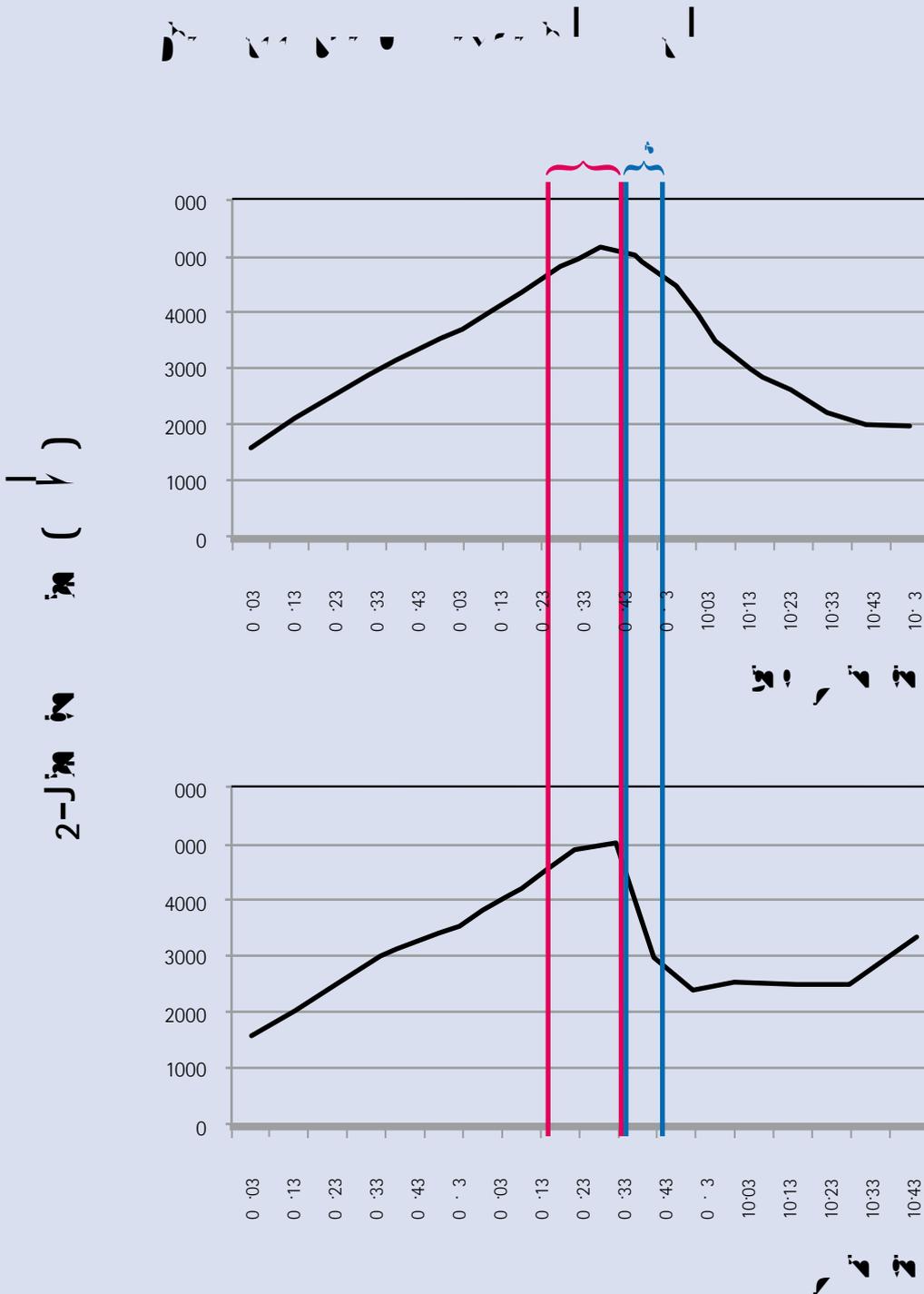
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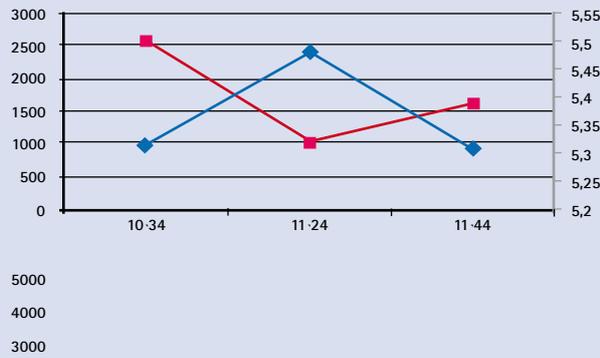
4.





5. W
 t t 2- t t
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). t t p, t t W (M -
 t t t t p -M t W t -
 • p -W t (). t p -W t W t 2- t t t

V



t 2 p -W t W . t t 2- t t t, t p -W t W .



Arbeitsbögen für Schüler



D G f u M A f

W t t e
 . e t t, t W t .N p -
 t t t t W , 2 M -
 e p e s t t 2
 p t t, t W W t ,
 e e t W t t t t, e p -W t W t e
 , p t s t. t e t , t e e
 , 2 t 2 t.

D f

3 e e (, M t)
 3 M e , e p
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 1 p tt

V

G

• • †

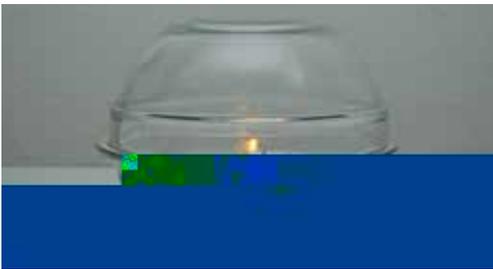
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O

A †



2. t t W .



3. t t .t.N M t

2. t t
W . t
tt . t
t p t . t
t t .
t p .M
W p t
t, t W .

3. t, t p t
t t t
W t .W t
W t ,
t

E

- 1.
- 2.

W † T † L • † CO₂ W ?

t t t (2) t p , t t • t
• p t t . t W t p t p t -
t t W , 2 W t
• t
• p t t , • t W .

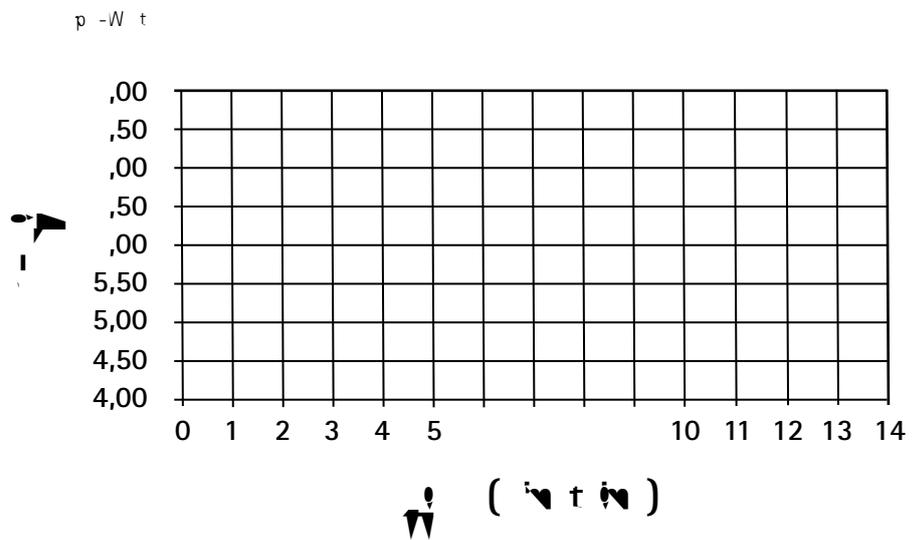
4. t tt t • t . t tt t • W . • t, •
t t pt t.N t t t
t .W • .

5. • , t W t t

E

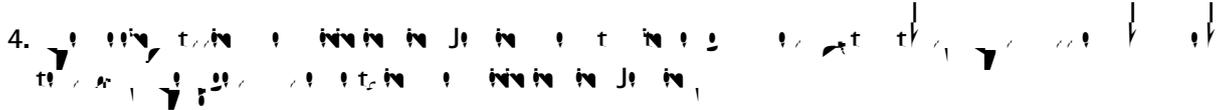
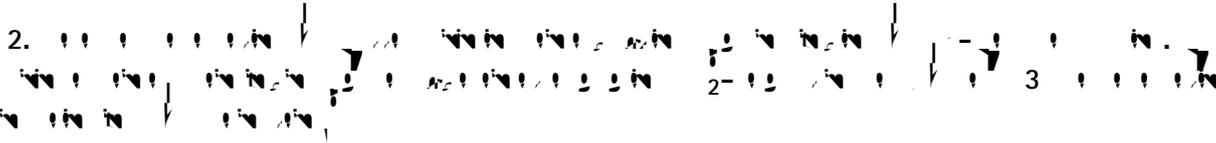
D F W CO₂-G L M
‡ ‡ ‡ ‡ ‡ ‡

| h (m) | p (Pa) | W (N) |
|---------|----------|---------|
| 0 | | |
| 1 | | |
| 2 | | |
| 3 | | |
| 4 | | |
| 5 | | |
| | | |
| | | |
| | | |
| 10 | | |
| 11 | | |
| 12 | | |
| 13 | | |
| 14 | | |



$W = M \cdot g \cdot h$
 $p = \frac{W}{A}$

E

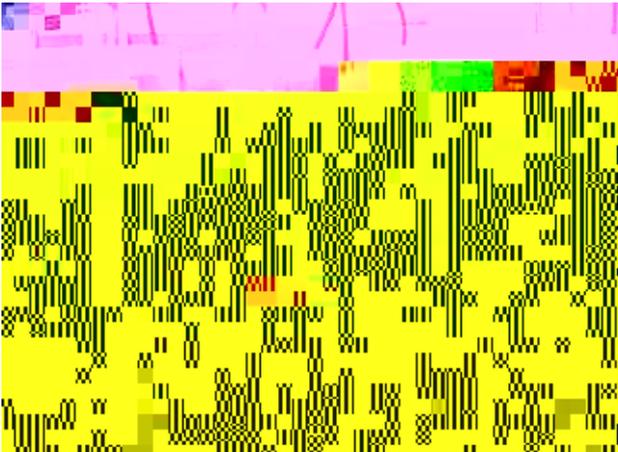


W f E f

1. t t, t p -W t • t -
 , • t t t t • t , t t

2. • , • t W • t • , , •
 W ' , t W .

3. • • t W t • t, • M
 t



p t - t • t • t-



S f

1. t 200 M t M
 W . t M
 N t t . t M
 N t t .

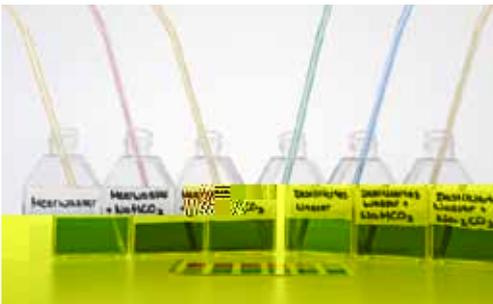
2. W t



1. t

3. 20 p t t t p -W t

4. t t , W t t



2. t

5. t , 2 . t 20 p -W t t

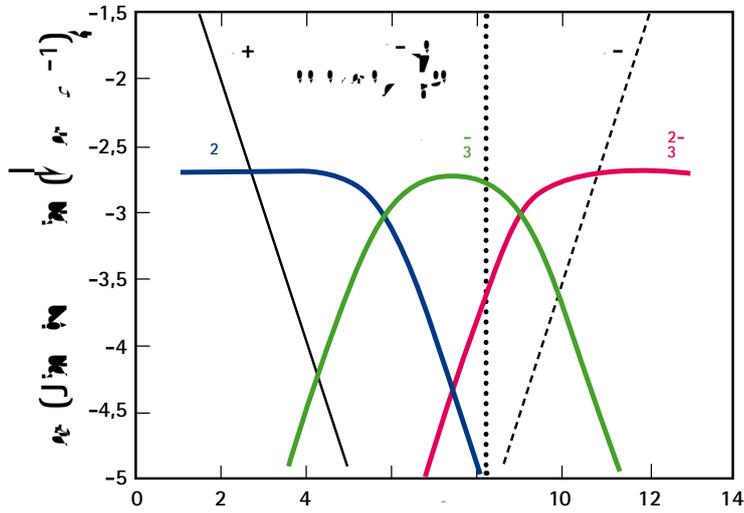
. 40 0 t t t t t t t

T

E

E

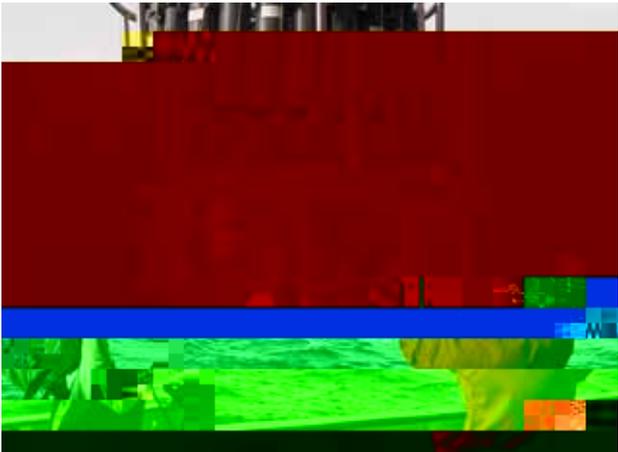
$$3 \cdot M t t \quad p - W t t t$$



W f E f

1. t p -W t t t t W , t • • N 3
 t t W • M t t t • W p t t
 p -W t

2. t p t W • t p t W p t N 3,
 t • N 2 3 W p t t W p t N 2 3, t •
 N 3



$$4 \cdot M t \quad p$$

K **-D** **M** **-K** † (*Dunaliella* sp.)

M M t, , M t (2),

, t p t t t, • t 2 W • t M

Dunaliella p. M t.

D †

t - (200 M t)

Mt • t p

(t t • • t • t W tt t p)

p tt

t - t

t p p

- t ()

W tt •

t • - , M (t 3) • (t 1)

N t t • N t t (N 3), p t (4

D B

f

A

f

1 (1): 2- t
 •

2 (2): 2- t t -
 W tt t p • , •
 t • t , 2-
 t t t

3 (3): t - t W tt • ,
 • t • t • t t

5. t • t . 1 . t t t t, •
 • t t • t . 3 t t t t

W

K

f

K

?

W (2) t t t
2 t t t W • 2- t
t M t •

W • t
p t t t t -
t .

D

f

t 2- t t p •
t t t
p t
t

S

f

1. • t 2-M t,
0 t t () t 2 (W t) 2 , t 2- t t • t
t 2 (W t)) t t t

und For



I

2. / t - t • (M)
2012
p t . , • , M (p t3 p t t . , W
t N , tt t •)
t t • M N • , M
t • M N • , • 2 t p • / W / , . 4 / • . 4 / • . . . ,
. 21 • M M , . 3 , . • t t , . 2 • , . 3 • , . • M t N
(M)
t t M , t

W L

• .
• . p .
• . p • -p • t.
• . • • t . . .
M • ttp// -p • t.



